Appendix D
Transportation

BT ENGINEERING
BTE
41 Adelaide Street North, Unit 71
London, Ontario, N6C 3S6

MEMORANDUM

TO:	File	**DATE:**	April 26, 2016
FROM:	Daniel Riendeau	**PROJECT #:**	16-006
PROJECT:	Innisfil 6th Line Interchange EA		
SUBJECT:	Ramp Volumes		

The purpose of this memorandum is to elaborate a methodology to estimate the turning movement volumes of a future interchange at Highway 400 and 6th Line.

The following data is available as reference:

- Existing (2013) daily traffic volumes on regional roadways, including Innisfil Beach Road (County Road 21) on each side of Highway 400, from Innisfil's *2013 Transportation Master Plan* (TMP);
- Existing (2012) turning movement volumes from AECOM's July 2015 memorandum titled *Highway 400 from Highway 89 to Highway 11, Existing Intersection Operations*; and
- Future (2031) traffic volumes from a regional simulation model prepared by HDR and documented in their January 2015 memorandum titled *6th Line Municipal Class Environmental Assessment – Needs Analysis: Travel Demand Forecasting*.

The following assumptions are used:

- The directional traffic distribution at the future 6th Line interchange will be practically the same as at the existing Innisfil Beach Road interchange; and
- The peak hour volume / daily volume ratio at the future 6th Line interchange will the same as at the existing Innisfil Beach Road interchange.

1. Existing Traffic on Innisfil Beach Road

Figure 1 presents the existing (2012) turning movement volumes at the Highway 400 / Innisfil Beach Road Parclo A4 interchange, as reported by AECOM.

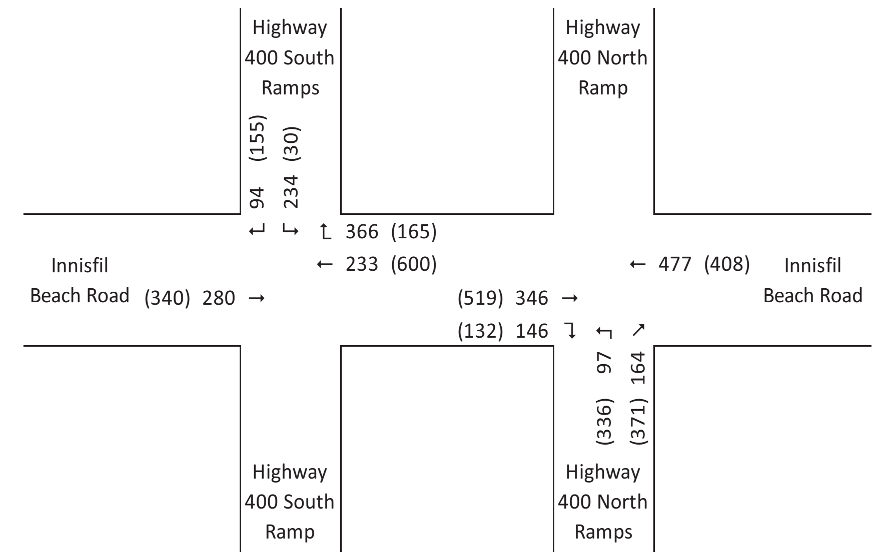

Figure 1: Existing Traffic on Innisfil Beach Road, Morning (Afternoon) Peak Hour

These volumes do not include channelized movements (i.e. eastbound and westbound right-turn movements) and, because the traffic volumes were collected at different times, the intersections are not balanced.

The channelized movements are estimated based on their opposite movements during the other peak hour (e.g. a driver performing an eastbound right turn in the morning is likely to perform a northbound left turn in the afternoon) and accounting for the volume variation between the morning period and the afternoon period (in this case, the afternoon peak hour is higher than the morning peak hour by a factor of 1.2).

Figure 2 shows balanced volumes with estimated channelized movements.

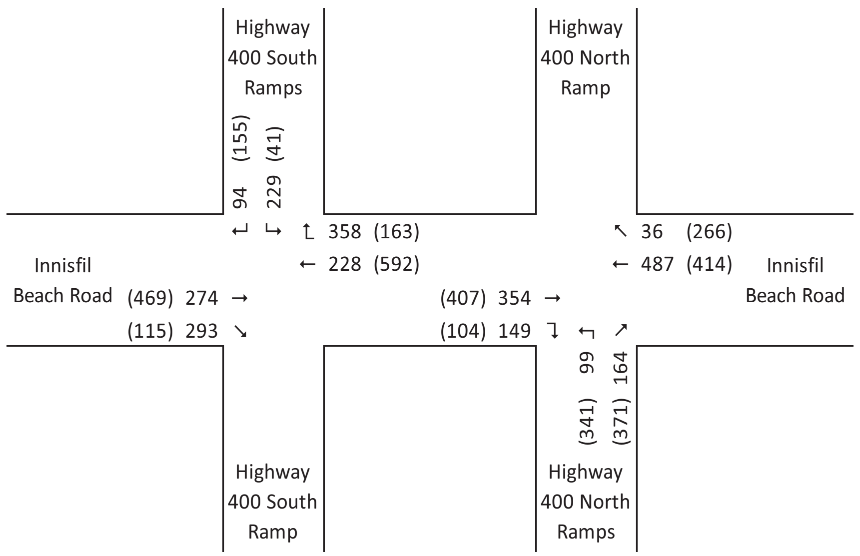

Figure 2: Balanced Traffic on Innisfil Beach Road, Morning (Afternoon) Peak Hour

Based on Innisfil's TMP, the annual average daily traffic (AADT) volumes currently found on Innisfil Beach Road are 14,324 and 13,403 vehicles per day respectively on the east and west sides of Highway 400. **Table 1** presents the peak hour traffic volumes in terms of percentage of daily volumes.

Table 1: Traffic on Innisfil Beach Road as Percentages of AADT

Location	Morning Peak Hour				Afternoon Peak Hour			
	Eastbound		Westbound		Eastbound		Westbound	
	Value	% of AADT	Value	% of AADT	Value	% of AADT	Value	% of AADT
East of Highway 400	518	3.6%	523	3.7%	778	5.4%	680	4.7%
West of Highway 400	567	4.2%	322	2.4%	584	4.4%	747	5.6%

2. 2031 Future Traffic Volumes on 6th Line with Interchange

A thorough examination of the regional simulation model developed by HDR for the 6th Line interchange scenario with road widening led to the following observations:

- The future AADT west of Highway 400 is approximately 35,000 vehicles per day;
- The future AADT east of 5 Sideroad is approximately 8,000 vehicles per day – this seems to include traffic redirected from Innisfil Beach Road, which exhibits only 3,000 vehicles per day; and
- A trip generator is located directly in the southeast quadrant of the 6th Line interchange – it generates approximately 10,000 vehicles per day, including 6,500 on 6th Line.

Considering that the existing daily traffic on 6th Line does not exceed 300 vehicles per day and that no road improvement is expected on 6th Line west of 5 Sideroad, it is deemed very unlikely that 6th Line would carry as many as 8,000 vehicles per day. For the purpose of this analysis, this value has been reduced to 3,000 vehicles per day. For consistency, the daily volume east of Highway 400 has been reduced by the same amount, from 35,000 to 30,000 vehicles per day.

It is estimated that the traffic volume between Highway 400 and the trip generator found in the HDR model would be equivalent to the generated trips (6,500 vehicles per day) plus the estimated traffic west of 5 Sideroad (3,000), totalling approximately 10,000 vehicles per day.

Table 2 shows the estimated peak hour volumes for the 2031 projection, using the estimated daily volumes in combination with the percentages of AADT presented in **Table 1**.

Table 2: 2031 Peak Hour Volumes on 6th Line

Location	2031 AADT	Morning Peak Hour		Afternoon Peak Hour	
		Eastbound	Westbound	Eastbound	Westbound
East of Highway 400	30,000	1,084	1,095	1,629	1,423
West of Highway 400	10,000	423	240	436	557

The traffic distribution at the future 6th Line interchange is expected to be the same as at the existing Innisfil Beach Road interchange (shown in **Figure 2**). A preliminary calculation is presented in **Table 3**.

Table 3: 2031 Turning Movement Volumes at the 6th Line Interchange

Direction	Movement	Morning Peak Hour		Afternoon Peak Hour	
		Distribution	Volume (veh/h)	Distribution	Volume (veh/h)
From East to…	**Total**	**100%**	**1,095**	**100%**	**1,423**
	West	22%	241	63%	891
	North	26%	288	18%	252
	South	52%	567	20%	280
To East from…	**Total**	**100%**	**1,084**	**100%**	**1,629**
	West	40%	434	34%	548
	North	29%	316	21%	338
	South	31%	334	46%	743
From West to…	**Total**	**100%**	**423**	**100%**	**436**
	East	25%	104	37%	161
	North	7%	29	39%	171
	South	69%	290	24%	104
To West from…	**Total**	**100%**	**240**	**100%**	**557**
	East	24%	58	47%	262
	North	44%	106	5%	30
	South	32%	76	48%	266

Because the proportion of future traffic on each side of Highway 400 is different than the current proportion found on Innisfil Beach Road, this calculation leads to inconsistent through movements in the eastbound and westbound directions (highlighted in **Table 3**). For example, during the morning peak hour, the traffic "from east to west" is calculated as 241 veh/h but the traffic "to west from east" is calculated as 58 veh/h. To resolve this inconsistency, the lowest value is selected and the turning volumes are adjusted proportionally so that the totals remain the same. In this case, the value of "58" being selected leads to the volume from east to north being adjusted from 288 to 350 veh/h and the volume from east to south being adjusted from 567 to 688 veh/h, thus maintaining the total volume from the east at 1,095 veh/h.

The adjusted 2031 turning movement volumes are shown in matrix format in **Table 4** for the morning peak hour and **Table 5** for the afternoon peak hour.

Table 4: Adjusted 2031 Turning Movement Volumes at the 6th Line Interchange, Morning Peak Hour

		Destination				
		East	West	North	South	**Total**
Origin	East		58	350	688	**1,095**
	West	104		29	290	**423**
	North	477	106			**583**
	South	503	76			**579**
	Total	**1,084**	**240**	**379**	**978**	**2,681**

Table 5: Adjusted 2031 Turning Movement Volumes at the 6th Line Interchange, Afternoon Peak Hour

		Destination				
		East	West	North	South	**Total**
Origin	East		262	550	612	**1,423**
	West	161		171	104	**436**
	North	459	30			**489**
	South	1,009	266			**1,275**
	Total	**1,629**	**557**	**721**	**716**	**3,623**

According to this projection, the south-to-east and the east-to-south movements will experience a very high demand in 2031 and will likely require a special treatment such as channelization or double-laning in order to limit congestion. The north-to-east and east-to-north movements are also expected to experience a moderate to high demand in 2031.

3. Discussion

It is noted that the volumes presented above are approximations based on the current trip distribution at the existing Innisfil Beach Road interchange and on a daily trip demand forecast which in turn is based on projected population and employment growth in Innisfil. According to its current TMP, by 2031 the Town of Innisfil is expected to more than double its population and employment.

Additionally, the values above were estimated for a long-term horizon (15 years from now). Therefore, they should be treated as approximate and uncertain. Monitoring traffic volumes is highly recommended as new facilities, such as the proposed interchange, are constructed.

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MEMORANDUM

TO:	File	**DATE:**	May 19, 2016
FROM:	Stephen Brook Daniel Riendeau	**PROJECT #:**	BTE 16-006
PROJECT:	Innisfil 6th Line Interchange EA		
SUBJECT:	Evaluation of Proposed Interchange Location		

1. Introduction

In response to a request submitted by an area resident that the proposed interchange be located at 4th Line, this technical memorandum revisits the interchange location as recommended by the 2013 Innisfil Transportation Master Plan (TMP). Three potential locations for the interchange on Highway 400 have been considered as follows:

- 6th Line;
- 5th Line; and
- 4th Line.

The TMP had recommended an interchange be located at 6th line after considering 5th Line (as identified in the Official Plan) as an alternative. Since the TMP has been completed the Innisfil ONroute Centre has been constructed on southbound Highway 400 between 5th Line and 4th Line.

2. Development Growth

One fundamental requirement for any proposed interchange is that it service both existing and proposed development. Innisfil's 2013 Transportation Master Plan (TMP) contains population and employment data from the 2006 census as well as population and employment projections for the years 2021 and 2031. The 6th Line Needs Analysis Memo prepared by HDR in 2015 includes updated population and employment projections for the year 2031.

The population and employment data, for the zone system as defined by the TMP, are presented graphically on **Figure 1** and **Figure 2** respectively.

Figure 1: Population per Zone

Figure 2: Employment per Zone

The majority of Innisfil's current population is located in the northeast part of Innisfil, in particular the community of Alcona (zones 5 & 6). Additionally, the majority of the planned population growth is expected in the northeast part of Innisfil, in particular the Alcona South Expansion Area (zone 7), directly accessible via 6th Line. Other expected areas for growth include the Alcona North Expansion Area (zone 4), Sandy Cove (zone 2), Big Bay Point (zone 1), and the existing Alcona community (zones 5 & 6). Some growth is also expected in Lefroy and in Belle Ewart (zone 9), both south of Alcona and located closer to 4th Line, but of lesser size in comparison to the other growth areas.

The major portion of the employment is located in Innisfil Heights (zone 18), at the interchange of Highway 400 and Innisfil Beach Road, and the rest is found mainly in the existing Alcona community (zones 5 and 6). Future employment growth is expected mainly in Innisfil Heights (zone 18), the Innisfil Heights Expansion Area (zone 17) located at Highway 400 and 6th Line, the Alcona South Expansion Area (zone 7), and Big Bay Point (zone 1). No significant employment growth is expected south of 6th Line.

3. Evaluation

The proximity of each alternative interchange location to both existing and planned development within the Town of Innisfil was measured by calculating a weighted average travel distance between each potential interchange location and the population and employment centres located between 6th Line and County Road 89, as summarized in **Table 1**.

Table 1 Weighted Average Travel Distances (km/person)

	Interchange Location		
	4th Line	5th Line	6th Line
Current	13.0	12.4	12.0
2031 Projection	12.5	11.7	11.0

The criteria used for the evaluation are listed in **Table 2**. Environmental Impacts, Property Impacts and Constructability / Cost were considered comparable for each of the options. These impacts would be determined mainly by the configuration of the interchange alternatives and can be mitigated at each potential interchange location.

Table 2 – Evaluation Summary

Criteria	4th Line Interchange	5th Line Interchange	6th Line Interchange
Network Wide Benefit (addresses Innisfil Beach Road Capacity Constraint)	×	×	✓
Supports Future Growth Areas	×	-	✓
Environmental Impacts	-	-	-
Property Impacts	-	-	-
Constructability and Cost	-	-	-
Proximity to Current Development	×	-	✓
Proximity to Projected Development	×	-	✓
Interchange Spacing	✓	✓	-
Highway Geometry - Spatial Separation from Travel Centre	×	×	-
Recommended to be carried forward	No	No	Yes

Based on this analysis which includes the ability to service existing and proposed development and the constraint created by the proximity to the ONroute Centre's access and egress ramps, it is recommended that an interchange located on Highway 400 at the 6th Line be carried forward for further analysis and evaluation, consistent with the recommendation of the Innisfil TMP.

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MEMORANDUM

TO:	File	**DATE:**	July 19, 2016
FROM:	Daniel Riendeau	**PROJECT #:**	16-006
PROJECT:	Innisfil 6th Line Interchange EA		
SUBJECT:	Coarse Screening of Interchange Alternatives		

1. Introduction

The Town of Innisfil (Town) has initiated a Municipal Class Environmental Assessment (EA) to plan for a new interchange on Highway 400 at 6th Line. This interchange has been identified in the Town's Official Plan (OP) and Transportation Master Plan (TMP). The current Study will review the previous analysis for the interchange identified in the TMP, validate those conclusions (which should satisfy Phases 1 and 2 of the Municipal Class EA) and then undertake Phases 3 and 4 of the Municipal Class EA for a proposed interchange at 6th Line and Highway 400.

1.1. Study Area

The project location is within the County of Simcoe and the Town of Innisfil as illustrated in **Figure 1**. The Study will provide options for a new interchange in the central area of Simcoe County on Highway 400. Improvements to 6th Line and a new interchange will service the Expansion Area in the Town of Innisfil. The Study Area, illustrated in **Figure 2**, will extend from 5th Sideroad easterly to approximately 600 m east of Highway 400. A secondary Study Area will consider downstream influences of trips attracted to the new interchange.

1.2. Town of Innisfil Official Plan

The 2011 OP identified future potential interchanges on Highway 400 as shown in **Figure 3**. The OP identified 5th Line as a potential interchange coinciding with a potential GO station at the 5th Line and 20th Sideroad intersection.

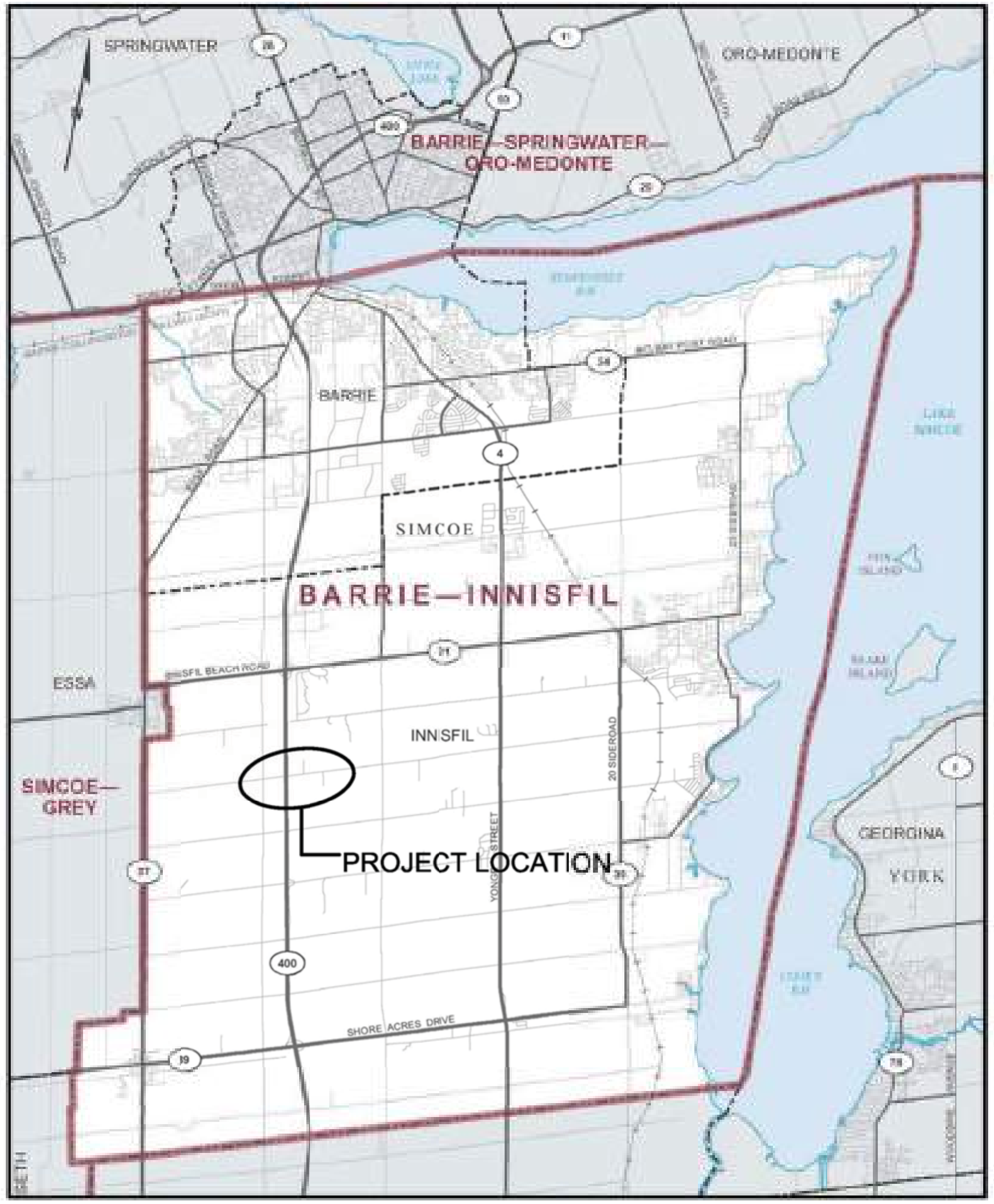

Figure 1: Project Location

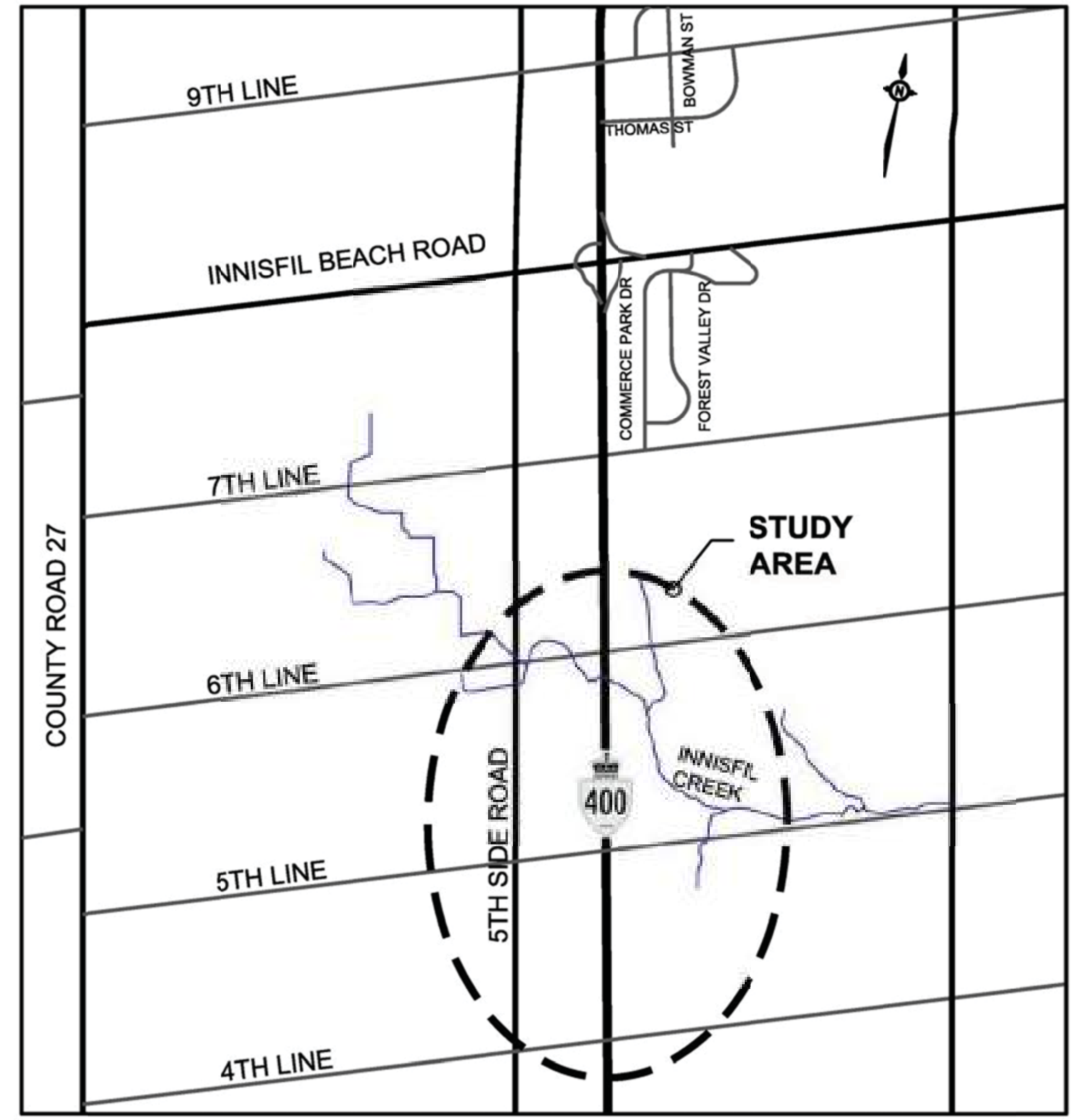

Figure 2: Study Area

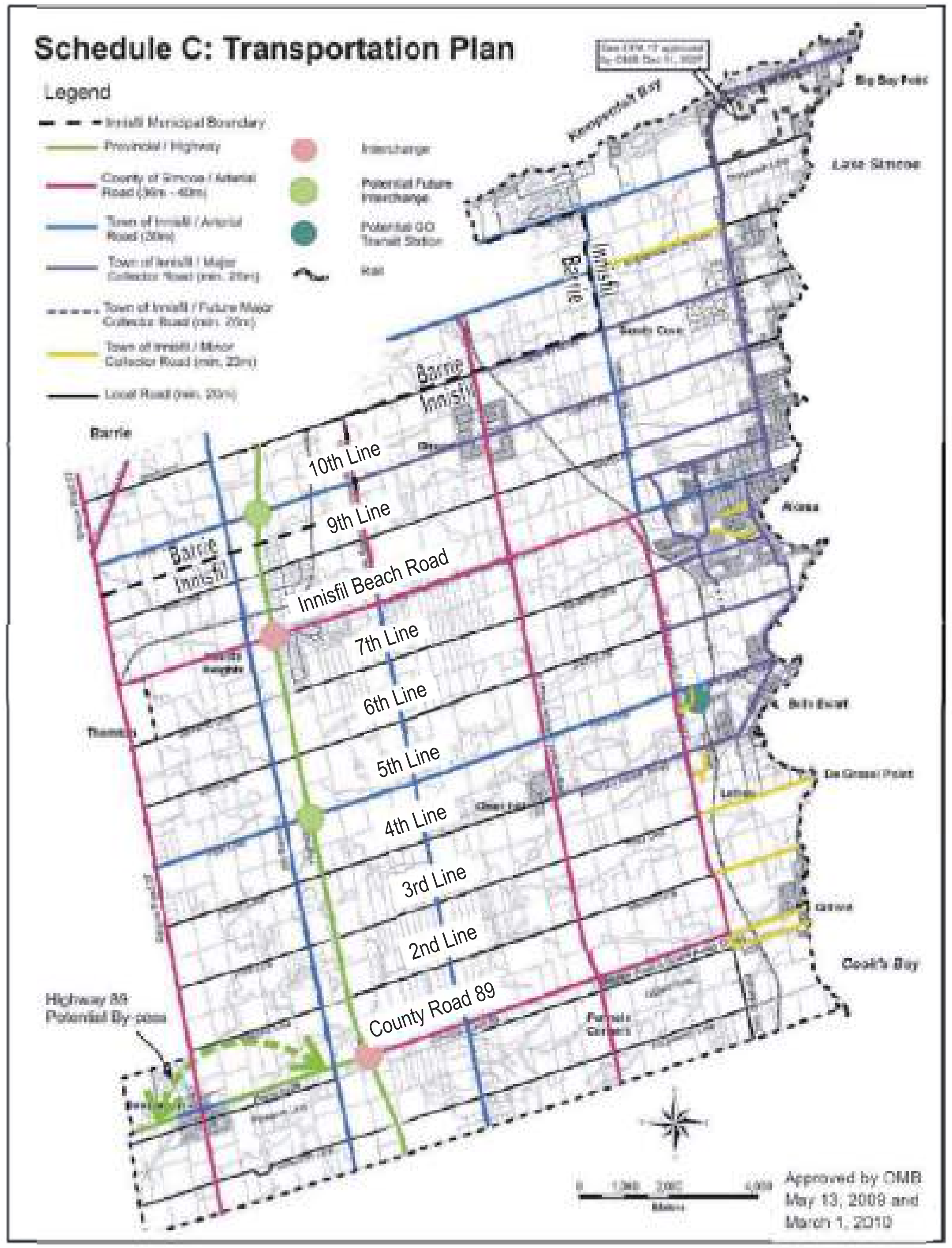

Figure 3: Innisfil Road Classifications (Source: Innisfil OP 2006 as approved by OMB 2009, 2010 and 2011)

The Town's OP review is in progress and is expected to be finalized by the end of 2016. In this review, the location of the new interchange is being reviewed to consider modifying the previous plan and relocating the proposed interchange from 5th Line to 6th Line. The TMP and the current interchange EA study will provide input into the update of the OP.

1.3. Town of Innisfil Transportation Master Plan (TMP) 2013

Phases 1 and 2 of the Municipal Class EA that were completed by the TMP involved confirming the need and justification of a set of transportation projects. The Town completed a TMP in 2013 that identified both improvements to 6th Line and an interchange on 6th Line at Highway 400. This review by the TMP completed the first two phases of the Class EA considering a Regional level analysis of needs.

The TMP discusses the Ontario Growth Plan for Simcoe County and the identification of the settlement of Alcona, located to the northeast of the Study Area, as a Primary Settlement area. Alcona is expected to see the highest population growth of the area and developers intend to build new homes south of Alcona in the development area called Sleeping Lion. The TMP for the Town of Innisfil has recommended revising the OP to identify 6th Line as a preferred corridor for road improvements and the location for a new interchange with Highway 400, as illustrated in **Figure 4.**

The TMP reviewed potential interchanges on Highway 400 at either the 5th Line or the 6th Line. An interchange at 5th Line will reduce traffic on Innisfil Beach Road and Shore Acres Drive / County Road 89 which are currently the only two roads that connect with Highway 400. An interchange at 6th Line will support future growth and provide better access to Innisfil Heights as well as the Sleeping Lion development in Alcona (if upgrades to 6th Line from Highway 400 to 20th Sideroad are also implemented). This location reduces out-of-way travel in comparison to the 5th Line interchange location. A comment received from the public requested the review of an interchange at 4th Line. These three potential interchange locations are discussed in the *Evaluation of Proposed Interchange Location* Memorandum dated May 19, 2016, which recommends the 6th Line interchange location to be carried forward as the preferred alternative.

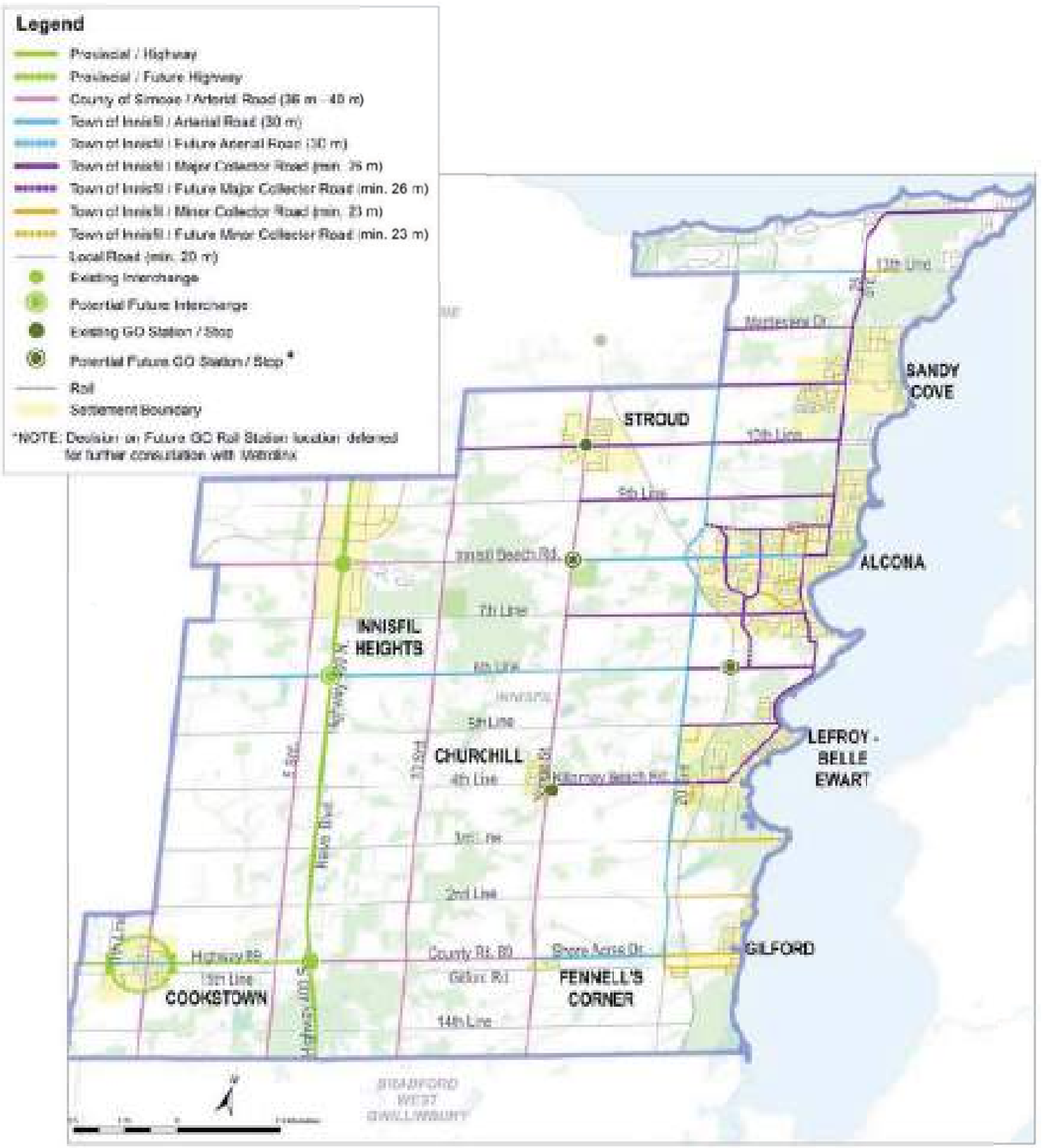

Figure 4: TMP Recommended Revisions to Official Plan Schedule C – Transportation Network
(Source: Innisfil TMP 2013)

2. Preliminary Screening

Six alignment alternatives are considered for the interchange at Highway 400 and 6th Line. They are the combination of 3 horizontal alignment alternatives and 2 vertical alignment alternatives. The proposed horizontal alignments are shown in **Figure 5** and consist of the current straight alignment, a northerly alignment and a southerly alignment. With the last two alternatives, 6th line is shifted away from its current alignment by 50 m.

Two vertical alignments are proposed: with Highway 400 over 6th Line and under 6th Line. **Figure 6** shows the proposed vertical alignments assuming the current horizontal alignment is selected. The vertical alignment is expected to be similar with the northerly and the southerly horizontal alignments.

A preliminary screening has been performed to determine the horizontal and vertical alignments to be carried forward. The screening process is summarized in **Table 1**.

Table 1: Preliminary Screening of Alignment Alternatives

Horizontal Alignment	Vertical Alignment	Carry Forward	Comment
A Current	**A1** Highway 400 over 6th Line	Yes	Requires a complex traffic staging plan in an area of high travel demand. Carried forward as the baseline solution reflected in both MTO's Transportation Environmental Study Report and the Town's 6th Line EA.
	A2 Highway 400 under 6th Line	Yes	
B Northerly	**B1** Highway 400 over 6th Line	No	Requires a complex traffic staging plan in an area of high travel demand and increases the limits of construction beyond the baseline conditions, making it the alternative with the highest capital cost.
	B2 Highway 400 under 6th Line	Yes	
C Southerly	**C1** Highway 400 over 6th Line	No	Greater impacts on natural environment (trees, creek) and existing houses.
	C2 Highway 400 under 6th Line	No	Greater impacts on natural environment (trees, creek) and existing houses.

Alternative A: Current Horizontal Alignment

Alternative B: Northerly Alignment

Alternative C: Southerly Alignment

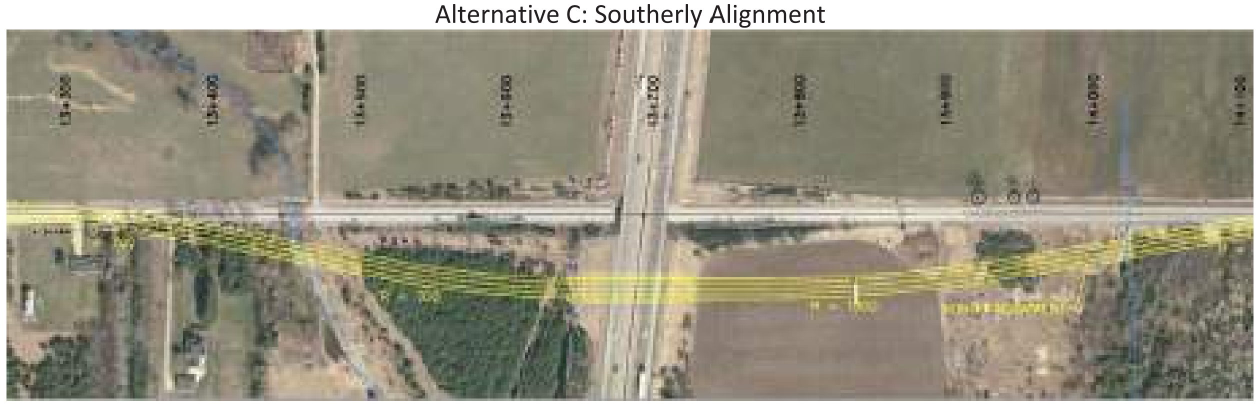

Figure 5: Horizontal Alignment Alternatives

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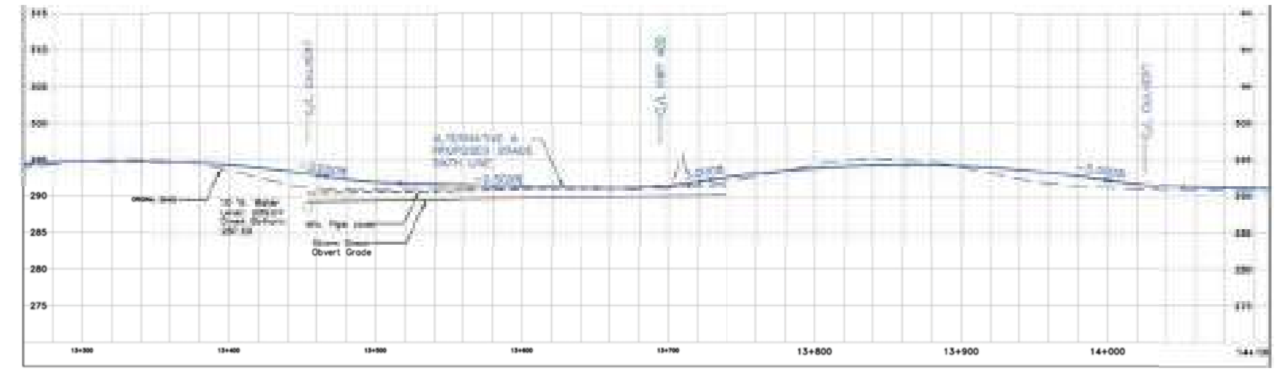
Alternative 1: Highway 400 over 6th Line



Alternative 2: Highway 400 under 6th Line

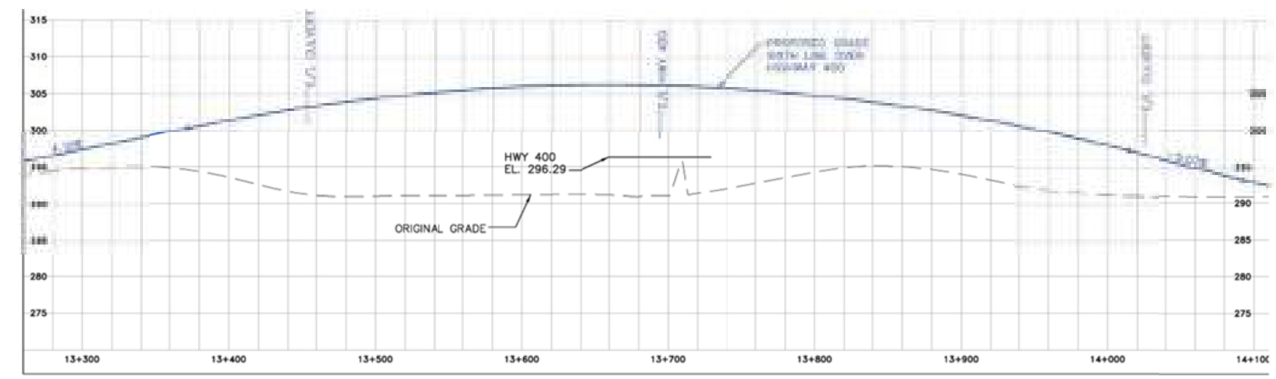


Figure 6: Vertical Alignment Alternatives

3. Interchange Configuration Alternatives

A total of ten interchange configurations are proposed for the evaluation process. They are illustrated in **Figure 7** to **Figure 11**. Each of these interchange configurations are combined with each of the vertical alignment and horizontal alignment alternatives for a total of 60 candidate interchange alternatives, as shown in **Table 2**. A total of 30 interchange alternatives are recommended to be carried forward for the evaluation; the coarse screening is shown in **Table 2**.

Six different interchange types of interchange are proposed; a comparison of the different interchange types is presented in

Horizontal Alignment	Vertical Alignment	Interchange Configurations	Alternative Number	Coarse Screening

Horizontal Alignment	Vertical Alignment	Interchange Configurations	Alternative Number	Coarse Screening
Alternative A: Existing Alignment	Alternative 1: 6th Line under Highway 400	Alternatives 1 to 10	Alt A1-1 Alt A1-2 Alt A1-3 Alt A1-4 Alt A1-5 Alt A1-6 Alt A1-7 Alt A1-8 Alt A1-9 Alt A1-10	Carried Forward (see **Table 1**)
	Alternative 2: 6th Line over Highway 400	Alternatives 1 to 10	Alt A2-1 Alt A2-2 Alt A2-3 Alt A2-4 Alt A2-5 Alt A2-6 Alt A2-7 Alt A2-8 Alt A2-9 Alt A2-10	Carried Forward (see **Table 1**)
Alternative B: Northerly Alignment	Alternative 1: 6th Line under Highway 400	Alternatives 1 to 10	Alt B1-1 Alt B1-2 Alt B1-3 Alt B1-4 Alt B1-5 Alt B1-6 Alt B1-7 Alt B1-8 Alt B1-9 Alt B1-10	Not Carried Forward (see **Table 1**)
	Alternative 2: 6th Line over Highway 400	Alternatives 1 to 10	Alt B2-1 Alt B2-2 Alt B2-3 Alt B2-4 Alt B2-5 Alt B2-6 Alt B2-7 Alt B2-8 Alt B2-9 Alt B2-10	Carried Forward (see **Table 1**)
Alternative C:	Alternative 1: 6th	Alternatives 1 to 10	Alt C1-1 Alt C1-2	Not Carried

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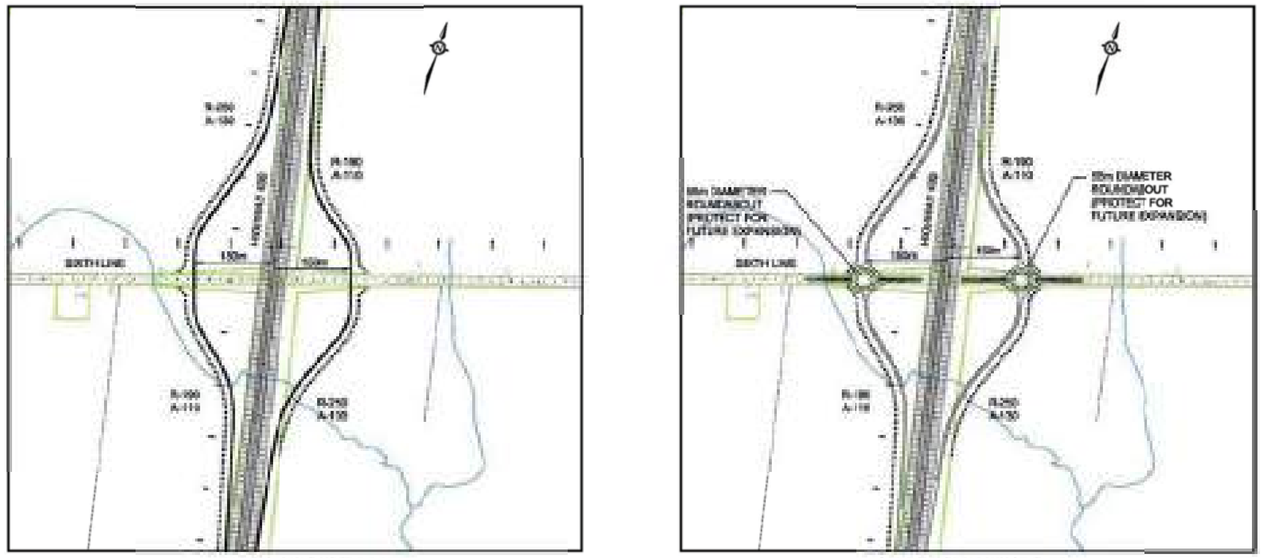
Horizontal Alignment	Vertical Alignment	Interchange Configurations	Alternative Number	Coarse Screening
Southerly Alignment	Line under Highway 400		Alt C1-3 Alt C1-4 Alt C1-5 Alt C1-6 Alt C1-7 Alt C1-8 Alt C1-9 Alt C1-10	Forward (see **Table 1**)
	Alternative 2: 6th Line over Highway 400	Alternatives 1 to 10	Alt C2-1 Alt C2-2 Alt C2-3 Alt C2-4 Alt C2-5 Alt C2-6 Alt C2-7 Alt C2-8 Alt C2-9 Alt C2-10	Not Carried Forward (see **Table 1**)

. Additionally, each Parclo A type is provided with three options:

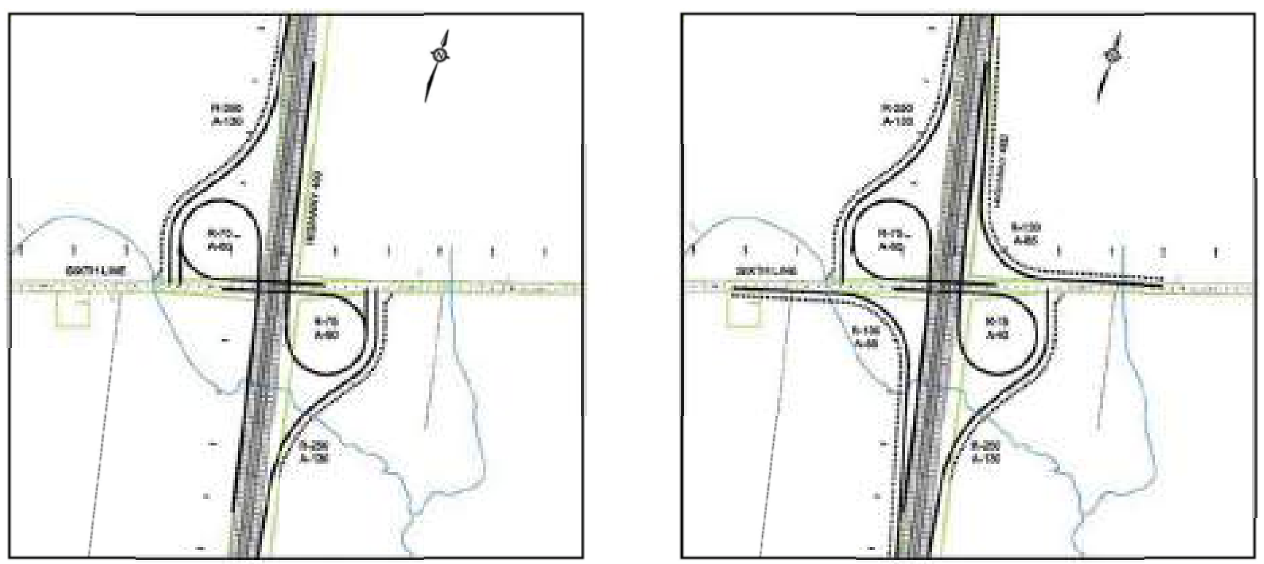
- **180 m direct taper on 6th Line**, consistent with MTO Standards for a 100 km/h ramp design speed;
- **110 m direct taper on 6th Line**, consistent with MTO Standards for a 80 km/h ramp design speed – the shorter taper allows for a smaller structure; and
- **110 m direct taper on 6th Line beyond the structure**, which is similar to the previous option but with the taper located outside the structure, allowing for an even smaller structure. However, this option requires larger entrance loops.



ALTERNATIVE 1
DIAMOND

ALTERNATIVE 2
DIAMOND WITH ROUNDABOUT

Figure 7: Interchange Alternatives 1 and 2 – Diamond Interchange



ALTERNATIVE 3
PARCLO A2
180m DIRECT TAPER ON SIXTH LINE
(100 km/h DESIGN SPEED)

ALTERNATIVE 4
PARCLO A4
180m DIRECT TAPER ON SIXTH LINE
(100 km/h DESIGN SPEED)

Figure 8: Interchange Alternatives 3 and 4 – Parclo A, 180 m Taper on 6th Line

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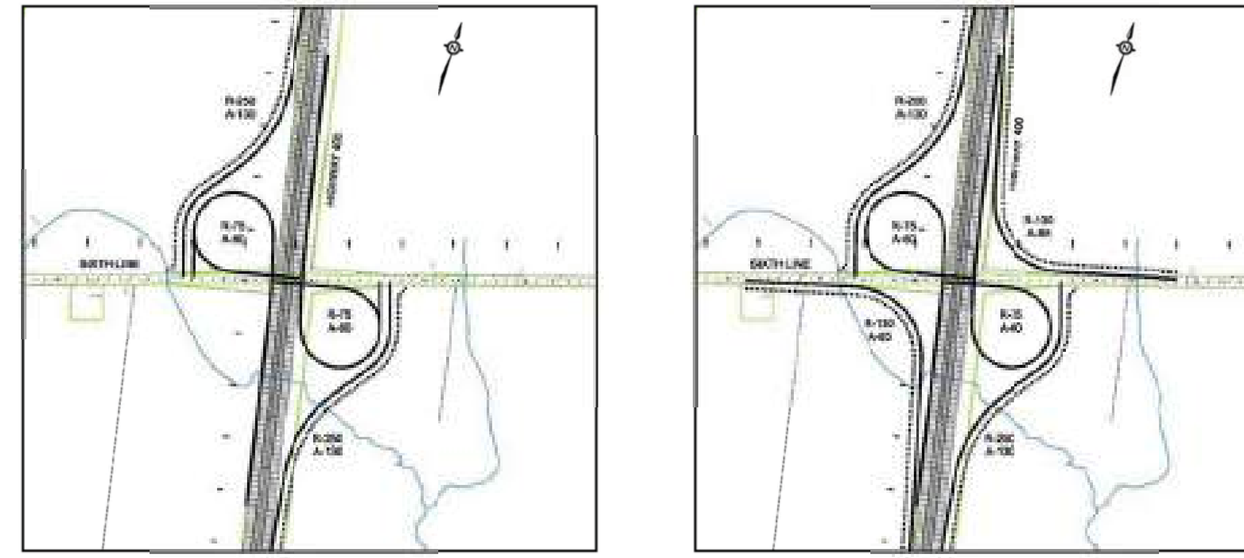
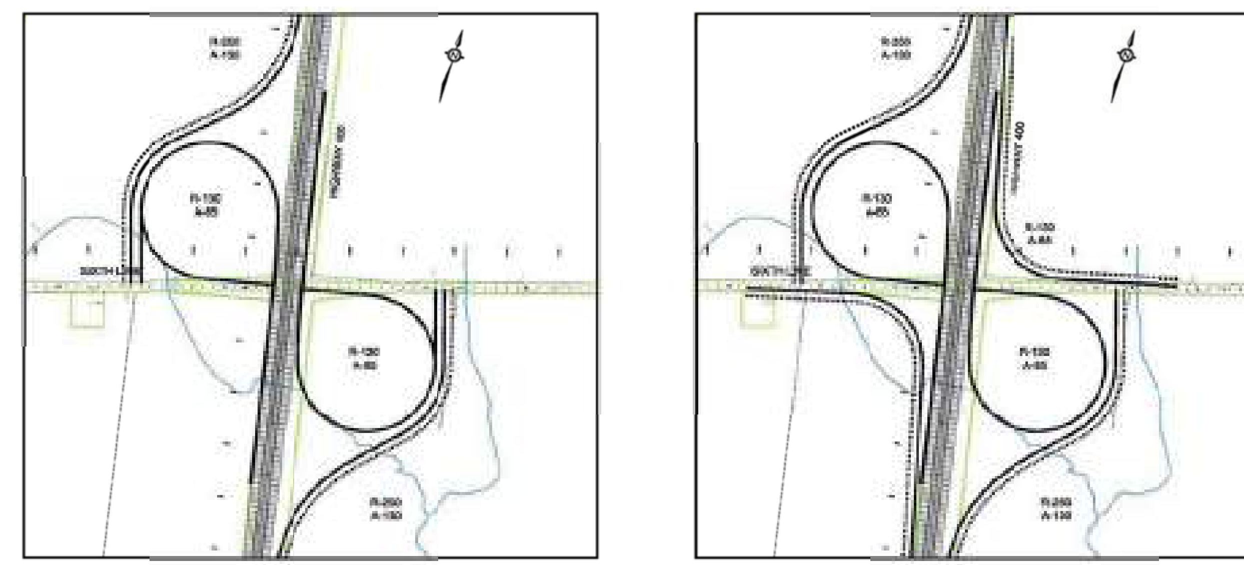


ALTERNATIVE 5
PARCLO A2
110m DIRECT TAPER ON SIXTH LINE
(80 km/h DESIGN SPEED)

ALTERNATIVE 6
PARCLO A4
110m DIRECT TAPER ON SIXTH LINE
(80 km/h DESIGN SPEED)

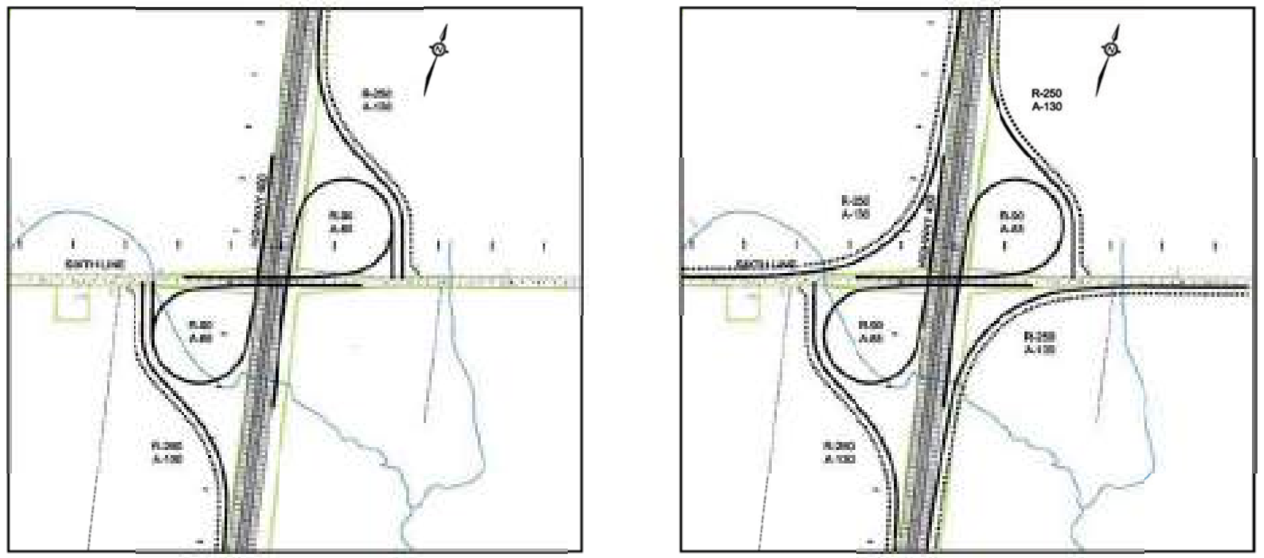
Figure 9: Interchange Alternatives 5 and 6 – Parclo A, 110 m Taper on 6th Line



ALTERNATIVE 7
PARCLO A2
110m DIRECT TAPER ON SIXTH LINE BEYOND STRUCTURE
(80 km/h DESIGN SPEED)

ALTERNATIVE 8
PARCLO A4
110m DIRECT TAPER ON SIXTH LINE BEYOND STRUCTURE
(80 km/h DESIGN SPEED)

Figure 10: Interchange Alternatives 7 and 8 – Parclo A, Taper on 6th Line beyond Structure



ALTERNATIVE 9
PARCLO B2

ALTERNATIVE 10
PARCLO B4

Figure 11: Interchange Alternatives 9 and 10 – Parclo B

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Table 2: Candidate Interchange Alternatives

Horizontal Alignment	Vertical Alignment	Interchange Configurations	Alternative Number	Coarse Screening
Alternative A: Existing Alignment	Alternative 1: 6th Line under Highway 400	Alternatives 1 to 10	Alt A1-1 Alt A1-2 Alt A1-3 Alt A1-4 Alt A1-5 Alt A1-6 Alt A1-7 Alt A1-8 Alt A1-9 Alt A1-10	Carried Forward (see **Table 1**)
	Alternative 2: 6th Line over Highway 400	Alternatives 1 to 10	Alt A2-1 Alt A2-2 Alt A2-3 Alt A2-4 Alt A2-5 Alt A2-6 Alt A2-7 Alt A2-8 Alt A2-9 Alt A2-10	Carried Forward (see **Table 1**)
Alternative B: Northerly Alignment	Alternative 1: 6th Line under Highway 400	Alternatives 1 to 10	Alt B1-1 Alt B1-2 Alt B1-3 Alt B1-4 Alt B1-5 Alt B1-6 Alt B1-7 Alt B1-8 Alt B1-9 Alt B1-10	Not Carried Forward (see **Table 1**)
	Alternative 2: 6th Line over Highway 400	Alternatives 1 to 10	Alt B2-1 Alt B2-2 Alt B2-3 Alt B2-4 Alt B2-5 Alt B2-6 Alt B2-7 Alt B2-8 Alt B2-9 Alt B2-10	Carried Forward (see **Table 1**)

Table 2: Candidate Interchange Alternatives

Horizontal Alignment	Vertical Alignment	Interchange Configurations	Alternative Number	Coarse Screening
Alternative C: Southerly Alignment	Alternative 1: 6th Line under Highway 400	Alternatives 1 to 10	Alt C1-1 Alt C1-2 Alt C1-3 Alt C1-4 Alt C1-5 Alt C1-6 Alt C1-7 Alt C1-8 Alt C1-9 Alt C1-10	Not Carried Forward (see **Table 1**)
	Alternative 2: 6th Line over Highway 400	Alternatives 1 to 10	Alt C2-1 Alt C2-2 Alt C2-3 Alt C2-4 Alt C2-5 Alt C2-6 Alt C2-7 Alt C2-8 Alt C2-9 Alt C2-10	Not Carried Forward (see **Table 1**)

Table 3: Comparison of Interchange Types

Type of Interchange	Advantages	Disadvantages
Diamond Simple structure with straight ramps on all quadrants intersecting the minor road at a right angle.	• Economical in property use and construction cost.	• Limited capacity on minor road; • Potentially conducive to wrong-way movements; • Stop on minor road for left turn; storage lane may be required through the structure.
Diamond with Roundabout Same as a conventional diamond but with safer and more efficient traffic control.	• Safer and more efficient intersection control; • Not conducive to wrong-way movements.	• Higher capital cost than conventional diamond.
Parclo A2, A4 Entrance loops provided for traffic from the minor road. Parclo A4 includes an additional on-ramp in each direction, eliminating left-turn stop from the minor road.	• Not conducive to wrong-way movements; • High capacity; • Stop for left turn confined to ramps (A4 only).	• Free-flow ramps not pedestrian-friendly or cyclist-friendly.
Parclo B2, B4	• Not conducive to wrong-way	• Limited capacity on minor road;

Table 3: Comparison of Interchange Types

Type of Interchange	Advantages	Disadvantages
Exit loops provided for traffic from the freeway. Parclo B4 includes an additional off-ramp in each direction, eliminating left-turn stop from the freeway.	movements; • Traffic from freeway does not have to stop for left turn (B4 only).	• Stop on minor road for left turn; storage lane may be required through the structure; • Free-flow ramps not pedestrian-friendly or cyclist-friendly; • High speed traffic from freeway must negotiate loop ramps; • Loop ramp hidden on the far side of structure.

4. Conclusions

A total of 30 interchange alternatives were carried forward for the quantitative evaluation. These alternatives are illustrated in a flowchart in **Figure 12**.

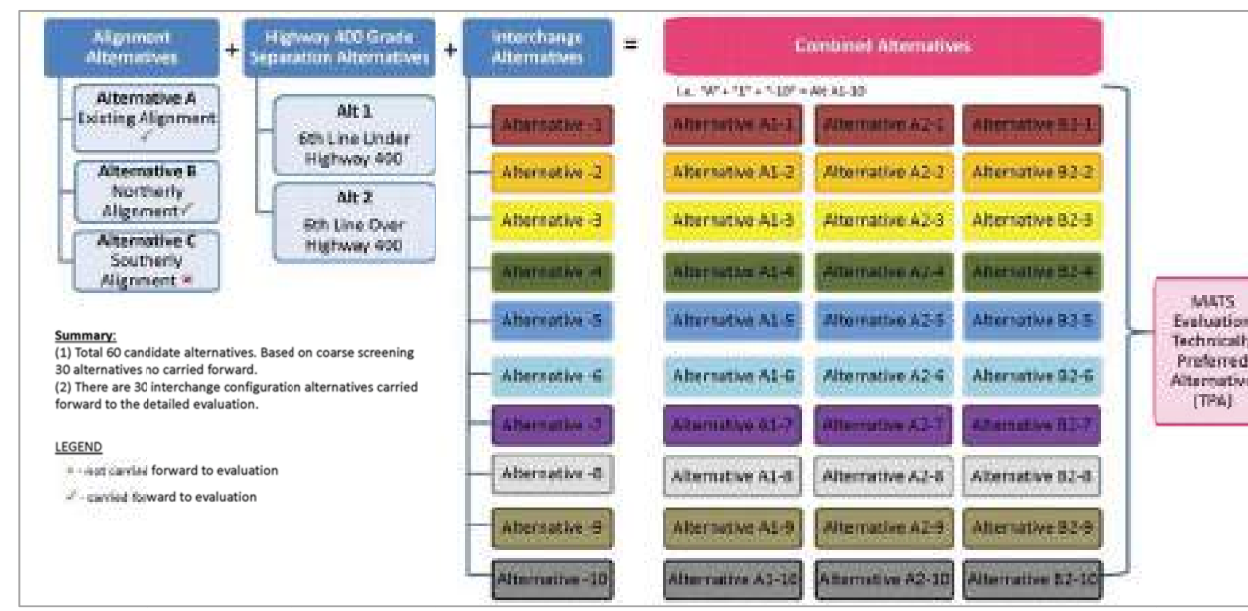


Figure 12: 30 Interchange Alternatives Carried Forward

41 Adelaide Street North, Unit 71
London, Ontario, N6C 3S6

MEMORANDUM

TO:	File	**DATE:**	September 26, 2016
FROM:	Daniel Riendeau	**PROJECT #:**	16-006
PROJECT:	Innisfil 6th Line Interchange EA		
SUBJECT:	Traffic Capacity Analysis		

This technical memorandum presents the traffic capacity analysis of the proposed interchange configuration at Highway 400 / 6th Line in Innisfil, Ontario, using 2031 turning movement volume projections and the microscopic simulation tool Vissim.

1. Introduction

The Town of Innisfil (Town) has initiated a Municipal Class Environmental Assessment (EA) to plan for a new interchange on Highway 400 at 6th Line. This interchange has been identified in the Town's Official Plan (OP) and Transportation Master Plan (TMP). The TMP discusses the Ontario Growth Plan for Simcoe County and the identification of the settlement of Alcona, located to the northeast of the Study Area, as a Primary Settlement area. Alcona is expected to see the highest population growth in the area and developers intend to build new homes south of Alcona in the development area called Sleeping Lion. The TMP for the Town of Innisfil has recommended revising the OP to identify 6th Line as a preferred corridor for road improvements and the location for a new interchange with Highway 400.

2. Preferred Interchange Alternative

Six alignment alternatives were considered for the interchange at Highway 400 and 6th Line, i.e. a combination of 3 horizontal alignment alternatives and 2 vertical alignment alternatives.

In addition, a total of 10 configuration alternatives were proposed for the evaluation process, including several diamond and partial cloverleaf configuration alternatives. Each configuration alternative was combined with each of the vertical and horizontal alignment alternatives for a total of 60 candidate interchange alternatives. A total of 30 interchange alternatives were recommended to be carried forward for the evaluation.

The technically recommended alternative (TPA) is a diamond interchange with roundabouts on a northerly alignment (6th Line shifted away by 50 m from its current alignment) with Highway 400 under 6th Line, as shown in **Figure 1**.

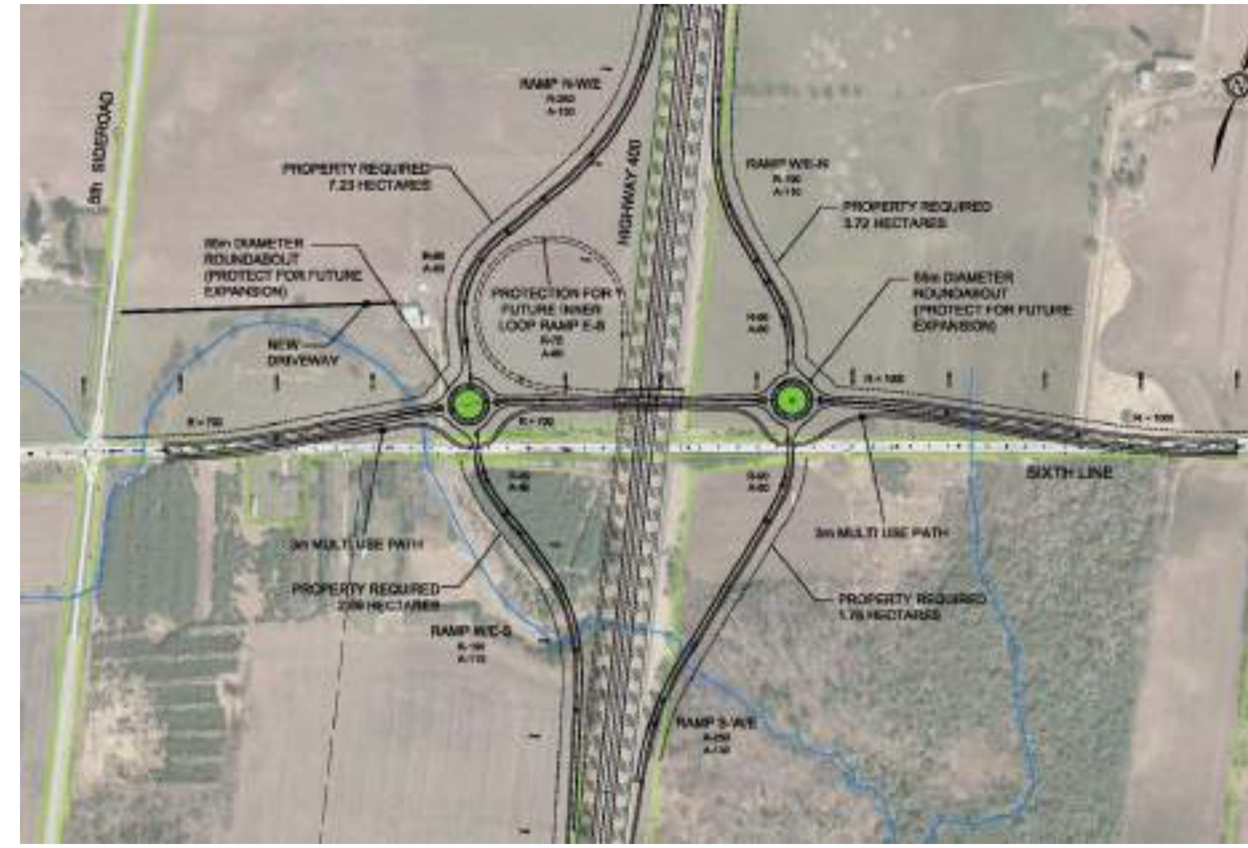


Figure 1: Technically Preferred Alternative

Based on the advice of the consultant, a refined TPA was tabled to the Technical Advisory Committee. This refinement would protect for a future inner loop on the east side of the interchange. The refined TPA is shown in **Figure 2**.

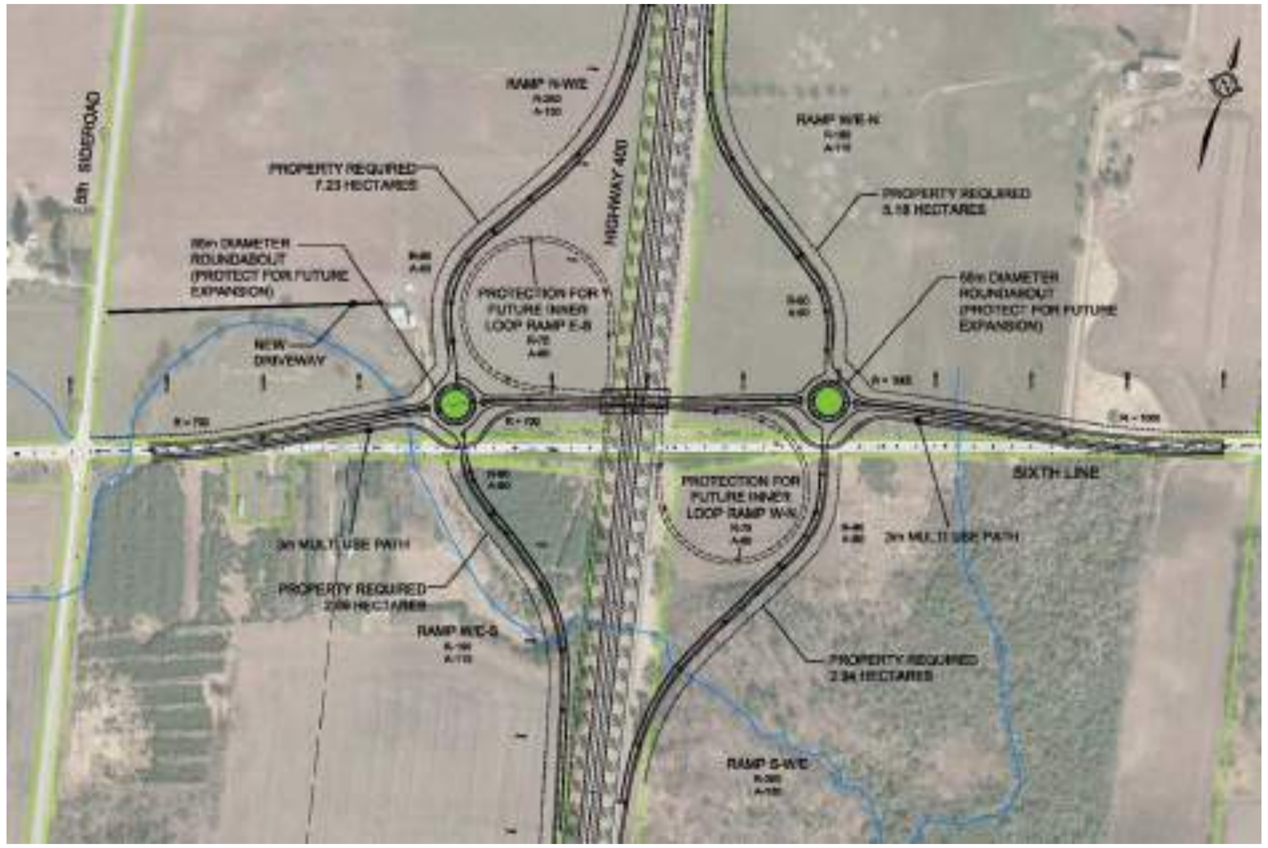


Figure 2: Refined Technically Preferred Alternative

3. 2031 Traffic Volumes on 6th Line

Future traffic volumes were estimated based on the following sources:

- Existing (2012) turning movement volumes from MTO traffic count reports dated August 9, 2012;
- Existing (2013) daily traffic volumes on Innisfil Beach Road, from Innisfil's *2013 Transportation Master Plan* (TMP); and
- Future (2031) traffic volumes from a regional simulation model (scenario with road widening) developed by HDR and documented in the *6th Line Municipal Class Environmental Assessment – Needs Analysis: Travel Demand Forecasting* memorandum dated January 2015.

The following assumptions were used:

- The directional traffic distribution at the future 6th Line interchange will be practically the same as at the existing Innisfil Beach Road interchange; and

- The peak hour volume / daily volume ratio at the future 6th Line interchange will the same as at the existing Innisfil Beach Road interchange.

The estimated 2031 turning movement volumes are shown in **Figure 3**.

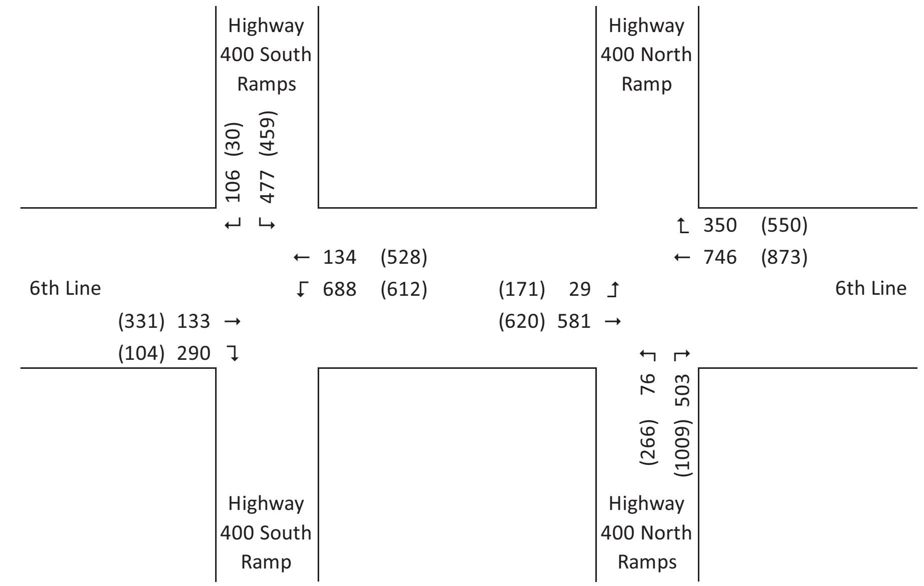


Figure 3: 2031 Traffic Volume Projection, Morning (Afternoon) Peak Hour

According to this projection, the south-to-east and the east-to-south movements will experience a very high demand in 2031 and will likely require a special treatment such as channelization or double-laning in order to avoid congestion. The north-to-east and east-to-north movements are also expected to experience a moderate to high demand in 2031.

It is noted that this projection is obtained by using the regional simulation model that includes 6th Line as a 4-lane roadway between Highway 400 and Alcona. As such, this projection is considered as a long-term scenario.

4. Lane Configuration on the 6th Line Interchange

Several lane configurations were tested for the traffic capacity analysis. The default lane configuration used for simulation is shown in **Table 1** for the east ramp terminal and **Table 2** for the west ramp terminal.

Table 1: Lane Configuration, 6th Line Interchange East Ramp Terminal

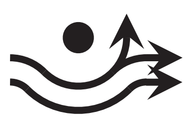
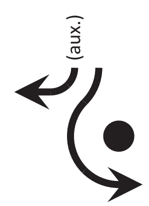
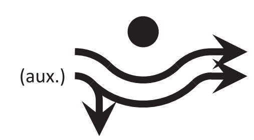
Eastbound	Northbound	Westbound
		

Table 2: Lane Configuration, 6th Line Interchange West Ramp Terminal

Westbound	Southbound	Eastbound
		

Key elements of the interchange lane configuration include:

- 4-lane cross-section on 6th Line east of the interchange and between the ramp terminals;
- 2-lane cross-section on 6th Line west of the interchange (transitioning from 4 lanes west of the interchange);
- One lane on all ramps except the northbound off-ramp (2-lane exit from Highway 400);
- Double right-turn movement from the northbound off-ramp to 6th Line; and
- Auxiliary (storage) lane on the southbound off-ramp.

A 4-lane cross-section is expected on 6th Line at the interchange, consistent with the long-term 6th Line configuration proposed in the 6th Line Municipal Class EA Study, and justified by the high anticipated traffic demand. Traffic approaching the interchange from the east is expected to reach 1,423 vehicles during the afternoon peak hour. The demand is much lower from west of Highway 400 (up to 435 veh/h in the afternoon) but 2 entry lanes are provided to increase gap opportunities against the southbound left turn (up to 477 veh/h in the morning) and the westbound left turn (688 veh/h) movements.

All ramps to and from 6th Line contain one lane only, except for the northbound off-ramp which is expected to experience high traffic volume (1,275 vehicles) during the afternoon peak hour. The southbound off-ramp contains an auxiliary (storage) lane to allow more gap opportunities.

5. Interchange Analysis

The Vissim microsimulation tool was used to measure the performance of the proposed interchange configuration with the 2031 traffic volume projections. Five 1-hour simulations were executed from which the simulated traffic volumes, average delays, and 95th percentile queue lengths were calculated.

Table 3 presents the intersection performance results with the 2031 traffic volume projections and the default ramp terminal configuration.

Table 3: Intersection Performance Results, 2031 Traffic, Default Configuration

Intersection	Movement	Morning Peak Hour			Afternoon Peak Hour		
		Delay (s)	Level of Service	95th Queue (m)	Delay (s)	Level of Service	95th Queue (m)
East Ramp Terminal	Eastbound Left	1	A	0	1	A	0
	Eastbound Through	0	A	0	0	A	0
	Northbound Left	2	A	28	8	A	84
	Northbound Right	1	A	28	5	A	84
	Westbound Through	1	A	28	6	A	143
	Westbound Right	1	A	28	9	A	143
	Overall	**1**	**A**		**5**	**A**	
West Ramp Terminal	Westbound Left	1	A	0	1	A	0
	Westbound Through	0	A	0	0	A	0
	Southbound Left	19	B	193	82	F	522
	Southbound Right	5	A	193	37	D	522
	Eastbound Through	74	E	369	18	B	77
	Eastbound Right	73	E	369	16	B	77
	Overall	**22**	**C**		**21**	**C**	

The results indicate that the east ramp terminal is operating satisfactorily, with a level of service A (LOS A). The 95th percentile queues in the northbound and westbound directions do not exceed 150 m during the afternoon peak hour, which is reasonable (the northbound off-ramp is approximately 500 m long).

The west ramp terminal, on the other hand, is operating poorly in the southbound and eastbound directions with delays reaching 82 seconds (LOS F) and 74 seconds (LOS E) in the southbound and eastbound directions respectively. The southbound 95th percentile queue reaches 522 m, which is almost the length of the entire ramp (580 m) and the eastbound 95th percentile queue reaches 369 m, which is beyond 5th Sideroad (located at 350 m from the west ramp terminal).

Figure 4 shows the simulated average traffic speeds through the interchange.

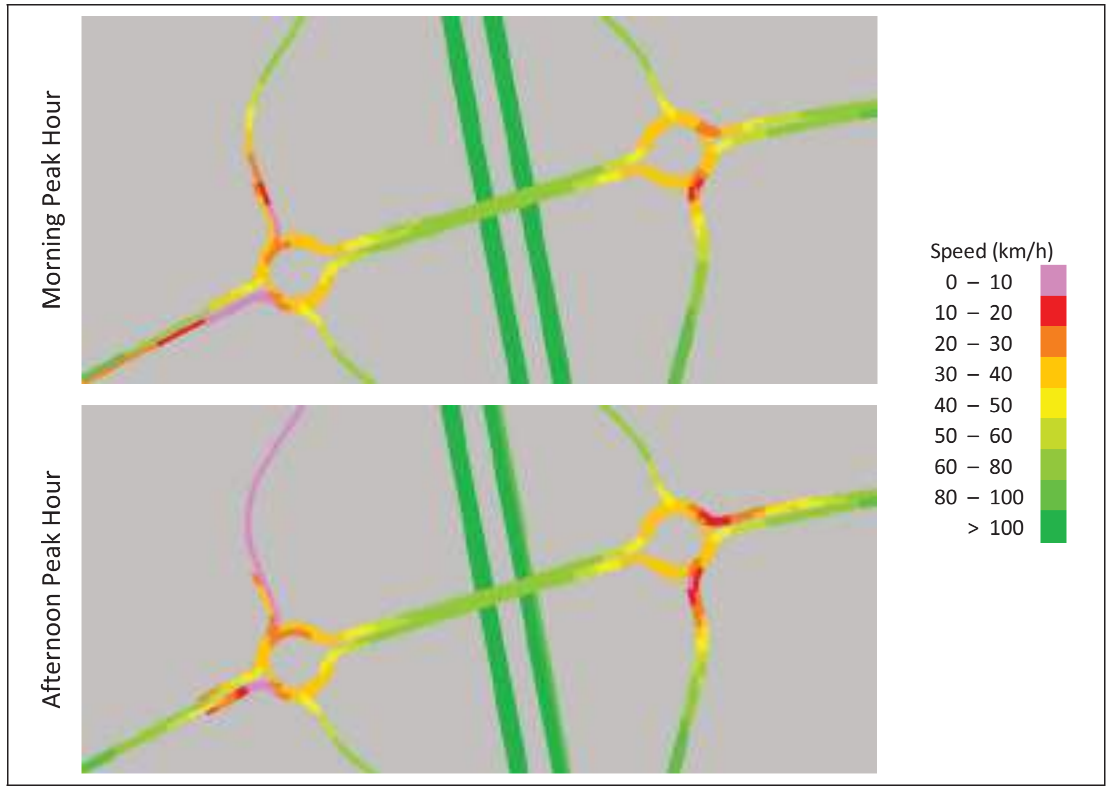


Figure 4: Average Speed, 2031 Traffic, Default Configuration

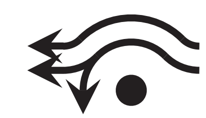
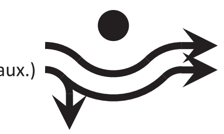
Two solutions are discussed below to solve the capacity issue of the west ramp terminal.

5.1. Double Southbound Left Turn Option

Considering the high traffic volumes performing a left turn from the southbound off-ramp, one solution to increase the capacity of the west ramp terminal is to add a second lane on the west side of the roundabout, thus effectively allowing double southbound left turns, as illustrated in **Table 4**.

Table 5 presents the intersection performance results with the 2031 traffic volume projections and the proposed southbound double left turn lane.

Table 4: Lane Configuration, 6th Line Interchange West Ramp Terminal, Double Southbound Left Turn Option

Westbound	Southbound	Eastbound
		

Note: colour identifies change from default; green = lane addition.

Table 5: Intersection Performance Results, 2031 Traffic, Double Southbound Left Turn Option

Intersection	Movement	Morning Peak Hour			Afternoon Peak Hour		
		Delay (s)	Level of Service	95th Queue (m)	Delay (s)	Level of Service	95th Queue (m)
East Ramp Terminal	Eastbound Left	1	A	0	1	A	0
	Eastbound Through	0	A	0	0	A	0
	Northbound Left	2	A	33	8	A	103
	Northbound Right	1	A	33	5	A	103
	Westbound Through	1	A	31	6	A	131
	Westbound Right	1	A	31	9	A	131
	Overall	**1**	**A**		**5**	**A**	
West Ramp Terminal	Westbound Left	1	A	0	1	A	0
	Westbound Through	0	A	0	0	A	0
	Southbound Left	6	A	42	14	B	136
	Southbound Right	6	A	42	13	B	136
	Eastbound Through	15	B	133	9	A	53
	Eastbound Right	23	C	133	10	A	53
	Overall	**7**	**A**		**6**	**A**	

As the results indicate, adding a second southbound left turn considerably improves the traffic operation of the west ramp terminal. The average delay per vehicle has been reduced to 23 seconds (LOS C) in the eastbound direction and 14 seconds in the southbound direction. Also, the 95th percentile queues are now limited to 136 m, which is more reasonable.

Figure 5 shows the simulated average traffic speeds through the interchange with the double southbound left turn.

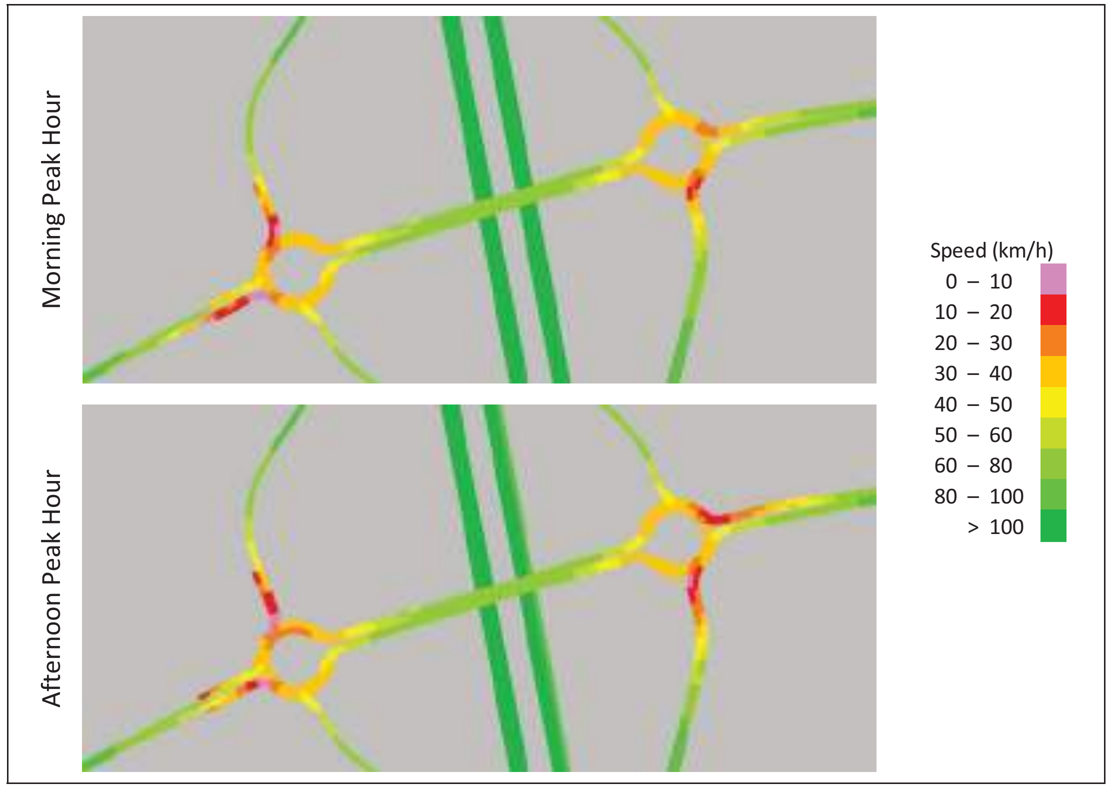


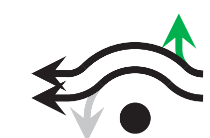
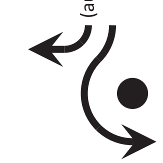
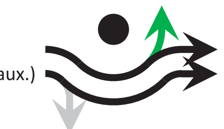
Figure 5: Average Speed, 2031 Traffic, Double Southbound Left Turn Option

5.2. Northwest Loop Option

The high traffic volumes travelling from east to south negatively affect traffic entering the roundabout from the west. This can be countered by relocating the southbound on-ramp from the southwest quadrant to the northwest quadrant, as illustrated by the dashed lines in **Figure 1**. The resulting lane configuration is illustrated in **Table 6**.

Table 7 presents the intersection performance results with the 2031 traffic volume projections and the proposed relocation of the southbound on-ramp.

Table 6: Lane Configuration, 6th Line Interchange West Ramp Terminal, Northwest Loop Option

Westbound	Southbound	Eastbound
	 (aux.)	 (aux.)

Note: colour identifies changes from default; green = lane addition, grey = lane removal.

Table 7: Intersection Performance Results, 2031 Traffic, Northwest Loop Option

Intersection	Movement	Morning Peak Hour Delay (s)	Morning Peak Hour Level of Service	Morning Peak Hour 95th Queue (m)	Afternoon Peak Hour Delay (s)	Afternoon Peak Hour Level of Service	Afternoon Peak Hour 95th Queue (m)
East Ramp Terminal	Eastbound Left	1	A	0	1	A	0
	Eastbound Through	0	A	0	0	A	0
	Northbound Left	3	A	35	10	A	122
	Northbound Right	1	A	35	6	A	122
	Westbound Through	1	A	33	6	A	144
	Westbound Right	1	A	33	9	A	144
	Overall	**1**	**A**		**5**	**A**	
West Ramp Terminal	Westbound Through	1	A	101	1	A	43
	Westbound Right	4	A	101	1	A	43
	Southbound Left	2	A	41	6	A	88
	Southbound Right	1	A	41	1	A	88
	Eastbound Left	5	A	47	4	A	36
	Eastbound Through	2	A	47	2	A	36
	Overall	**3**	**A**		**3**	**A**	

Providing an on-ramp loop in the northwest quadrant instead of a direct on-ramp in the southwest quadrant allows for even better traffic operation at the west ramp terminal, with delays reduced to 6 seconds (LOS A) in the southbound direction and 5 seconds (LOS A) in the eastbound direction. The 95th percentile queue in the southbound direction is reduced to 88 m while it is reduced to 38 m in the eastbound direction.

Figure 6 shows the simulated average traffic speeds through the interchange with the northwest loop option.

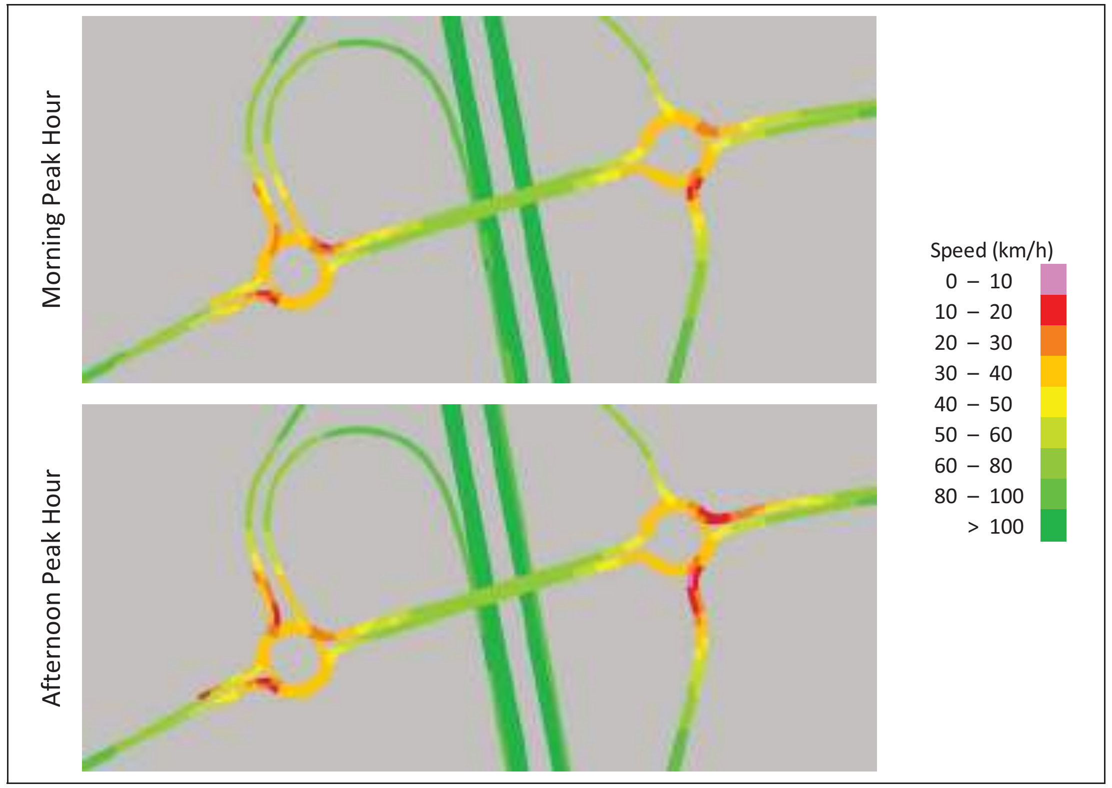


Figure 6: Average Speed, East Ramp Terminal, 2031 Traffic, Northwest Loop Option

One particular advantage of this configuration option is that it allows for a longer weaving zone between the freeway on-ramp from 6th Line and the off-ramp to the ONroute travel centre.

One minor disadvantage is that it somewhat reduces the capacity of the westbound direction since it must yield to the traffic travelling from west to south. This however does not affect the overall efficiency of the ramp terminal. If volumes get higher than expected, the potential capacity issue may be corrected by providing an on-ramp in both the northwest and the southwest quadrants (as suggested on **Figure 1**) so that the east-to-south and the west-to-south traffic could perform a right turn movement without interfering directly with each other.

5.3. Northwest and Southwest On-ramp Option

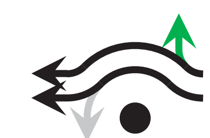
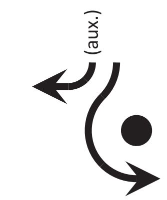
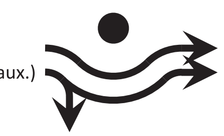
As illustrated in **Figure 1**, the technically recommended alternative includes a direct southbound on-ramp in the southwest quadrant of the interchange with protection for a future inner loop in the northwest quadrant. The option above suggests a reversed order of implementation: an inner loop in the northwest quadrant with protection for a future direct ramp in the southwest quadrant.

Subject: Traffic Capacity Analysis
Project: 16-006 Innisfil 6th Line Interchange EA
Date: September 26, 2016

This section examines the performance of the interchange with both southbound on-ramps in place. The lane configuration is illustrated in **Table 10**.

Table 11 presents the intersection performance results with the 2031 traffic volume projections and both southbound on-ramps.

Table 8: Lane Configuration, 6th Line Interchange West Ramp Terminal, NW and SW On-ramp Option

Westbound	Southbound	Eastbound
		

Note: colour identifies changes from default; green = lane addition, grey = lane removal.

Table 9: Intersection Performance Results, 2031 Traffic, Northwest and Southwest On-ramp Option

Intersection	Movement	Morning Peak Hour Delay (s)	Morning Peak Hour Level of Service	Morning Peak Hour 95th Queue (m)	Afternoon Peak Hour Delay (s)	Afternoon Peak Hour Level of Service	Afternoon Peak Hour 95th Queue (m)
East Ramp Terminal	Eastbound Left	1	A	0	1	A	0
	Eastbound Through	0	A	0	0	A	0
	Northbound Left	2	A	28	11	B	121
	Northbound Right	1	A	28	6	A	121
	Westbound Through	1	A	33	6	A	124
	Westbound Right	1	A	33	8	A	124
	Overall	**1**	**A**		**5**	**A**	
West Ramp Terminal	Westbound Through	0	A	0	0	A	0
	Westbound Right	1	A	0	1	A	0
	Southbound Left	2	A	32	6	A	78
	Southbound Right	1	A	32	1	A	78
	Eastbound Through	3	A	42	3	A	29
	Eastbound Right	4	A	42	4	A	29
	Overall	**2**	**A**		**2**	**A**	

The implementation of both southbound on-ramps provides the best results overall, and is slightly more efficient than the northwest-only loop option. Its key advantage is the separation of the east-to-south and the west-to-south movements, which are no longer conflicting with each other and causing delays to either direction. With this option, the westbound direction experiences no delay while the delay in the eastbound direction is reduced to 4 seconds. The delay in the southbound direction remains similar to the northwest-only loop option.

Figure 7 shows the simulated average traffic speeds through the interchange with both the northwest and southwest on-ramps.

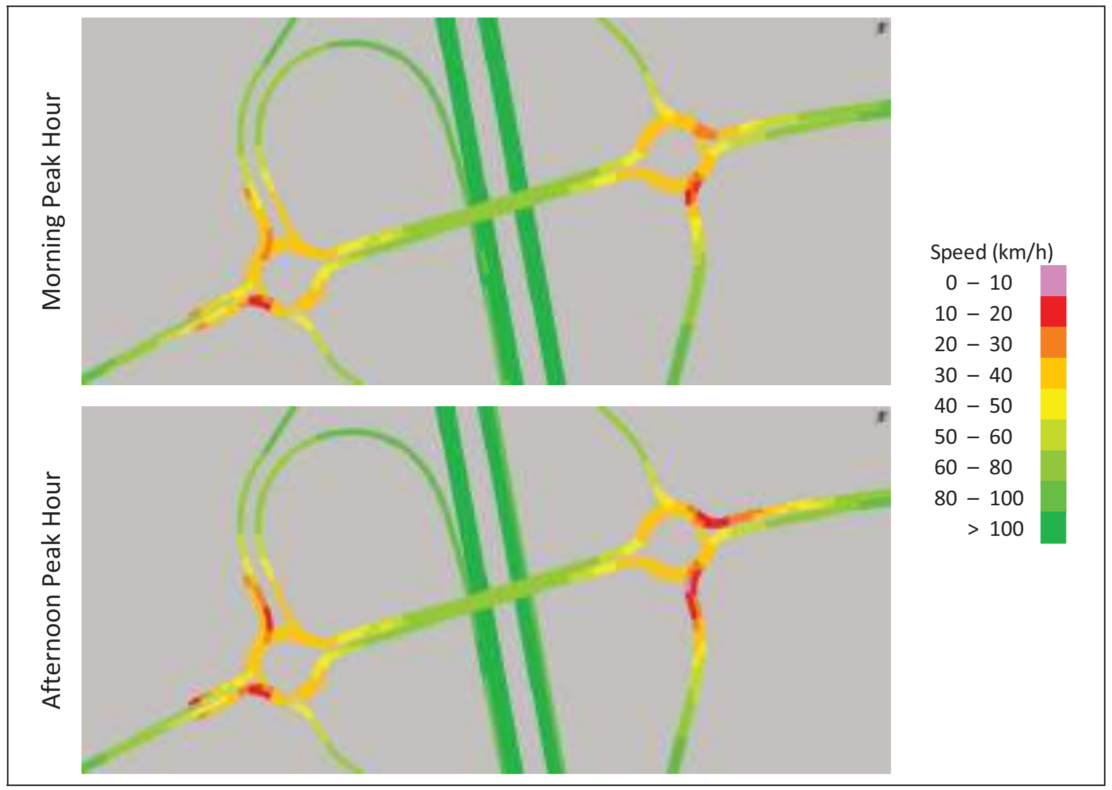


Figure 7: Average Speed, East Ramp Terminal, 2031 Traffic, Northwest and Southwest On-ramp Option

6. ONroute Weaving Analysis

An ONroute travel service centre is located on Highway 400 in the southbound direction at 1.5 km from 6th Line. A traffic count performed on May 19, 2016 indicates that as much as 82 vehicles per hour exit the freeway to stop at the ONroute centre during the morning and 85 vehicles per hour during the afternoon. Assuming a growth rate of 2.7%, as calculated from the MTO Provincial Highways Traffic Volumes data (2002-

2012 growth), the traffic demand for the ONroute centre is expected to reach 122 and 127 vehicles during the morning and the afternoon peak hours respectively.

According to traffic counts provided by MTO for the periods of July 22-29, August 21-28, and September 2-8, 2014, southbound traffic volumes on Highway 400 north of Highway 89 reach 4,039 and 3,415 veh/h during the weekday morning and afternoon peak hours respectively. Assuming the same growth rate as above, the future traffic volumes are estimated at 6,353 and 5,371 veh/h respectively.

For the purpose of analysis, the weaving zone between 6th Line and the ONroute centre has been included and simulated in the Vissim model. The diamond configuration has been selected as the worst case scenario since the distance between the on-ramp from 6th Line and the off-ramp to ONroute is the shortest.

Table 10 presents the measured traffic volume for each lane at different sections on the freeway while **Table 11** presents the measured average speed from the Vissim simulations.

Table 10: Measured Traffic Distribution on Highway 400 between 6th Line and ONroute, 2031 Traffic

Location	Morning Peak Hour					Afternoon Peak Hour				
	Ramp	Right-most Lane	Right Lane	Left Lane	Left-most Lane	Ramp	Right-most Lane	Right Lane	Left Lane	Left-most Lane
At the 6th Line on-ramp bullnose	966	1621	1497	1231	1013	702	1548	1354	1012	726
At the 6th Line on-ramp taper	–	2047	2005	1372	902	–	1926	1709	1073	633
At the ONroute off-ramp taper	–	1781	1768	1530	1246	–	1690	1566	1214	872
At the ONroute off-ramp bullnose	121	1815	1734	1453	1199	124	1742	1537	1144	793

Table 11: Average Speed on Highway 400 between 6th Line and ONroute, 2031 Traffic

Location	Dist. (m)	Average Speed (km/h)									
		Morning Peak Hour					Afternoon Peak Hour				
		Ramp Lane	Right-most Lane	Right Lane	Left Lane	Left-most Lane	Ramp Lane	Right-most Lane	Right Lane	Left Lane	Left-most Lane
Between the 6th Line on-ramp bullnose and the taper	200	99	99	103	107	109	100	100	104	108	110
Between the on-ramp taper and the off-ramp taper	287	–	98	102	105	108	–	99	104	107	110
Between the ONroute off-ramp taper and the bullnose	221	99	99	102	105	106	101	100	104	107	109

The results above indicate that the traffic on Highway 400 is generally well-balanced and that the speed between the 6th Line interchange and the ONroute centre is not significantly affected by the traffic entering from 6th Line or exiting to ONroute.

Figure 8 shows the simulated average traffic speeds between 6th Line and the ONroute centre.

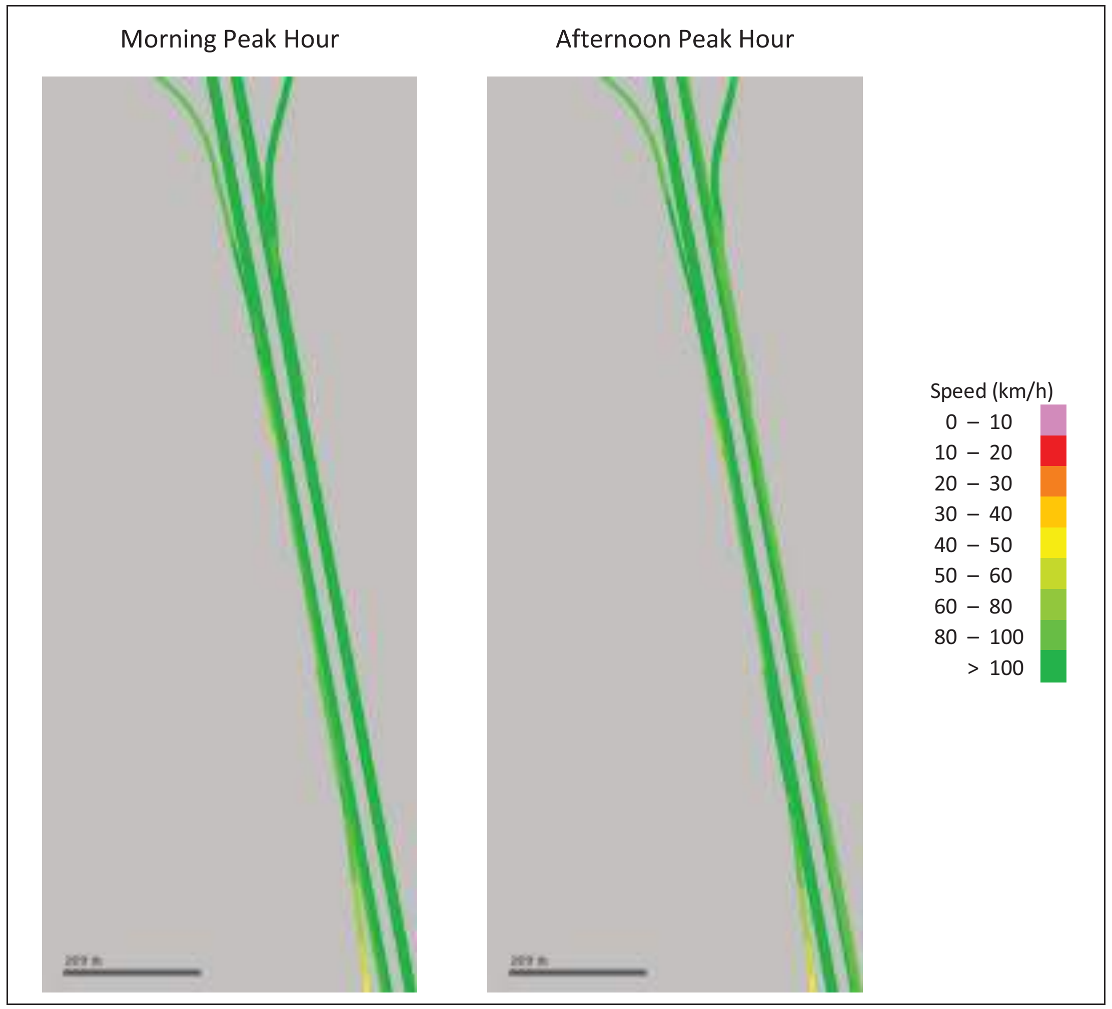


Figure 8: Average Speed, Highway 400 between 6th Line and ONroute, 2031 Traffic

7. Summary

The 2031 traffic projections are based on a regional simulation model that includes a 4-lane cross-section on 6th Line between Highway 400 and Alcona. Therefore, these projections are considered as long-term.

The technically recommended interchange alternative includes a roundabout at each ramp terminal. The lane configuration used in the present analysis assumes a 4-lane cross-section on 6th Line through the interchange. This configuration is consistent with the long-term configuration proposed in the 6th Line Municipal Class EA Study and is warranted by the high traffic demand estimated in 2031.

Key elements of the interchange lane configuration include:

- 4-lane cross-section on 6th Line east of the interchange and between the ramp terminals;
- 2-lane cross-section on 6th Line west of the interchange (transitioning from 4 lanes west of the interchange);
- One lane on all ramps except the northbound off-ramp (2-lane exit from Highway 400);
- Double right-turn movement from the northbound off-ramp to 6th Line; and
- Auxiliary (storage) lane on the southbound off-ramp.

Optional elements were also analyzed:

- Double left-turn movement from the southbound off-ramp to 6th Line; and
- Northwest loop option (southbound on-ramp in the northwest quadrant instead of, or in addition to, a direct ramp on the southwest quadrant).

Vissim simulation results indicate that the east ramp terminal would operate satisfactorily within the 2031 horizon whereas the west ramp terminal would operate satisfactorily only if either optional element (double southbound left turn or northwest loop) is implemented.

The analyses also indicate that Highway 400 would operate with minimal to no disruption between 6th Line and the ONroute service centre despite the limited separation distance.

8. Recommendation

It is expected that most of the traffic that will use the new interchange at Highway 400 and 6th Line will be travelling from east to south and vice versa and, to a lesser extent, from east to north and vice versa. Consequently, the proposed interchange configuration with the northwest loop option would be the most efficient choice, as confirmed by the traffic capacity analysis, either as an initial element of the design or included as protection for future expansion. This option has the additional benefit of allowing a greater weaving distance between the 6th Line on-ramp and the ONroute off-ramp. The interchange can still be complemented with a second southbound on-ramp in the southwest quadrant as well as double southbound left-turn lanes, depending on future traffic demand.

The refined TPA, as modified according to this recommendation, is illustrated in **Figure 9**.

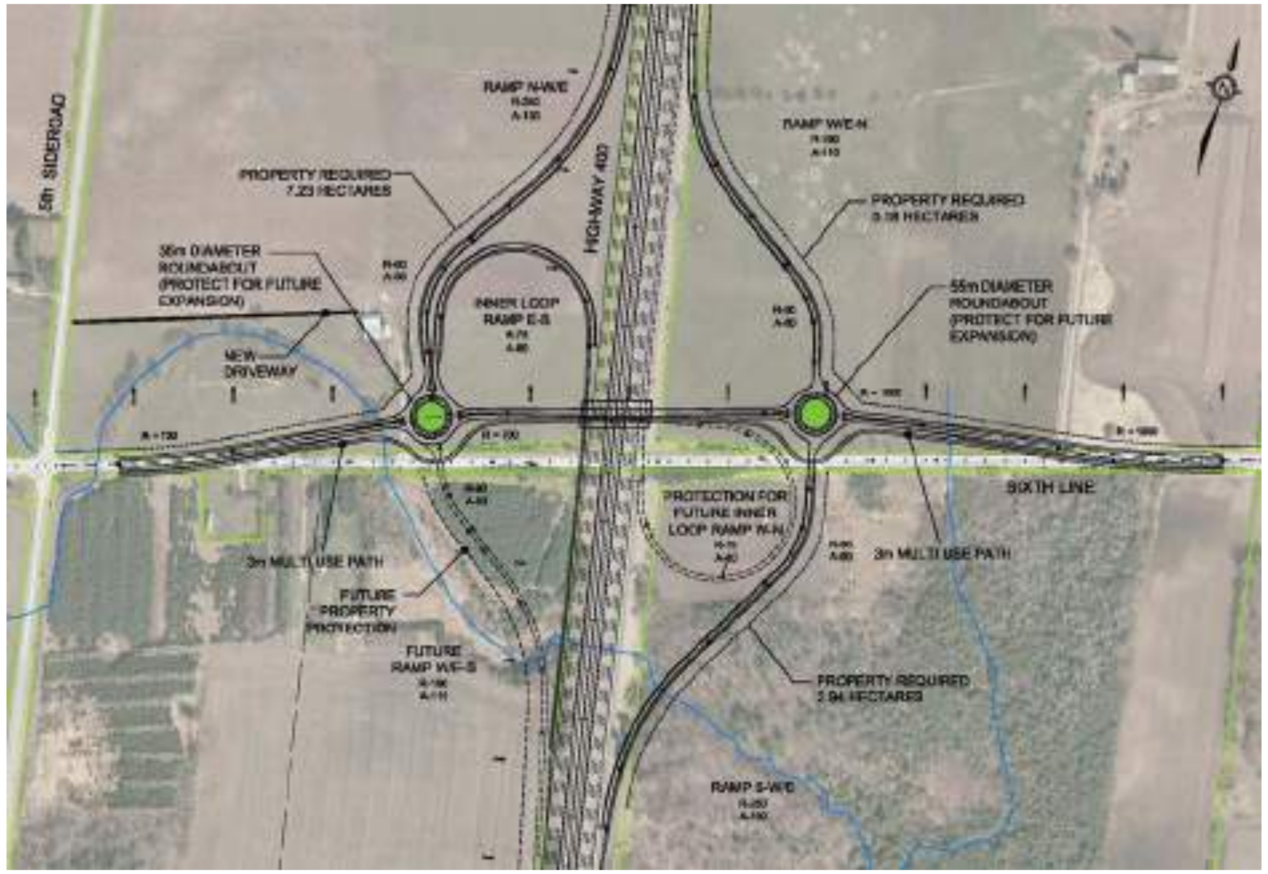


Figure 9: Modified Refined Technically Preferred Alternative

Appendix E
Geotechnical Desktop Review

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LOCATIONS:
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Barrie
Oshawa
Napanee

LABORATORY:
Peterborough

BT Engineering
41 Adelaide Street North
London, Ontario N6B 3P4

Attn: Darcie Dillon

Re: 6th Line Interchange Desktop Geotechnical Review
6th Line and Highway 400, Innisfil, Ontario
Cambium Reference No. 4636-001

Dear Ms. Dillon,

Cambium Inc. (Cambium) is pleased to present our geotechnical desktop study for the Class EA for the 6th Line Interchange in Innisfil, Ontario (Site). We have reviewed all available information regarding the region and have provided a summary of the important data in the following sections of this letter report.

PHYSIOGRAPHY

The Site is located in the drumlinized till planes known as the Innisfil Uplands as a part of the Peterborough drumlin field physiographic region (Chapman and Putnam 1984). The Peterborough drumlin field extends from east of Hastings County and west to Simcoe County. General characteristics of the specific Site region show shallow sand and gravel deposits with drumlins to the south east of the Site oriented north east to southwest (Chapman and Putnam 1984). The region is bordered on all sides by the Simcoe Lowlands which is defined by the old shorelines of the once Lake Algonquin (Algonquin Lake Plain). Many Quaternary swamps are also located in the Algonquin Lake Plains, including near the tip of the Innisfil Creek to the south of the Site. In addition to the west of the site are the sand plains of Camp Borden (Chapman and Putnam 1984).

Based on the above general physiography of the Innisfil Uplands the expected geology is that of primarily Pleistocene aged till formed by either glacio-fluvial deposits of sand and gravel or outwash, or ground moraines (Chapman and Putnam 1984).

WELL RECORDS

Ontario groundwater well records for the area surrounding the proposed interchange were analyzed for general stratigraphy present. It was established that intermittent layers of clay, sand, silt and gravel are present confirming the physiographic presence of primarily till in the region. The till was observed to depths exceeding 45 meters below ground surface (mbgs) with more shallow soils up to approximately 10 mbgs having a finer texture. None of the local well records

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were advanced to bedrock depth with the deepest record found to a depth of approximately 56 mbgs in till.

AVAILABLE REPORTS

The following sections of this report identify any applicable information from past reports in the area for the 6th Line and Highway 400 interchange.

FACTUAL GEOTECH AND PAVEMENT DESIGN (GOLDER ASSOCIATES)

Golder Associates Ltd. completed a geotechnical investigation and pavement design report for 6th Line from County Road 27 to St. Johns Road, in the town of Innisfil, County of Simcoe, Ontario. This field investigation was part of the Municipal Class Environmental Assessment (EA) and Preliminary Design Study for the widening and potential reconstruction of 6th Line. One (1) borehole was advanced on either side of Highway 400 and both holes were advanced to 1.5 m depth through the asphalt surface.

The subgrade conditions to the west and east of Highway 400 are shown in Table 1, and are consistent with the expected till present in the subgrade.

Table 1: Subsurface conditions for borehole on 6th Line either side of Highway 400

Depth (mbgs)	West of Highway 400	Depth (mbgs)	East of Highway 400
0.0 – 0.025	Asphalt	0.0 – 0.05	Asphalt
0.025 – 0.20	Granular Base – sand and gravel, trace to some silt	0.05 – 0.26	Granular Base – sand and gravel, trace to some silt
0.20 – 0.90	Granular Subbase – gravelly sand, some silt	0.26 – 0.56	Granular Subbase – gravelly sand, some silt
0.90 – 1.2	Organic silt and sand, trace clay	0.56 – 1.5	Clayey silt and sand, trace gravel
1.2 – 1.5	Silt and sand, trace clay, trace gravel		

In addition it was found that the water level in the borehole west of Highway 400 was found to be at 0.9 mbgs but was not encountered in the boring depth east of Highway 400.

CONTAMINATION REPORT (GOLDER ASSOCIATES)

Golder Associates Ltd. completed a Contaminated Property and Waste Management report for the 6th Line EA region. This process included a radial region of 500 m around the 6th Line and Highway 400 intersection. The investigation identified no contamination risks within the 500 m region but did state that a residential home approximately 550 m east located at 3386 6th Line was present with evidence of vehicle maintenance onsite. The potential contaminants of concern

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for this location are volatile organic compounds (VOCs), petroleum hydrocarbons, (PHC F1 to F4), metals, inorganics, and polycyclic aromatic hydrocarbons (PAHs) and should be considered for investigation during the project 6th Line interchange geotechnical investigation.

HYDROGEOLOGICAL REPORT (GOLDER ASSOCIATES)

The immediate region surrounding the proposed Highway 400 and 6th line interchange is situated within the Nottawasaga River watershed and the Innisfil Creek sub-watershed. The groundwater is expected to flow through local tributaries and the Innisfil creek and discharge in the Nottawasaga River located west of the Site.

Based on topographic surveys and windshield surveys, the vicinity of Highway 400 (500 m east and west) is situated in a topographic low and is observed to be an area of high water table with groundwater levels within 1 m of the surface. In addition this wet land area has the potential for more significant groundwater discharge. The primary groundwater recharge area for the Site is located in an area of ice contact sediments about 0.7 km to 1.7 km east of Highway 400.

The local area is dependent on groundwater pumping wells for both residential and agricultural use. The wells in the immediate site area were advanced to approximately 11 mbgs with a water level of between 4.7 mbgs and 6.9 mbgs. The wells in the surrounding area are most commonly advanced through the surface glacial till confining layer and into a confined aquifer typically encountered between 270 masl and 285 masl. The surface elevation near Highway 400 is approximately 292 masl.

The hydrogeological report also shows surficial geology for the Highway 400 area (500 m east and west) indicating primarily fine grained till and ice contact sediments (eskers) with isolated regions of glaciolacustrine deep water deposits and fluvial sand.

DESKTOP STUDY FOUNDATION ASSESSMENT (GOLDER ASSOCIATES)

Based on digital terrain model provided by Golder Associates, the 6th Line road surface at the bridge is at an approximate elevation of 291 m (geodetic datum), the surrounding area has an approximate elevation of 294 m to 295 m, and the ground surface at the Highway 400 grade is at an approximate elevation of 296.5 m.

Two (2) boreholes were completed in 2002 by Golder Associated Ltd. as part of a Preliminary Foundation Investigation Report for the 6th Line overpass. They were completed through the asphalt surface of 6th Line east and west of the overpass with subsurface conditions consisting of sand and gravel to silty sand fill underlain by clayey silt till. The pavement structure fill was 300 mm to 500 mm thick with proposed trench backfill extending to 1.8 mbgs west of the overpass. The clayey silt till was encountered at an approximate elevation of 290.7 m east of the overpass and extended to termination depth of 283 m and 279.5 m in boreholes east and west of the overpass respectively.

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The clayey silt till contains a significant portion of sand and trace to some gravel, with particle size distribution indicating approximately 5% gravel, 40% sand, 40% silt, and 15% clay. Atterberg limits were also completed, indicating a plastic limit in the range of 11% to 12%, liquid limits from 14% to 15%, and plasticity index from 3% to 4%. From this it can be stated that the clayey silt till is inorganic and of low plasticity. The SPT N values ranged from 67 to 138 blows, but were typically 100 blows per 300 mm of penetration, indicating a hard relative density. The measured groundwater depth in the open boreholes on completion of drilling were 6.9 m depth or 284.5 m (and rising) west of the overpass and 4.0 m depth or 287 m east of the overpass.

STORMWATER MANAGEMENT (HDR)

Based on a stormwater management report completed by HDR, two (2) tributaries of the Innisfil Creek system cross the 6th Line near the proposed interchange with Highway 400. One of the tributaries is located approximately 200 m west of Highway 400 while the other crosses approximately 300 m east. The tributaries both flow south and meet approximately 700 m southeast of the Highway 400 and 6th Line intersection with a third crossing beneath Highway 400 approximately 200 m south of 6th Line. The culvert west of Highway 400 is 1.8 m diameter and 17.8 m long with a peak design flow of 1.66 cm/s while the culvert east of Highway 400 is 0.5 m diameter and 12.4 m long with a peak design flow of 0.74 cm/s.

SUMMARY

In general the site is part of a physiographic glacial till plane as evidenced by borehole logs for the road reconstruction work along 6th Line and the overpass reconstruction work at the Highway 400, as well as Geological Survey of Canada maps. The till is found to be primarily clayey silt with sand and a trace to some gravel and a very dense relative density. The maps also show the presence of glaciolacustrine deep marine deposits, eskers, and fluvial sands. The immediate area surrounding the Highway 400 and 6th Line interchange is characterized by high groundwater table at approximate elevation of 290 masl to 295 masl with tributaries of the Innisfil Creek crossing both Highway 400 and 6th Line. A subsurface confined aquifer at an approximate elevation of 270 masl to 285 masl is present with surface water in the region surrounding the proposed interchange.

Best regards,

Cambium Inc.

Stuart Baird, P.Eng.
Senior Project Manager

SEB/kwt

Appendix F
Natural Environment Assessment Report

Brunton Consulting Services
216 Lincoln Heights Road, Ottawa, Ontario K2B 8A8
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Natural environment assessment (existing conditions):

6th Line Interchange

December 2016

Natural Environment Assessment (existing conditions): 6th Line Interchange Study Area, Innisfil, Simcoe County, Ontario

Daniel F. Brunton,

Brunton Consulting Services,
Ottawa, Ontario

December 2016

Prepared for:
BT Engineering,
Ottawa, Ontario K2G 5W3

1. Introduction

A natural environment assessment was undertaken of the 6th Line Interchange study area in Innisfil, Simcoe County, as part of the Class Environmental Assessment for a Highway 400 interchange at this site (Figure 1 - shaded area).

On-site investigations were conducted for specific natural environment features within and adjacent to the study area on 8 May 2016 and 16 June 2016 by Daniel F. Brunton. Reconnaissance level considerations of ecological function potentials were also applied mor widely, extending across natural habitats up to 1 km from the study area to where potential influences could extend from interchange construction or operational activities (e.g. along the creek).

The purposes of the investigation were as follows:

1) to evaluate natural environment conditions and ecological significance within the study area;
2) to identify potential impacts of transportation development alternatives on the

6TH Line Interchange Natural Environment Assessment

apparent and potential natural environment values within and/ or in adjacent to the study area; and
3) to identify ecologically appropriate mitigation opportunities.

This existing conditions/ natural environment assessment undertaken as part of the TPA selection process, is less rigorous than investigations typically required after a project has been decided upon (e.g. at the design stage). This not only reflects practical considerations for the efficient expenditure of time and resources but recognizes that the precise detail required for impact mitigation is only pertinent when a TPA has been chosen. Sufficient information must be available to provide the evaluation team with information about natural environment implications of all potential alternative, however, in order to permit an ecologically informed choice to be made amongst those alternative. The present study is designed to achieve that necessary confidence level. No nocturnal site investigations were conducted.

A single season field investigation of the study area landscape was deemed to be sufficient for study purposes. An earlier reconnaissance (8 May 2016) of areas potentially impacted by route alternatives was undertaken, however, to assess early-season assets and to provide a preliminary understanding of the features and functions of the study area.

In the course of on and off-site investigations particular attention was paid both to wildlife corridor values and to the potential presence of Species At Risk (SAR). Potential SAR species and other values of provincial significance were identified through reference to the Ontario Ministry of Natural Resources and Forestry (MNRF) on-line Natural Heritage Areas mapping (Figure 12, below).

Although not protected by SAR legislation, Special Concern species were also considered in this investigation of potential rare or significant flora or fauna, as these contribute to the identification of Significant Wildlife Habitat in southern Ontario. The occurrence of all SAR and provincially rare species potentially occurring in the habitats present in and adjacent to the study area was actively considered, regardless of whether or not those species had been documented as occurring there. The investigation of the potential for occurrence of less conspicuous taxa, however, such as insects (dragonflies and butterflies) and non-vascular plants (lichens and moss), was considered only incidentally in favour of field time allocated to more analytically valuable vegetation, floristic and vertebrate faunal features.

All major habitats in the study area were examined internally on foot and externally from existing roadways, with topographic mapping and aerial photography at hand. Field notes were taken during these investigations and photographic documentation was obtained for some features and landscapes. Where possible (i.e. technically possible and with no negative impact), voucher specimens were secured and preserved to permanently document significant plant species occurrences.

Faunal observations (aside from significant species) were gathered incidentally to the investigations of vegetation and flora. Reviews of local and regional literature and natural environment data sources were conducted during and after the on-site investigations, as noted below.

2. Site context

The majority of the study area landscape has been transformed from a natural condition and is now a combination of regenerating or active agricultural land (Figures 2 and 3). The cropland consists of corn fields west of Highway 400 and both fallow and pastureland east of Highway 400. Woodland occupies areas south of 6th Line, consisting of Cultural (artificial) in the west (plantation) and a variety of upland and wetland forest to the east. The dominate landscape feature is the deep ravine of Innisfil Creek flowing northwest to southeast across the site.

No bedrock outcropping is evident, the Ordovician limestone bedrock being buried deeply by the overlying drumlinized till (Freeman 1979, Chapman 1984).

Much of the upland landscape beyond the Innisfil Creek ravine has been substantially impacted by tree removal and land clearing during a long history of agricultural activity. Where woodland has developed in these less topographically dramatic portions of the 6th Line Interchange study area it is dominated by young forest cover. Both deciduous and coniferous forest canopy species dominate remnant and regenerating woodlands.

3. Natural features

3.1 Natural Habitats

The natural habitats of the landscape within the 6th Line Interchange study area are mapped (Figure 5) and described below. Codes from the Southern Ontario Vegetation Classification system (Lee et al. 1998) are included in the habitat descriptions to assist in comparisons of these values within a regional or larger context. The matches are approximate in some cases, reflecting the identification implications of a history of severe landscape disturbance (fragmentation) and mixed regeneration.

3.1.1 **Habitat 1 - Upland Cultural Meadow** (CUM of Lee et al. 1998)

Open meadow dominated by regenerating native weedy species such as Tall Goldenrod (*Solidago altissima*), Common Raspberry (*Rubus strigosus*) and Blue-grass (*Poa pratensis*) occur where forest clearing had occurred west of Highway 400. It also occurs by the creek west of Highway 400 by the conifer plantation. Meadow habitat is adjacent the fallow field immediately east of Highway 400 south of 6th Line as well (Figure 4).

This non-native habitat is common, supports depauperate wildlife diversity and is of a low intrinsic level of significance.

3.1.2 **Habitat 2 - Upland Coniferous Forest** (White Cedar Forest vegetation (FOC4) of Lee et al. 1998)

Pure White Cedar (*Thuja occidentalis*) forest occurs in low peaty ground north of the ravine and east of Highway 400. Green Ash (*Fraxinus pennsylvanica*) and Trembling Aspen (*Populus tremuloides*) are common along the edges of the cedar grove where it grades into young deciduous forest. The dense shade and acidic substrate beneath this canopy precludes virtually all ground vegetation (Figure 6), with only scattered occurrences of shade-tolerant species such as Oak Fern (*Gymnocarpium dryopteris*) and Canada Mayflower (*Maianthemum canadense*).

This is a common habitat across southern Ontario with a low intrinsic level of significance, but which can serve as locally valuable shelter for raptors, White-tailed Deer, and other species. No regionally significant species or features were noted or suspected in this habitat, however, and it is not considered to have significant potential to support regionally uncommon features.

3.1.3 **Habitat 3 - Young Upland Deciduous Forest** (Dry-Fresh Deciduous Forest (FOD4) vegetation of Lee et al. 1998)

A dense growth of Trembling Aspen and Red Maple (*Acer rubrum*) with Green Ash and White Ash (*Fraxinus americana*) (Figure 7) occupies the area between the lower, wetter conifer forest and mixed swamp areas on the landscape above, and the mature maple-dominated woodland of Habitat 4 (below).

The undergrowth is dominated by a dense tangle of canopy saplings with White Cedar scattered throughout. Ground vegetation consists of a mixture of native and non-native herbs and shrubs tolerant of disturbance and edge effects, such as Common Raspberry (*Rubus strigosus*), Bracken Fern (*Pteridium aquilinum*), Dog-strangling Vine (*Cynanchum rossicum*), Dandelion (*Taraxacum officinale*), Pinesap (*Hypopithys monotropa*), the sedge *Carex gracillima*, Wild Strawberry (*Fragaria virginiana*) and Canada Mayflower (*Maianthemum canadense*). The woodland represents regeneration from substantial past disturbance involving considerable but perhaps not total tree removal. No large or evidently old individual trees were noted within this woodland.

No significant species or features were noted in this severely disturbed habitat; it is not considered to have significant potential to support regionally uncommon native features.

3.1.4 **Habitat 4 - Mature Upland Deciduous Forest** (Dry-Fresh Sugar Maple Deciduous Forest (FOD5) vegetation of Lee et al. 1998)

Situated in deep till soil, maple-dominated deciduous forest characterizes the ravine slopes and shoulders. Younger growth recovering from more significant disturbance is evident at the outer edges of the habitat. Sugar Maple (*Acer saccharum*) predominates, with Red Maple, Ironwood (*Ostrya virginiana*) being common and White Pine (*Pinus strobus*), Black Cherry (*Prunus serotina*), Green Ash, White Ash and occasional non-native Scot's Pine (*Pinus sylvestris*) scattered throughout. At the ravine edge, about 240 m from 6th Line and especially along ravine slopes, the dominance of Sugar Maple becomes pronounced (Figure 8) with a more open under story with less woody growth and a greater density of herbaceous species characteristic of more natural, mature deciduous forests in southern Ontario. American Beech (*Fagus grandifolia*), Yellow Birch (*Betula alleghaniensis*) and White Birch (*Betula papyrifera*) are represented on the ravine slopes as well. These slopes are naturally unstable, with evidence of recent slumping being common (Figure 9).

The characteristic 'rich woods' ground species of this sloping natural woodland include Christmas Fern (*Polystichum acrosticoides*), Blue-cohosh *(Caulophyllum giganteum*), sedges *Carex radiata* and *C. rosea*, Green-osier Dogwood (*Cornus alternifolia*), Bellwort (*Uvularia grandiflorum*), Toothwort (*Cardamine diphylla*), White Baneberry (*Actaea pachypoda*), Gooseberry (*Ribes cynosbati*), White Trillium (*Trillium grandiflorum*) and Blue-beech (*Carpinus caroliniana*).

The most natural and undisturbed forest cover occurs in more moist substrate at the base of the ravine slope with large, Sugar Maple and more abundant Yellow Birch being evident amongst scattered large White Cedar, particularly along the edge of the creek riparian zone. Such moisture tolerant herbaceous species as Jack-in-the-Pulpit (*Arisaema triphyllum*), Sensitive Fern (*Onoclea sensibilis*) and Spinulose Woodfern (*Dryopteris carthusiana*) are common in the lower area of the maple forest as it grades into the White Cedar-lined riparian zone at th ravine bottom.

Although significantly reduced from its historical extent, this habitat remains widespread across southern Ontario and thus is not intrinsically significant here. No rare species or features were noted although one designated SAR -SC bird species is present. This habitat likely represents natural vegetation that satisfies one or more criteria for designation as Significant Wildlife

Habitat (see *4.3 Significant ecological functions*, below). The habitat also has potential to support regionally uncommon native features and perhaps provincially significant features and functions as well (see *4.4. Significant Areas and Features*, below).

3.1.5 **HABITAT 5 - <u>Mixed Swamp Forest</u>** (White Cedar Mineral Mixed Swamp (SWM1) vegetation of Lee et al. 1998)

White Cedar, Green Ash (*Fraxinus pensylvanica*), and White Elm (*Ulmus americana*) occur in various combinations over a densely tangled undergrowth of canopy saplings and shrubs such as Speckled Alder (*Alnus incana* ssp. *rugosa*) and Red-osier Dogwood (*Cornus sericea*) in thin organic substrate over the till base. Ground flora includes Sensitive Fern (*Osmunda sensibilis*), Jewelweed (*Impatiens capensis*), Swamp Gooseberry (*Ribes glandulosum*), Manna-grass *(Glyceria striata*), Canada Avens (*Geum canadense*) and Red Trillium (*Trillium erectum*). Although dry at the time of the June 2016 site inspection this habitat is saturated to flooded in spring time.

No regionally significant species or features were noted in this habitat and it is not considered to have significant potential to support regionally uncommon features.

3.1.6 **HABITAT 6 - <u>Mineral Marsh</u>** (Forb Mineral Marsh (MAM2-10) vegetation of Lee et al. 1998)

A thin strip along several hundred metres of either side of Innisfil Creek is covered by Ostrich Fern (*Matteuccia struthiopteris*) marsh (Figure 10). Wetland herbs such as Meadow-rue (*Thalictrum pubescens*), Recurved Buttercup (*Ranunculus recurvatum*), Manna-grass *(Glyceria striata*), Enchanter's-nightshade (*Circaea canadensis*) and Jewelweed (*Impatiens capensis*) are scattered throughout. Although dry at the time of the June 2016 site inspection this habitat is flooded during spring run-off and saturated into late spring.

No regionally significant species or features were noted in this habitat which is locally common in southern Ontario and it is not considered to have significant potential to support regionally uncommon features.

3.2 Faunal diversity

Faunal activity is limited in the 6th Line Interchange study area, with most species being typical of numerous such disturbed, younger habitats in and about southern Ontario. The area of mature forest along the Innisfil Creek ravine supports some species typical of larger extents of natural woodland, including at least one designated SAR (see *4.2 Significant fauna*, below). No regionally or provincially rare species were found here, however.

3.2.1 **Breeding Birds**

The diversity of avifauna is limited by the minimal variation and extent of natural habitats present in the 6th Line Interchange study area.

The dominance of common, disturbed habitats and the absence of known rare bird species imply that the potential for significant bird species is minimal. Some representation of typical 'old forest' species is provided from the ravine woodlands.

Bird species observed on-site are listed below. Several commonly occurring species which have been designated SAR (underlined) were also noted and are discussed further in *4.2 Significant Fauna* (below).

American Turkey
Turkey Vulture
Ring-billed Gull
Yellow-bellied Sapsucker
Barn Swallow (SAR-TH)
Great Crested Flycatcher
Eastern Wood-Pewee (SAR-SC)
Common Crow
Blue Jay
Black-capped Chickadee
American Robin
Red-eyed Vireo

Ovenbird
Eastern Meadowlark (SAR-TH)
Red-winged Blackbird
Common Grackle
Bobolink (SAR-TH)
Song Sparrow
American Goldfinch

3.2.3 Other fauna

Common mammal species observed incidentally during field studies, either directly or by signs (tracks, droppings, etc.), include Raccoon, White-tailed Deer, Red Squirrel, Woodchuck and Striped Skunk.

No amphibians and reptile species were noted although the habitat along Innisfil Creek ravine is ideal for common species such as American Toad, Eastern Garter Snake and Leopard Frog; all are expected to occur.

3.3 Floristic diversity

The terrestrial floristic diversity here is modest, with 88 species of native species observed in the study area (Appendix 1, Native Vascular Flora). The ecological integrity of the native flora as measured by its Coefficient of Conservatism (CC) rating is low. The CC rating presents an indication of the naturalness of individual native plant species (Oldham et al. 1995).

The average CC rating of the 6th Line Interchange study area is 4.08; this is lower than most comparable southern Ontario roadway study areas previously sampled. Such sites across southern Ontario have an average CC of 4.21 (Table 1, below).

This low rating of ecological integrity likely reflects the transformed and fragmented nature of the landscape and the long history of site disturbance. Only the Innisfil Creek ravine offers a substantial area of intact natural habitat. Native species typical of exposed edge sites are disproportionately represented here.

Table 1: Floristic Coefficient of Conservatism ratings of southern Ontario roadway corridors (pers. obs.)				
	Landscape type	**Year**	**No of taxa**	Average CC
Gervais Property, Westmeath	rural	2013	136	**5.01**
Hwy 62 (Limerick)	rural	2005	199	**4.97**
Gervais Property, Westmeath	rural	2013	136	**4.96**
Cotnam's Island Property (Pembroke)	rural	2013	112	**4.95**
Hwy 62 (Maynooth)	rural	2009	113	**4.6**
Drummond Tp Property (Perth)	rural	2013	1.02	**4.59**
Hwy 41 (Griffith)	rural	2006	178	**4.58**
Babcock Mill Property (Odessa)	rural/ suburban	2013	136	**4.53**
Innes Walkley Hunt Club (Ottawa)	rural/ suburban	2005	203	**4.44**
Hwy 7 (Perth)	rural suburban	2006	160	**4.28**
Coville Road Property, North Augusta	rural	2014	130	**4.22**
Hwy 132 (Dacre)	rural	2009	153	**4.25**
Highway 41 - 7 intersection (Kaladar)	rural residential	2007	80	**4.16**
6th Line Rd Interchange (Innisfil)	**rural**	**2016**	**88**	**4.08**
Big Oak Property (Pembroke)	rural	2013	70	**4.07**
Hwy 7 (Peterborough)	rural/ suburban	2004	118	**4.07**
Airport Road (Peterborough)	rural	2010	154	**4.06**
Hwy 138 (Cornwall)	rural	2010	225	**4.04**
Jockvale Road (Ottawa)	rural	2007	90	**3.80**
Black Bridge Road (Cambridge)	rural/ suburban	2012	94	**3.7**
Station St- Haig Rd extension (Belleville)	rural/ suburban	2014	78	**3.51**
Hall Road extension (Renfrew)	rural/ suburban	2013	89	**3.46**
Victory Hill Property (Ottawa)	suburban	2012	90	**3.38**
Old Carp Road (Ottawa)	rural/ suburban	2007	256	**3.27**
***Average of CC ratings* : 4.21**		**CC Aggregate**		96.9

3.4 Ecological functions

In addition to the review of particular features, consideration of ecological function contributions both internally and in regards to surrounding landscapes are valuable in assessing the overall significance of a particular area. That review is described below under several broad ecological function themes.

3.4.1 Representation and Condition

Due to a long history of site disturbance, the majority of the study area study offers limited representation of intact native terrestrial habitats that would be representative of the larger area. Accordingly, this is not considered to present a significant ecological asset here.

3.4.2 Wildlife Corridor and Ecological Linkages

The natural habitat within the Innisfil Creek ravine provides a potentially significant local wildlife corridor. This is particularly valuable for migratory passerine birds and small mammals.

The largely transformed and non-natural character of the landscape west of Highway 400, however, severely limits the potential wildlife corridor value of that portion of Innisfil Creek ravine in regards to lands to the west.

3.4.3 Wildlife Concentration Areas

No areas of significant wildlife concentration are reported or are evident in the study area.

3.4.4 Native Biodiversity

Native flora and fauna are representative of those species found in disturbed, young habitats in the general area and throughout southern Ontario.

4. Ecological significance

As is expected from an area with an extensive disturbance history, significant features and important natural functions are limited. They are confined to several designated SAR capable of utilizing artificial landscapes and to native species resident within the creek ravine forest.

4.1 Significant flora

No vascular plant Species At Risk (SAR) were noted or are recorded from within or adjacent to the study area corridor. Although habitat exists for Butternut (*Juglans cinerea*), one of the designated SAR identified as possibly occurring in this area by MNRF, none were observed. No habitat for other floristic SAR is evident.

No Regionally Significant plant species were noted here although the sedge *Carex cryptolepis* documented from Habitat 5 east of Highway 400 once qualified as such (Riley 1989) and might do so still.

4.2 Significant fauna

No rare faunal species were noted in or about the study area nor does there appear to be habitat present with a high potential to support the occurrence of such species. Designated SAR (Threatened) Whip-poor-will occurs in dry, young upland forests such as those found along the upper slopes of the ravine. While the species conceivably could utilize woodland edges in the study area for feeding, no breeding evidence was detected within several kilometers of the study area during the 2001-2005 Ontario Breeding Bird Atlas (Mills 2007).

The following designated SAR bird species are known to be present in the 6^{th} Line Interchange study area:

Barn Swallow (SAR - Threatened): widely known from the areas of the 6^{th} Line Interchange study area. This is a formerly abundant and still common species (Lepage 2007) that almost exclusively utilizes artificial (agricultural) habitat for both feeding and nesting (hayfields and pastures, man-made structures) across populated Ontario.

Several (5-8) Barn Swallows were observed aerial-feeding over the active cropland west of Highway 400. They likely nest in the barn and associated buildings in the northwest quadrant of the 6^{th} Line intersection site.

Eastern Meadowlark (SAR - Threatened): another formerly abundant and still locally common species (Leckie 2007) that almost exclusively utilizes artificial (agricultural) habitat.

Three birds were noted, two in the pasture north of 6^{th} Line east of Highway 400 and one in the opposite, smaller regenerating field south of 6^{th} Line.

Bobolink (SAR - Threatened): much like Barn Swallow and Eastern Meadowlark (above), this is a formerly very common and still locally common species (Gahbauer 2007) that almost exclusively utilizes artificial (agricultural) habitat.

At least four territorial pairs occupied the pasture north of 6^{th} Line east of Highway 400 (Figure 11).

Eastern Wood-Pewee (SAR - Special Concern): a widespread and formerly very common breeding woodland bird (McLaren 2007); this species is commonly found in most extensive deciduous forest areas in southern Ontario.

At least two singing (territorial) birds were noted in the woodland on the south side of the Innisfil Creek ravine during the June 2016 site inspection.

4.3 Significant ecological functions

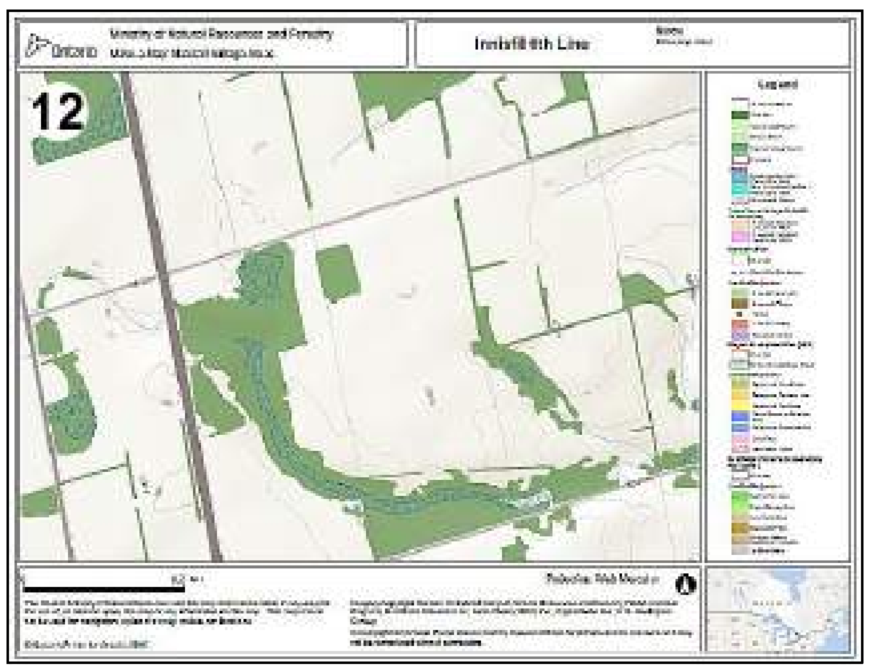
Ecological functions (e.g. wildlife corridor and native biodiversity representation) are representative of those of disturbed, larger woodlots, especially those including a stream courses, across southern Ontario. Accordingly, they are not considered to provide more than a local scale ecological contribution at the 6th Line Interchange study area.

Similarly, the combination of common habitat types, largely unexceptional natural features and limited ecological functions is insufficient to distinguish portions of the study area as Provincially Significant Wildlife Habitat (SWH). The presence of one SAR (Special Concern) species can qualify a particular habitat as SWH, however (Ontario 2012). See Significant Wildlife habitat, below).

4.4 Significant areas and features

As noted above, the intrinsic natural environment values of wetland habitat within the study area corridor is not high, aside from the local biodiversity significance of the Innisfil Creek ravine east of Highway 400.

The MNRF Natural Heritage mapping (Figure 12) indicates that no Areas of Natural and Scientific Interest (ANSI) or Provincially Significant Wetlands (PSW) exist in or about the 6th Line Interchange study area. Similarly, the ravine is not designated as representing Provincially Significant Valley lands.



The MNRF draft criteria (Ontario 2012) for the identification of Significant Wildlife Habitat (SWH) provide a wide variety of tests for the designation of SWH in this portion of southern Ontario (Ecoregion 6E). These include the presence of Special Concern SAR (SAR-SC), breeding habitat for sufficient numbers of amphibians and/ or reptiles, the presence of significant wildlife corridor capacity, the presence of indicator fauna, etc. The occurrence of SAR-SC

Eastern Wood Pewee could be employed to designate at least the ravine woodland habitat as constituting SWH. Similarly, the presence of SAR-TH Bobolink, Eastern Meadowlark and Barn Swallow could be employed to designate all of the agricultural lands of the 6th Line Interchange study area as SWH.

At least one ‘Specimen Tree - an unusually large and/ or well-formed individuals - was noted here. Such plants are often more landscape than ecological features but can also provide wildlife sheltering and breeding opportunities as well as potential seed sources for habitat renewal.

The Specimen Tree noted in the 6th Line Interchange study area is a mature Sugar Maple of approximately 1 m dbh, located along the upper southern slope of the ravine at 44.2586 °N 79.6712 °W.

5. Conclusions and development implications

An appropriate set of data has been gathered to provide the 6th Line Interchange TPA selection process with sufficiently ecologically informed insight into study area natural environment features and functions.

Non-fisheries natural environment constraints are minimal beyond the Innisfil Creek ravine east of Highway 400. Although grassland SAR are impacted by all possible Alternatives, such impact (to be precisely defined during design stages of the interchange development) is readily mitigated by habitat protection and/ or off-site habitat enhancement, if and as necessary.

Similarly, designatable Significant Wildlife Habitat appears to be present within the Inisfil Creek ravine and across the agricultral landscape of the 6th Line Interchange study area. All interchange Alternatives are affected but the most significant impact would be from those directly involving the ravine. All other SWH impact can readily be mitigated by habitat protection/ enhancement measures during interchange construction.

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Appendix 1: Native vascular flora observed within the 6th Line Interchange study area (May-June 2016)

The scientific names of the native vascular plant species, subspecies and hybrids observed in the study area are listed below in alphabetical order within plant families arranged in natural (checklist) order. This is followed by a common English name and the southern Ontario Coefficient of Conservativism (CC) value for this taxon. For taxa not provided with a southern Ontario CC value in Oldham et al. (1995), such as hybrids involving native species (and marked with an asterisk [*]), an estimated value has been assigned here. Species with a CC rating of 7 or better (CC number **bolded**) typically require sites with a relatively high level of ecological integrity.

Taxa considered to be Regionally Rare (Riley 1998) are also noted by listing in **bold** type.

SPECIES/ TAXON	COMMON NAME	NOTES (Voucher reference number)	CC
EQUISETACEAE (Horsetail Family)			
Equisetum arvense L.	Field Horsetail		0
OSMUNDACEAE (Flowering-fern Family)			
Osmunda regalis L. var. *spectabilis* (Willd.) Gray	Royal Fern		**7**
DENNSTAEDTIACEAE (Bracken Fern Family)			
Pteridium aquilinum (L.) Kuhn var. *latiusculum* (Desv.) Underw.	Bracken		2
THELYPTERIDACEAE (Marsh Fern Family)			
Thelypteris palustris (Salisb.) Schott	Marsh Fern		5
DRYOPTERIDACEAE (Woodfern Family)			
Athyrium filix-femina (L.) Roth var. *angustum* (Willd.) Lawson	Lady Fern		4
Dryopteris carthusiana (Vill.) Fuchs (*D. spinulosa* (Muell.) Watt)	Spinulose Woodfern		5
Dryopteris intermedia (Muhl.) A. Gray	Evergreen Woodfern		5
Dryopteris marginalis (L.) A. Gray	Marginal Shieldfern		5
Gymnocarpium dryopteris (L.) Newm.	Oak Fern	DFB 19,255	**7**
Matteuccia struthiopteris (L.) Todaro	Ostrich Fern		5

Onoclea sensibilis L.	Sensitive Fern		4
Polystichum acrostichoides (Michx.) Schott	Christmas Fern		5
PINACEAE (Pine Family)			
Pinus strobus L.	White Pine		4
Juniperus communis L.	Common Juniper		4
Thuja occidentalis L.	White Cedar		4
TYPHACEAE (Cat-tail Family)			
Typha latifolia L.	Common Cat-tail		3
POACEAE (Grass Family)			
Glyceria striata (Lam.) A. Hitchc.	Fowl Manna Grass		3
Poa palustris L.	Swamp Meadow Grass		5
CYPERACEAE (Sedge Family)			
Carex aurea Nutt.	Golden Sedge		4
Carex blanda Dew.	Smooth Sedge		3
***Carex cryptolepis* Mack.**	**Hidden-scale Sedge**	Dfb 19,257	**7**
Carex gracillima Schw.	Filiform Sedge		4
Carex interior Bailey	Inland Sedge		6
Carex peckii Howe	Peck's Sedge		6
Carex radiata (Wahl.) Small (*C. rosea*, auct., non Willd.)	Stellate Sedge	Dfb 19,255b	4
Carex rosea Schkuhr ex Willd. (*C. convoluta* Mack.)	Rolled-up Sedge		5
Carex tenera Dew.	Slender Sedge		4
Carex vulpinoidea Michx.	Fox Sedge		5
ARACEAE (Arum Family)			
Arisaema triphyllum (L.) Schott	Jack-in-the-pulpit		5
LILIACEAE (Lily Family)			
Maianthemum canadense Desf. var. *canadense*	Canada Mayflower		5
Trillium erectum L.	Red Trillium		6
Trillium grandiflorum (Michx.) Salisb.	White Trillium		5
Uvularia grandiflora Sm.	Bellwort		6
SALICACEAE (Willow Family)			
Populus balsamifera L.	Balsam Poplar		4
Populus tremuloides Michx.	Trembling Aspen		2
Salix nigra Marsh.	Black Willow		6
Salix petiolaris Sm.	Meadow Willow		3

BETULACEAE (Birch Family)			
Alnus incana (L.) Moench ssp. *rugosa* (Du Roi) Clausen (*A. rugosa* (Du Roi) Spreng.)	Speckled Alder		6
Betula alleghaniensis Britt.	Yellow Birch		6
Betula papyrifera Marsh.	White Birch		2
Carpinus caroliniana Walt.	Blue-beech		6
Ostrya virginiana (Mill.) K. Koch	Ironwood		4
FAGACEAE (Oak Family)			
Fagus grandifolia Ehrh.	American Beech		6
ULMACEAE (Elm Family)			
Ulmus americana L.	White Elm	Dfb 19,222	3
RANUNCULACEAE (Crowfoot Family)			
Anemone canadensis L.	Canada Anemone		3
Anemone virginiana L. (*s.l.*) (incl. *A. riparia* auct., non Fern.; *A. virginica* L. var. *cylindroidea* Boivin))	Tall Anemone		4
Ranunculus abortivus L.	Small-flowered Buttercup		2
Ranunculus hispidus Michx. var. *caricetorum* (Greene) Duncan (*R. septentionalis* Poir.)	Swamp Buttercup		5
Ranunculus recurvatus Poir.	Hooked Buttercup		4
Thalictrum dioicum L.	Early Meadow-rue		5
Thalictrum pubescens Pursh (*T. polygamum* Muhl.)	Tall Meadow-rue		5
Caulophyllum giganteum (Farw.) Loc. & Black. (*C. thalictroides var. giganteum* Farw.)	Blue-cohosh		6
Podophyllum peltatum L.	Mayapple		5
BRASSICACEAE (Mustard Family)			
Cardamine diphylla (Michx.) Wood (*Dentaria diphylla* Michx.)	Toothwort		7
GROSSULARIACEAE (Currant Family)			
Ribes cynosbati L.	Wild Gooseberry		4
Ribes glandulosum Grauer	Skunk Currant		6
Ribes lacustre (Pers.) Poir.	Swamp Currant		7
ROSACEAE (Rose Family)			
Fragaria virginiana Duchesne	Common Strawberry		2
Geum canadense Jacq.	White Avens		3
Prunus serotina Ehrh.	Black Cherry		3

Prunus virginiana L.	Choke Cherry		2
Rubus allegheniensis Porter	Blackberry		2
Rubus pubescens Raf.	Dwarf Raspberry		4
Rubus strigosus Michx. (*R. idaeus* L. var. *strigosus* (Michx.) Max.)	Common Raspberry		0
ANACARDIACEAE (Cashew Family)			
Rhus glabra L. (*R. typhina* L.)	Smooth Sumac		7
ACERACEAE (Maple Family)			
Acer rubrum L.	Red Maple		4
Acer saccharum Marsh.	Sugar Maple		4
BALSAMINACEAE (Touch-me-not Family)			
Impatiens capensis Meerb.	Spotted Touch-me-not		4
VITACEAE (Grape Family)			
Parthenocissus vitacea (Knerr) Hitchc.	Virginia Creeper		3
Vitis riparia Michx.	River Grape		0
VIOLACEAE (Violet Family)			
Viola labradorica Shrank (*V. conspersa* Reich.)	Dog Violet		4
ONAGRACEAE (Evening-primrose Family)			
Circaea lutetiana L. ssp. *canadensis* (L.) Asch. & Magnus	Enchanter's-nightshade		3
CORNACEAE (Dogwood Family)			
Cornus alternifolia L.f.	Alternate-leaved Dogwood		6
Cornus sericea L. (*C. stolonifera* Michx.)	Red-osier Dogwood		2
Hypopithys monotropa L.	Pinedrops		6
Pyrola elliptica Nutt.	Shinleaf		5
OLEACEAE (Olive Family)			
Fraxinus americana L.	White Ash		4
Fraxinus pennsylvanica Marsh.	Green Ash		3
APOCYNACEAE (Dogbane Family)			
Apocynum androsaemifolium L.	Spreading Dogbane		3
ASCLEPIADACEAE (Milkweed Family)			
Asclepias syriaca L.	Common Milkweed		0
HYDROPHYLLACEAE (Waterleaf Family)			

Hydrophyllum virginianum L.	Waterleaf		6
RUBIACEAE (Bedstraw Family)			
Galium palustre L.	Marsh Bedstraw		5
ASTERACEAE (Aster Family)			
Erigeron philadelphicus L.	Philadelphia Fleabane		1
Solidago canadensis L. ssp. *canadensis*	Canada Goldenrod		1
Symphyotrichum lanceolatum (Willd.) Nesom ssp. *lanceolatum* (*Aster lanceolatus* Willd.; *A. simplex* Willd.)	Panicled Aster		3
Symphyotrichum puniceum (L.) A. & D. Love var. *puniceum* (*Aster puniceus* L.)	Purple-stemmed Aster		6
Total: 88 native taxa Average CC value: 4.08		CC Aggregate	359

Appendix G
Aquatic Habitat Field Investigation and Assessment

6th Line Interchange Environmental Assessment Study

Town of Innisfil

Aquatic Habitat Field Investigation and Assessment

December 2016

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Attachments

1.0 Summary and Introduction

The Town of Innisfil is conducting an Environmental Assessment (EA) in order to assess options for a new interchange on Highway 400 at 6th Line in the central area of Simcoe County. Current and expected increases in traffic in the County of Simcoe and Town of Innisfil necessitate improvements to the road network for a new interchange on Highway 400 within the Town's 20 year planning horizon. The location of 6th Line and Highway 400 is adjacent to Innisfil Creek, a tributary of the Nottawasaga River.

Several alternative interchange locations and configurations were considered and evaluated by a Technical Advisory Team of engineering and environmental specialists, and a technically preferred alternative (TPA) was selected. The TPA locates a new interchange 150 m north of the existing overpass in order to avoid or minimize impacts to terrestrial and aquatic features in the area. The new interchange will require installation of a culvert to convey Innisfil Creek on a realigned 6th Line west of Highway 400, a westerly extension to the existing concrete arch culvert beneath Highway 400 south of the 6th Line or new culvert for the Highway 400 southbound access ramp from 6th Line, and an easterly extension to the existing culvert arch or new culvert for the Highway 400 northbound off-ramp at 6th Line. There will be no impacts to the Innisfil Creek East Tributary since there is now no watercourse north of 6th Line (cultivated field).

New culverts and culvert extensions will require approval from the Department of Fisheries and Oceans as well as a work permit from the Nottawasaga Region Conservation Authority. Rigorous implementation of erosion and sediment control measures, particularly in areas adjacent to watercourse channels will be mandatory conditions under agency permits. Open footing or at minimum embedded culverts are recommended and in-water construction activities will be limited to the period of June 1 through March 14. The un-perching of the existing 6th Line culvert and implementation of Level 1 stormwater management measures for the roadway improvement areas will result in immediate improvements to aquatic habitat conditions in the vicinity of the new interchange.

2.0 Study Area Description

The broader study area (**Figure 1**) on the west side of Lake Simcoe just south of the City of Barrie is located at the western limit of the Peterborough Drumlin Field Physiographic Region within an area of drumlins and drumlin uplands rising from sand plains surrounding the Lake[1]. The lands within the 1 km radius study area, however, are generally level until one approaches the flood plain of Innisfil Creek, which is contained within a well-defined valley. The main creek channel approaches the study area from the west beyond the intersection of 5 Sideroad and 6th Line. An April reconnaissance identified an algae filled main channel west of Highway 400 with stream flows highly enriched as a result of adjacent cultivation and cattle pasturing activities. Bank erosion and sediment deposition were extensive throughout this reach. The Creek crosses under 6th Line 100 metres west of Highway 400 through a 1.8 m diameter CSP. The enrichment of channel flow remained very much in evidence with algae coating the bottom substrate. Further downstream the watercourse entered an area of grassy meadow and scattered forest in the southeast quadrant of the intersection with more natural conditions. In April 2016, the water temperature entering the reach was 18^{0}C. Riffles and runs dominated the downstream morphology with silt and scattered cobble substrate.

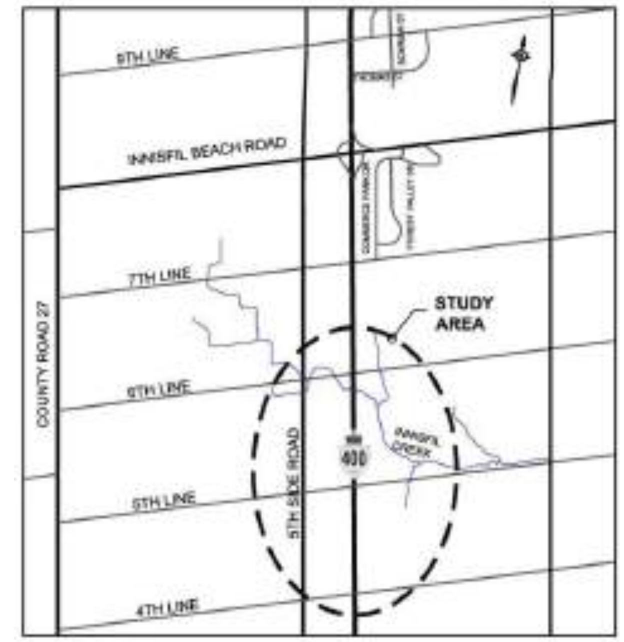


Figure 1: Study Area

Approximately 300 m south of 6th Line under Highway 400 a large diameter concrete arch culvert (MTO Culvert C-55, 7.32 m span x 3.96 m rise) accommodates the Innisfil Creek channel as it emerges from the scattered woodlands. A concrete base slab covers the entire culvert obvert and the stream was observed to flow as a thin film over the concrete for most of the barrel length in the April 2016 reconnaissance. A 300 mm fall at the downstream end of the slab also contributes to the obstruction of upstream fish passage. From here, the stream enters the wooded area across a stony, gravel channel where fish habitat conditions quickly improve. Based on field observations this channel supports seasonal flow and fish habitat.

MTO Culvert C-56, a 1.5 m x 0.9 m concrete box culvert, is located 70 m north of the 6th Line overpass. It conveys highway right-of-way surface drainage from north of the bridge west and south via ditches to the Creek and has no fish habitat significance.

[1] Chapman, L.J. and D.F. Putnam. 1951. *The Physiography of Southern Ontario, 2nd Edition*. Ontario Research Foundation.

A tributary of Innisville Creek finds its source on 6th Line approximately 0.5 kilometres east of Highway 400. There is no channel evident across a cultivated field extending north from the road. A well head is located at the field edge several metres north of the road. To the south a defined channel was apparent, connected to the north field by a 300 mm diameter CSP and entering the woodlands downstream. The CSP conveys storm/spring freshet drainage from roadside ditches and the fields north of the roadway. In the April 2016 reconnaissance the channel south of the roadway quickly took definition from spring sources as it entered dense woodland and did appear to offer what appeared to be fish habitat opportunities, although no fish were observed. Water temperature was recorded at 16^0 C. It was clear in colour and confined to a shallow, defined, 1 m wide channel. By mid June, however, flows had ceased in the east tributary and the channel remained dry through the remaining summer months.

The floodplain lands adjacent to Innisfil Creek are regulated by the Nottawasaga Valley Conservation Authority (NVCA). Significant infiltration areas are identified on NVCA area mapping. According to secondary source data, the watercourse supports cold water brook trout habitat downstream of the study area, perhaps associated with the extensive wooded zone extending through the southeast quadrant.[2]

[2] Department of Fisheries and Oceans/Ontario Ministry of Natural Resources and Forestry/Nottawasaga Valley Conservation Authority. 2014. *Distribution of Fish Species at Risk Mapping*

3.0 Fish Survey Methodology

A background literature search of existing fisheries data and review of topographic mapping preceeded a site visit.[3] The Study Area was investigated at a reconnaissance level on April 20, 2016 to ascertain the early spring water quality and fish habitat status of Innisfil Creek and its easterly tributary. A June 17, 2016 follow-up visit and subsequent mid-summer inspection on July 28, 2016 confirmed that the main channel at the culvert west of Highway 400 and the east tributary at 6th Line were no longer flowing.

Two representative stations were subsequently selected for detailed study along the main channel. Community fish surveys as well as field assessments of fish habitat were undertaken on August 20, 2016 at these locations. A Fish Collection Licence was obtained from MNRF – see **Attachment A**. The summer season provides optimal visibility and access to fish habitat, confirms the presence of aquatic plants, permits assessment of the thermal regime and enables identification and assessment of summer refuge areas.

Riverine morphological features supporting fish habitat functions were documented for each survey station. Significant in-water and shoreline features, water depths, substrate size, in-water cover, overbank vegetation and any erosion issues were noted on stream assessment data sheets. A water chemistry sample station was also established at each site to measure and record dissolved oxygen, pH, conductivity, turbidity, as well as air and water temperature. Captured (by electrofishing) resident fish species were identified and recorded at each site and released. Watercourse field record forms and habitat sketches were completed. These can be reviewed in **Attachment B**.

Investigational and reporting procedures, including determination of the impacts of this project on fish and fish habitat followed standardized procedures, in this case the provisions set out in the "MTO/DFO/MNR Protocol for Protecting Fish and Fish Habitats on Provincial Transportation Undertakings" (2006) as well as the "Eastern Conservation Authorities Fish and Fish Habitat Review Guidelines" (2008).

[3] Environmental Study Report, 6th Line Municipal Class Environmental Assessment - County Road 27 to St. John's Road, Town of Innisfil, HDR Inc., 2016

Harvie Road/Big Bay Point Road/Highway 400 Class Environmental Assessment Study, City of Barrie, Morrison Hershfield Ltd., 2015

4.0 Results

Photographs were taken at each station on April 20, 2016 and again on August 20, 2016 and can be viewed in **Attachment C**.

4.1 Community Fish Survey Station Descriptions

Station 1 - UTM Coordinates: 17T E605679 N4901636

Station 1 was located on the main channel of Innisfil Creek immediately downstream of the crossing of 6th Line west of Highway 400. At this location the creek flows south through a 1 m diameter CSP. On the April 20, 2016 reconnaissance the channel immediately downstream of the 6th Line was approximately 2 m in width and 0.2 m in depth, flowing as a run. A short riffle area of cobbles occurred 20 m downsteam. A series of pools, runs and riffles extended further downstream into the woodlands. The water temperature was 18^0C and the colour was brown-green. The water was very turbid. A side flow from an adjacent 0.3 m diameter CSP was contributing additional turbid water from the north ditch, which was flowing steadily. An in-stream pond was 50 m upstream of 6th Line and the pond outlet channel was filled with watercress. By July, the channel to the 5 Sideroad crossing was dry and filled with terrestrial vegetation.

By August 20, 2016 the flow in the channel through Station 1 was minimal and water temperature was 20.3^0C, flowing very slowly over the heavily algae covered muck substrate. The wetted width was 1.5 m and depth 0.05 m at a station established immediately downstream of the culvert. Fish collection was difficult in the shallow, mucky water.

Station 2 - UTM Coordinates: 17T E605939 N4901533

Station 2 was established also on the main channel of Innisfil Creek, located immediately upstream of the Highway 400 culvert. The creek flows east through the 4 m high concrete arch culvert over the exposed concrete base. On the April 20, 2016 reconnaissance the debris filled channel upstream of the concrete arch was approximately 2 m in width and 0.2 m in depth, with a good flow. When it entered the culvert it widened to 3 m and the depth reduced to less than 0.1 m over the concrete base slab. The water colour was brown-green, although no longer turbid. There were no signs of springs/seepage or watercress in the immediate upstream area and shrub growth was dense. A 0.8 m perch obstructs upstream fish passage at the culvert outlet where it drops off of the concrete slab. Aquatic habitat conditions continue to improve as the stream continues its course through the more heavily wooded southeast quadrant.

By August 20, 2016 the flow in the channel through Station 2 was minimal as it emerged from the upstream brush clogged channel to flow almost imperceptably as a thin film over the heavily algae covered concrete invert slab with occsional pockets of muck. The channel meandered as a series of pools as it moved through the culvert. Although fish were observed to be present in good numbers, collection efforts were hampered by the lack of water depth.

4.2 Water Quality

The following readings were obtained for each station on August 20, 2016 using a Hanna HI 9829 Multiparameter Meter. The results, as expected, were similar at both locations. The results are summarized in **Table 1** and were all within acceptable and expected ranges. Water temperatures were noted as cool at both sites.

Table 1: Water Quality Results

Location	pH	Dissolved Oxygen (ppm)	Conductivity (uS/cm)	Air/water temperature (°C)	Turbidity (FTUs) /TDS (ppm)
Station 1: 6th Line culvert 100 m west of Highway 400	8.5	7.7	4060	25/20.3	4.8/2032
Station 2: Highway 400 culvert 300 m south of 6th Line	7.9	8.6	3365	25/19.3	4.3/1683

4.3 Fish Collection Results

Table 2 presents the results of the electrofishing survey undertaken at each of the stations. Although weather conditions were favourable, the small pools of water, often too shallow to sample effectively, severely limited the catch success of the electrofishing effort. Fish collection occurred on August 20, 2016 between 0930 and 1300 hours.

Table 2: Fish Collection Results

Station 1 (70 seconds*)	**Station 2** (86 seconds*)
Brook stickleback (*Cottus bairdii)*	Brook stickleback

* electrofisher effort

4.4 Aquatic Species at Risk

No Species at Risk have been identified as present in Innisfil Creek on the Department of Fisheries and Oceans Aquatic Species at Risk website (Ontario Southwest Map 4 of 33).

5.0 Discussion

The location of 6th Line and Highway 400 is adjacent to Innisfil Creek, a tributary of the Nottawasaga River joining the main channel near Alliston. The Creek enters the study area from the west and crosses under 6th Line west of Highway 400 before crossing under the highway south of the overpass. An ephemeral tributary crosses under 6th Line east of Highway 400 and continues south through a wooded area to join the main channel. It has been suggested that the Innisfil Creek system may support a cool water biota in its upper reaches. Flows were strong at all road crossings in late April of 2016. By mid-June, however, the Tributary and main channel west of Highway 400 were dry. Flows did pick up marginally by late August and forage fish (brook stickleback) were captured at the west culvert on 6th Line as well as at the Highway 400 culvert south of 6th Line.

Although the summer of 2016 was a record drought year, it appears, nevertheless, that Innisfil Creek (and tributary) flows quickly diminish through the warmer months at the 6th Line west and Highway 400 culvert locations in the study area. Only the Highway 400 culvert had a measureable flow in mid-June and significantly deteriorated water quality was noted, particularly along 6th Line west closer to 5 Sideroad. The Creek and its tributary (in high precipitation years) where they cross 6th Line appear only capable of supporting a transient and hardy forage fish population that can tolerate the highly enriched, oxygen stressed conditions, even in summers with normal precipitation patterns.

5.1 Proposed Work

The technically preferred alternative (TPA) shown on **Figure 2** locates a new Highway 400 interchange 150 m north of the existing overpass. An interchange road network at this location will avoid or minimize impacts to identified terrestrial and aquatic features in the area.

The new interchange will require installation of a new culvert to convey Innisfil Creek under a realigned 6th Line west of Highway 400. A westerly extension to the existing concrete arch culvert beneath Highway 400 south of 6th Line (or new culvert) for the Highway 400 southbound access ramp from 6th Line will also be necessary, as will an easterly extension to the existing culvert arch (or new culvert) for the Highway 400 northbound off-ramp at 6th Line. There will be no impacts to the Innisfil Creek East Tributary since there is now no watercourse north of 6th Line, which is a cultivated field at present.

New culverts and culvert extensions will require approval from the Department of Fisheries and Oceans as well as a work permit from the Nottawasaga Valley Conservation Authority. Although Innisfil Creek has been identified as cool water in the vicinity of Highway 400, flows appear to be intermittent, particularly in drier years, water quality is significantly impacted by agricultural activities and the resident fish community is therefore limited to the hardier forage species. Open footing or at minimum embedded culverts may be required by agencies and in-water construction limited to the period of July 1 through March 14. The un-perching of the existing downstream Highway 400 arch culvert outlet, improvements to the internal channel of this Highway 400 culvert and implementation of Level 1 stormwater management measures for the roadway improvement areas will result in immediate improvements to aquatic habitat conditions in the vicinity.

6th Line Interchange Environmental Assessment Study, Town of Innisfil
Aquatic Habitat Field Investigation and Assessment
December2016

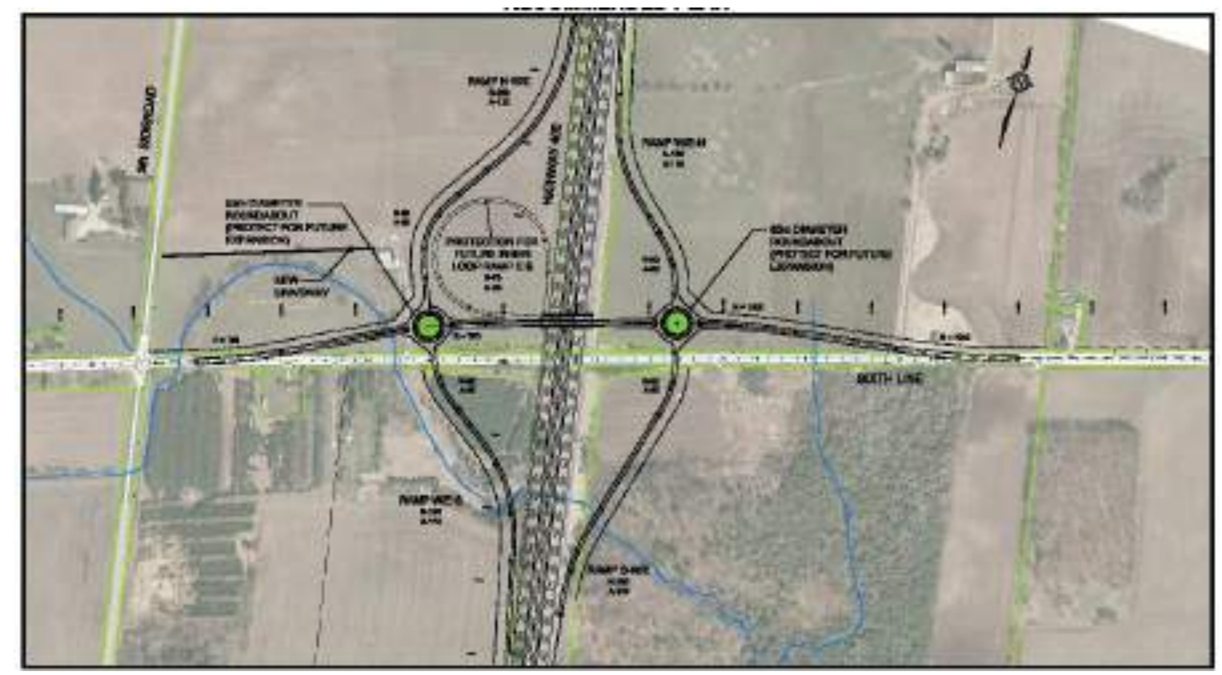


Figure 2: Technically Preferred Alternative

5.2 Effects on Fish and Fish Habitat

Table 3 summarizes the construction related impacts to be anticipated with these infrastructure improvements and presents a series of mitigation measures that are designed to address and minimize the identified impacts and eliminate any residual effects to the environment.

Table 3 : Potential Construction Impacts and Mitigation Summary

Construction Operation	Stressors (Potential Impacts) to Fish and Fish Habitat	Mitigation Measures	Residual Effect(s)
Industrial Equipment Use (excavators, trucks, generators) -site access, rock fill placement work	- bank instability and soil exposure - re-suspension of sediment - oil, grease and fuel leaks from equipment - vehicle exhaust emissions	- sediment and erosion control measures will be installed to isolate work areas - no refuelling of equipment will be allowed within 30 m of a waterbody - all equipment will be clean and maintained so that no oil, grease or other contaminants are on the surface of the machine and so that no leaks occur - emergency spill kits will be located on site, and with equipment - a dust control plan will be implemented to prevent airborne materials from being generated	- no residual negative effect is expected if mitigation techniques are followed and properly installed
Vegetation Clearing (terrestrial SAR) - site access - clearing for new road alignments and culverts	- change in habitat structure and cover, change in sediment concentration, change in water temperature, change in food supply and change in nutrient concentrations	- limit use of equipment at stream edge as much as possible - confine vegetation clearing to the period of August 1 through April 30 to avoid disturbing nests of migratory birds - minimize damage and removal of vegetation (confirm butternut absence) - prune adjacent trees and shrubs to protect roots and prevent disturbance - use of biodegradable materials or 'nurse'-crop vegetation to stabilize slope and exposed soils in the interim until vegetation is fully established	- change in solar and sediment inputs will be negligible - overall impacts are considered temporary and are not anticipated to be significant with proper implementation of mitigation measures
Placement of Materials in Water (impacts to fish habitat) new culverts and/or culvert extensions	- permanent loss of fish habitat at culverts - change in substrate composition	- material and equipment required to be on-site prior to start of operations - disturbed ground areas will be covered with native soils that include a natural seed bank and stabilized with erosion blanket, mulch, etc. - the new culverts will result in a loss of fish habitat; however, it is not considered critical habitat and can be mitigated with use of open footing or embedded culverts, substrate enhancements and vegetation restoration with native, indigenous species.	- the new interchange (and new culverts) will improve vehicle and pedestrian movements, community linkages and contribute to reduction in vehicle emissions. - minimal residual negative effects are anticipated

5.3 Measures and Standards to Avoid or Mitigate Serious Harm to Fish

The following are highlights of environmental items recommended for incorporation into the contract documents for the road works where they come into contact with watercourses when the construction is tendered. These measures are in addition to those that have been identified in the previous impact mitigation summary (**Table 3**).

5.3.1 Project Timing

- To protect fish, including their eggs, juveniles, spawning adults and/or the organisms upon which they feed, in-water work can only occur between *July 1 and March 14*; and
- Materials to be stockpiled off-site and available for placement during periods of minimal local traffic.

5.3.2 Contaminant and Spill Management

- Materials such as grout, paint, primers, poured concrete or other chemicals are to be stored away from water. An emergency spill kit is to be kept on site; and
- Building material that is to be placed in the water must be treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to aquatic biota.

5.3.3 Erosion and Sediment Control

An *Erosion and Sediment Control Plan* is to be developed and implemented for the site that minimizes risk of sedimentation of the adjacent watercourse during all phases of the project. Erosion and sediment control measures will be maintained until all disturbed ground has been permanently stabilized. The Plan will include:

- Installation of effective erosion and sediment control measures before starting work to prevent sediment from dispersing beyond the work zone and into the adjacent waters. Site isolation measures (i.e. silt curtain) may be necessary for containing suspended sediment where in-water work is under way;
- Regular inspection and maintenance of erosion and sediment control measures and structures during the course of construction; and
- Removal of non-biodegradable erosion and sediment control materials once site is stabilized.

5.3.4 Operation of Machinery

- All machinery that arrives on site is to be in a clean condition and maintained free of fluid leaks, invasive species and aquatic vegetation;
- Machinery will at all times be operated on land above the high water mark in a manner that minimizes disturbance to the banks and bed of the waterbody;
- Machinery is to be washed, refuelled and serviced in such a way as to prevent any deleterious substances from entering the water;
- In no case is equipment to be refuelled within 30 m of a waterbody;
- Fuel is to be stored a minimum of 30 m from a waterbody;
- Generators and pumps are to be operated within a spill control facility; and

BT ENGINEERING

BTE

Attachment A
MNRF Fish Collection Licence

BT Eng Project XXX

Ontario

Ministry of Natural Resources

Ministère des Richesses naturelles

Licence to Collect Fish for Scientific Purposes

Permis pour faire la collecte de poissons à des fins scientifiques

Licence No. / Nº de permis	1083508
Local Reference No. / Nº de référence local	71
Issuer Account No. / Nº de compte du délivreur de permis	7190610

This licence is issued under Part I of the Fish Licensing Regulation made under the Fish and Wildlife Conservation Act, 1997 to:

Ce permis est délivré en vertu de la Partie I du règlement sur la délivrance de permis de pêche formulé conformément à la Loi sur la protection du poisson et de la faune de 1997 à:

Name of Licensee / Nom du titulaire du permis

Last Name / Nom de famille	First Name / Prénom	Middle Name / Second Prénom
Mr. WARME	RUDI	

Name of Business/Organization/Affiliation (if applicable) / Nom de l'entreprise/de l'organisme/de l'affiliation (le cas échéant)

BT ENGINEERING

Mailing address of Licensee / Adresse postale du titulaire du permis

Street Name & No./PO Box/RR#/Gen. Del./ Nº rue/C.P./R.R./poste restante

223 WILLIAM STREET

City/Town/Municipality / Ville/village/municipalité	Province/State / Province/État	Postal Code/Zip Code / Code Postal/Zip
BELLEVILLE	ON	K8N 3K1

to collect the species, size and quantites of fish from the waters as set out below.

Pour faire la collecte des espèces suivantes (stade et nombre indiqués ci-dessous):

Species / Espèces	Eggs / Oeufs	Juvenile / Fretin	Adults / Adultes	Numbers / Nombre	Name of Waterbody / Nom de l'étendue d'eau
	X	X	X		
VARIOUS SPECIES PRESENT					Innisfil Creek and tributaries in the area of Innisfil Line 6
					and HWY 400 intersection

Yes/Oui ☐ Additional species/Waterbody list attached / Liste d'espèces/d'étendue d'eau additionnelles ci-jointe

Purpose of collection / But de la collecte: To collect fish community data to inform the environmental assessment process for a potential highway interchange project.

Licence Dates / Dates du permis

Effective Date / Date d'entrée en vigueur (YYYY-MM-DD)	Expiry Date / Date d'expiration (YYYY-MM-DD)
2016-06-01	2016-09-30

Licence conditions / Conditions du permis: This licence is subject to the conditions contained in Schedule A if included. / Ce permis doit respecter les conditions de l'annexe A si celle-ci est jointe.

Yes/Oui ☒ No/Non ☐ Schedule A Included. / Annexe A ci-jointe

Issued by (please print) / Délivré par (veuillez écrire en caractères d'imprimerie)	Signature of Issuer / Signature du délivreur	Date of Issue/Date de délivrance (YYYY-MM-DD)
Suzanne Robinson	[signature]	2016-05-25

Signature of Licensee / Signature du titulaire du permis	Date (YYYY-MM-DD)
[signature]	2016-05-25

Personal information contained on this form is collected under the authority of the Fish and Wildlife Conservation Act, 1997 and will be used for the purpose of licensing, identification, enforcement, resource management and customer service surveys. Please direct further inquiries to the District Manager of the MNR issuing district.

Les renseignements personnels dans ce formulaire sont recueillis conformément à la Loi sur la protection du poisson et de la faune, 1997, et ils seront utilisés aux fins de délivrance de permis, d'identification, d'application des règlements, de gestion des ressources et de sondage sur les services à la clientèle. Veuillez communiquer avec le chef du district du MRN qui délivre le permis si vous avez des questions.

FW0002 (04/00)

Licence to Collect Fish for Scientific Purposes
Permis pour faire la collecte de poissons à des fins scientifiques
Schedule A - Licence Conditions
Annexe A - Conditions du permis

Licence No. 1083508
No de permis ____________

This licence is subject to the conditions listed below.

1. This Licence is valid only for the persons, species, numbers, areas and calendar year indicated in this licence.
2. A Mandatory Report documenting the sampling conducted under this licence must be submitted to the licence issuer within 30 days of the termination date, but in no case later than January 31 next following the year of issue. The Mandatory Report form (Part 1) must be completed for each sampling program and the Site Collection Reports (Part 2) must be completed for each collection site. A map clearly indicating the location of each collection site must be attached to the Site Collection Reports. Submit the Mandatory Report (Part 1) and the Site Collection Reports (Part 2 & maps) electronically by email to graham.findlay@ontario.ca. The submission of a satisfactory report is a prerequisite to any subsequent renewals.
3. Before carrying out any operation under the licence in any area the licenced person shall inform the Resource Operations Supervisor or District/Lake Manager of his or her intentions at least one week before commencing work and include information as to the type of operation, location, duration, and the names of personnel involved.
4. A copy of the original licence must be at the designated collections sites while sampling is occuring and carried by the licenced person or a designated assistant.
5. This licence is not valid in Provincial Parks, park reserves, or National Parks without the written permission from the authorized person in charge of the area concerned.
6. This licence does not allow access to any property without permission of the landowner.
7. All capture gear shall be clearly marked with the licencee name and the licence number of this licence.
8. Capture gear shall be inspected regularly and live holding traps/containers must be inspected regularly to ensure fish survival.
9. Due to potential spawning activity by spawning salmonids visual inspection of all sampling areas should be done prior to sampling with the electrofisher or seine nets. Should spawning activity or redds be observed all sampling must be stopped in order to prevent disturbance to the fish and habitats.
10. Licencee may collect fish with: backpack electrofisher, dip nets and minnow traps.
11. Name of assistants covered under this Licence are as follows: Andrea Bishop & Rui Soug. Any changes to assistants must be confirmed in writing.
12. The licencee shall follow the best management practices for the collection, handling, transportation and holding of fish identified in FS Bulletin 2008-01 (June 10, 2008) included with the licence in order to minimize the risk of spreading aquatic invasive species and diseases.
13. All field equipment, including boats, motors and trailers must be de-contaminated prior to use on each water body in order to prevent the spread of exotic species and disease
14. Unless specified otherwise, all captured fish must be released alive at the capture site.
15. Any person acting under the authority of this licence, shall immediately report the capture of any invasive species (e.g. ruffe, tubenose goby, round goby, rusty crayfish, Asian carp, etc.) found outside its previously known range (as determined by the distribution information available at: www.invadingspecies.com/criteon.cfm, to the appropriate Area Biologist at the local MNR District office. Any such specimens captured outside of their established range (not already naturalized) shall be euthanized (not returned to the water) and kept for identification purposes.
16. Unless specifically authorized by a separate Endangered Species Act (ESA) permit and/or Federal Species at Risk Act (SARA) permit, no person shall attempt to catch a Species at Risk.
17. Unless specifically authorized by a separate Endangered Species Act (ESA) permit and/or Federal Species at Risk Act (SARA) permit, any Species at Risk that are incidentally captured must be photographed and immediately released alive at the point of capture. The photographs, including capture coordinates and date caught, must be forwarded to the appropriate Area Biologist or Species at Risk Biologist at the local MNR District office for identification and confirmation.
18. Unless specifically authorized by a separate Endangered Species Act (ESA) permit and/or Federal Species at Risk Act (SARA) permit, sampling must cease immediately in an area when a Species at Risk is caught.
19. Sampling locations must be reported using GPS location data using: Projection: Universal Transverse Mercator (UTM); Datum: North American 1983 (NAD83), Canadian Transformation (CNT); Zone: 17N; Units: Metres.

Signature of Licencee / Signature du titulaire du permis ____________

Date May 27/16

BT ENGINEERING
BTE

Attachment B
Watercourse Field Record and Habitat Sketches

GENERAL INFORMATION

PROJECT #:	PROJECT DESCRIPTION:	DAY: 20	MONTH: 8	YEAR: 2016

Is STREAM REALIGNMENT required for this section: O Yes ☒ No ☒ Unknown

COLLECTORS: KW AW	WEATHER CONDITIONS: Sunny hot	TIME STARTED: 0930	TIME FINISHED: 1030
AIR TEMP: 25°	WATER TEMP: 20.3	CONDUCTIVITY (µS/cm): 4060	

PHOTO NUMBERS AND DESCRIPTIONS:

LOCATION

NAME OF WATERBODY: Innisfil Cr	DRAINAGE SYSTEM: L. Simcoe	CROSSING #:	STATION #: 1

LOCATION OF CROSSING: 6th Line west of Hwy 400

GPS COORDINATES: E 605679 N 4901636	MTO CHAINAGE:
TOWNSHIP: Innisfil	MNR DISTRICT: Midhurst

LAND USE AND POLLUTION

SURROUNDING LAND USE: Agriculture w/s woodland	SOURCES OF POLLUTION: agriculture

EXISTING STRUCTURE TYPE

Bridge O | Box Culvert O | Open Foot Culvert O | CSP ☒ | N/A O

Other O Describe: | Size (w x h) m^2

SECTION TYPE AND MORPHOLOGY

SECTION IDENTIFIER: | SECTION LOCATION: (include on habitat map)

TYPE:	Stream / river	Channelized	Permanent	Intermittent	Ephemeral	ASSOCIATED WETLAND:
	☒	O	O	☒	O	no

TOTAL SECTION LENGTH (m): | CURRENT VELOCITY (m/s):

SUB-SECTION(S)	Run O	Pool O	Riffle O	Flats O	Inside culvert O	Other
Percentage of area		almost				
Mean depth wetted (m)		dry				
Mean width wetted (m)		muck/algae				
Mean bankfull width (m)		bottom				
Mean bankfull depth(m)		0.05 deep				
Substrate		1.5m W				

Bedrock Br	Boulder Bo	Cobble Co	Gravel Gr	Sand Sa	Silt Si	Clay Cl	Muck Mu	Detritus D

1

GENERAL INFORMATION

PROJECT #: BTEI	PROJECT DESCRIPTION:	DAY: 20	MONTH: 8	YEAR: 2016

COLLECTORS: Kai Warne Anton Warne	TIME STARTED: 0930	TIME FINISHED:

WEATHER CONDITIONS: Sunny, warm

SURFACE CONDITIONS (if applicable): Calm ☒ | Rippled O | Wavy O | Rough O

GENERAL LOCATION

NAME OF WATERBODY: Innisfil Creek	LOCATION OF STATION: 6th line west of Hwy 400
TOWNSHIP: Innisfil	MNR DISTRICT: Midhurst

SAMPLING LOCATIONS AND WATER CHEMISTRY

Turb	LOCATION:	LENGTH (m)	AIR TEMP. (°C)	pH	DISSOLVED OXYGEN (mg/L)	WATER TEMP (°C)	CONDUCTIVITY (µS/cm)	TDS
	Upstream							
48	Downstream	10 m		8.5	87% 7.7ppm	20.3	4060	2032
	Culvert / Hwy ROW						mv ct	

WATER COLOUR: Colourless O | Yellow/brown ☒ | Blue/green O | Turbid O | Other O

GEAR

ELECTROFISHER: ☒
Length (m): | Settings: 160 Hz 150V | Seconds: 70

NETS and TRAPS:

MINNOW TRAP: O # | DIP NET ☒ | TRAP NET O
SEINE: O | GILL O | OTHER O specify

HAULS (#): | Period Of Time (24 hour clock): Set Time | Clear time

LENGTH (m): 20 m | MESH SIZE: Smallest (cm): Largest (cm): | DEPTH OF CAPTURE: Minimum (m): Maximum (m):

SAMPLE COLLECTION

FISH KEPT? O Yes ☒ No | # OF BAGS | PRESERVATIVE: Formalin O | Frozen O | Alcohol O | Other O

COMMENTS:

Additional Notes Appended? o No o Yes number of pages ______

BANK STABILITY

	Stable	Slightly Unstable	Moderately Unstable	Unstable
Left Upstream Bank	ø	O	O	O
Right Upstream Bank	ø	O	O	O

HABITAT

IN-STREAM COVER (% surface area):	Undercut banks	Boulders	Cobble	Woody Debris: Instream / Overhanging	Organic debris	Vascular Macrophytes: Instream / Overhanging	None
						overhead trees	

SHORE COVER (% stream shaded):	100 – 90 %	90 – 60%	60- 30%	30 – 1%	None
	O	ø	O	O	O

VEGETATION TYPE (%):	Submergent	Floating	Emergent	None
				✓
Predominant Species				

MIGRATORY OBSTRUCTIONS:	None ✓	Seasonal	Permanent

POTENTIAL CRITICAL HABITAT LIMITING:	Spawning	Evidence of Groundwater	Other

POTENTIAL ENHANCEMENT OPPORTUNITIES:

u/s land use changes (grazing)

COMMENTS:

Additional Notes Appended? O No O Yes number of pages ______

CAPTURE INFORMATION

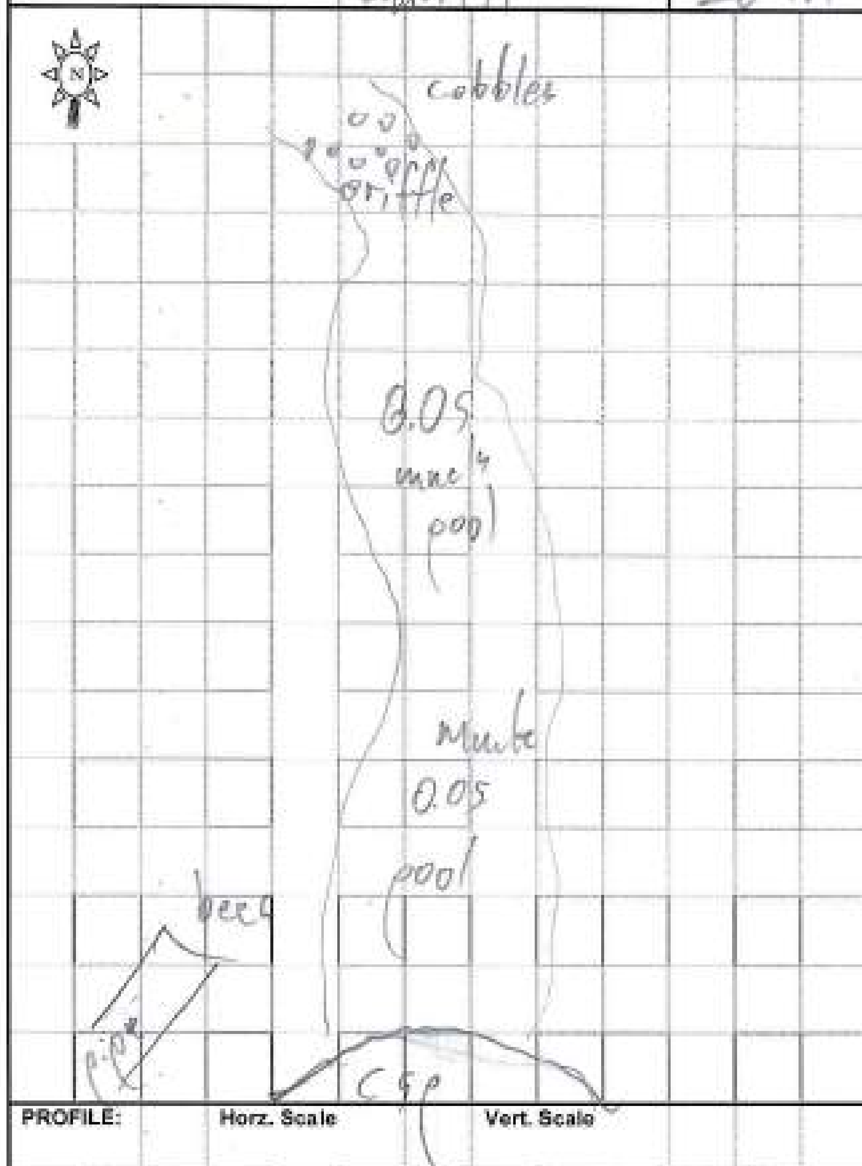
PROJECT NO.: BTE STATION NO.: (1) Fairfield 6th line w of 400

NO.	SCIENTIFIC NAME / COMMON NAME	PHYSICAL CONDITION: # fish with blackspot	PHYSICAL CONDITION: # fish with lesions, tumours, maturity etc.	TOP PREDATOR: Length (mm) F= total fork or L = total length	TOP PREDATOR: AGE CLASS YOY / Adult
3	brook stickleback				

Circle number if a sample was kept

PAGE 1 of ____ Number all pages

SECTION IDENTIFIER:	SECTION LOCATION: Innisfil	SECTION LENGTH (m): 20 m	SCALE (cm / m):



PROJECT #: BTE

MAPPER: R. Warne

NAME OF WATERBODY: Innisfil Cr

CROSSING #:

STATION #: 1

DATE: DD-MMM-YY 20-Aug-16

LEGEND

- **10d** depth (cm)
- **6w** width
- ➡ Riffle
- ⇨ Run/Glide
- ⬭ Pool
- ▮ Island/Bar
- ▯ Fine Substrate
- ### Gravel Substrate
- oOooO Cobble /Boulder
- * * * Debris
- CT Cattail
- SV/FV Submerg/Float Veg
- EV Emergent Vegetation
- W Watercress
- Fe Iron Staining
- ////// Eroded Bank
- XXX Riprap / Other Stabilization
- Instream Log/Tree
- ^^^ Dam/Weir/Obstruction
- ® Riparian Tree
- |► Seep/Spring
- -------- Undercut Bank
- — Barrier to Fish Movement
- -S- Seasonal Barrier
- -x--x- Fence line
- Culvert

PROFILE: Horz. Scale Vert. Scale

GENERAL INFORMATION

PROJECT #: BTE	PROJECT DESCRIPTION:	DAY: 20	MONTH: 9	YEAR: 2016

Is STREAM REALIGNMENT required for this section:
O Yes ☒ No O Unknown

COLLECTORS: RW AW	WEATHER CONDITIONS: hot, sunny	TIME STARTED: 1030	TIME FINISHED: 1200
AIR TEMP: 25.0	WATER TEMP: 19.3	CONDUCTIVITY (µS/cm): 3365	

PHOTO NUMBERS AND DESCRIPTIONS:

LOCATION

NAME OF WATERBODY: Innisfil Cr	DRAINAGE SYSTEM: L. Simcoe	CROSSING #:	STATION #: 2

LOCATION OF CROSSING: Hwy 400 300m south of Innisfil 6th line

GPS COORDINATES: E605989 N4901533	MTO CHAINAGE:
TOWNSHIP: Innisfil	MNR DISTRICT: Midhurst

LAND USE AND POLLUTION

SURROUNDING LAND USE: woodlands	SOURCES OF POLLUTION: Hwy 400, u/s cattle

EXISTING STRUCTURE TYPE

Bridge O | Box Culvert O | Open Foot Culvert O | CSP O | N/A O

Other ☒ Describe: 5m concrete ditch with concrete invert Size (W x h) m²

SECTION TYPE AND MORPHOLOGY

SECTION IDENTIFIER:	SECTION LOCATION: (include on habitat map)

TYPE:	Stream / river ☒	Channelized O	Permanent O	Intermittent ☒	Ephemeral O	ASSOCIATED WETLAND: no

TOTAL SECTION LENGTH (m):	CURRENT VELOCITY (m/s):

SUB-SECTION(S)	Run O	Pool O	Riffle O	Flats O	Inside culvert O	Other
Percentage of area	- pool meandering through culvert					
Mean depth wetted (m)	- channel u/s clogged with vegetation					
Mean width wetted (m)						
Mean bankfull width (m)						
Mean bankfull depth(m)						
Substrate	Concrete, some mud with algae					

Bedrock Br	Boulder Bo	Cobble Co	Gravel Gr	Sand Sa	Silt Si	Clay Cl	Muck Mu	Detritus D

BANK STABILITY

	Stable	Slightly Unstable	Moderately Unstable	Unstable
Left Upstream Bank	✓	O	O	O
Right Upstream Bank	✓	O	O	O

HABITAT

IN-STREAM COVER (% surface area):	Undercut banks	Boulders	Cobble	Woody Debris (Instream / Overhanging)	Organic debris	Vascular Macrophytes (Instream / Overhanging)	None
	n/s veg overhanging						

SHORE COVER (% stream shaded):	100 – 90 %	90 – 60%	60- 30%	30 – 1%	None
	O	✓	O	O	O

VEGETATION TYPE (%):	Submergent	Floating	Emergent	None
				✓
Predominant Species				

MIGRATORY OBSTRUCTIONS:	None ✓	Seasonal	Permanent
POTENTIAL CRITICAL HABITAT LIMITING:	Spawning	Evidence of Groundwater	Other

POTENTIAL ENHANCEMENT OPPORTUNITIES:

COMMENTS:

Additional Notes Appended? O No O Yes number of pages ______

GENERAL INFORMATION

PROJECT #: BTE	PROJECT DESCRIPTION:	DAY: 20	MONTH: 8	YEAR: 2016
COLLECTORS: Rudi Warne Anton Warne		TIME STARTED: 10 30	TIME FINISHED: 1200	

WEATHER CONDITIONS: Sunny, hot

SURFACE CONDITIONS (if applicable): Calm O Rippled O Wavy O Rough O

GENERAL LOCATION

NAME OF WATERBODY: Innisfil Creek	LOCATION OF STATION: 300 m South of 6th line on 400
TOWNSHIP: Innisfil	MNR DISTRICT: Midhurst

SAMPLING LOCATIONS AND WATER CHEMISTRY

Turb 4.3

LOCATION:	LENGTH (m)	AIR TEMP. (°C)	pH	DISSOLVED OXYGEN (mg/L)	WATER TEMP (°C)	CONDUCTIVITY (µS/cm)
Upstream	10 m		7.9	94% 8.4?	19.3	3356
Downstream						
Culvert / Hwy ROW						

TDS 1683

WATER COLOUR: Colourless O Yellow/brown ✓ Blue/green O Turbid O Other O

GEAR

ELECTROFISHER: ✓

Length (m): 20 | Settings: 160Hz 350V | Seconds: 86

NETS and TRAPS:

MINNOW TRAP: O #	DIP NET O	TRAP NET O
SEINE: O	GILL O	OTHER O specify
HAULS (#):	Period Of Time (24 hour clock): Set Time	Clear time
LENGTH (m): 20	MESH SIZE: Smallest (cm): Largest (cm):	DEPTH OF CAPTURE: Minimum (m): Maximum (m):

SAMPLE COLLECTION

FISH KEPT? O Yes ✓ No | # OF BAGS | PRESERVATIVE: Formalin O Frozen O Alcohol O Other O

COMMENTS:

Additional Notes Appended? ✓ No o Yes number of pages ______

CAPTURE INFORMATION

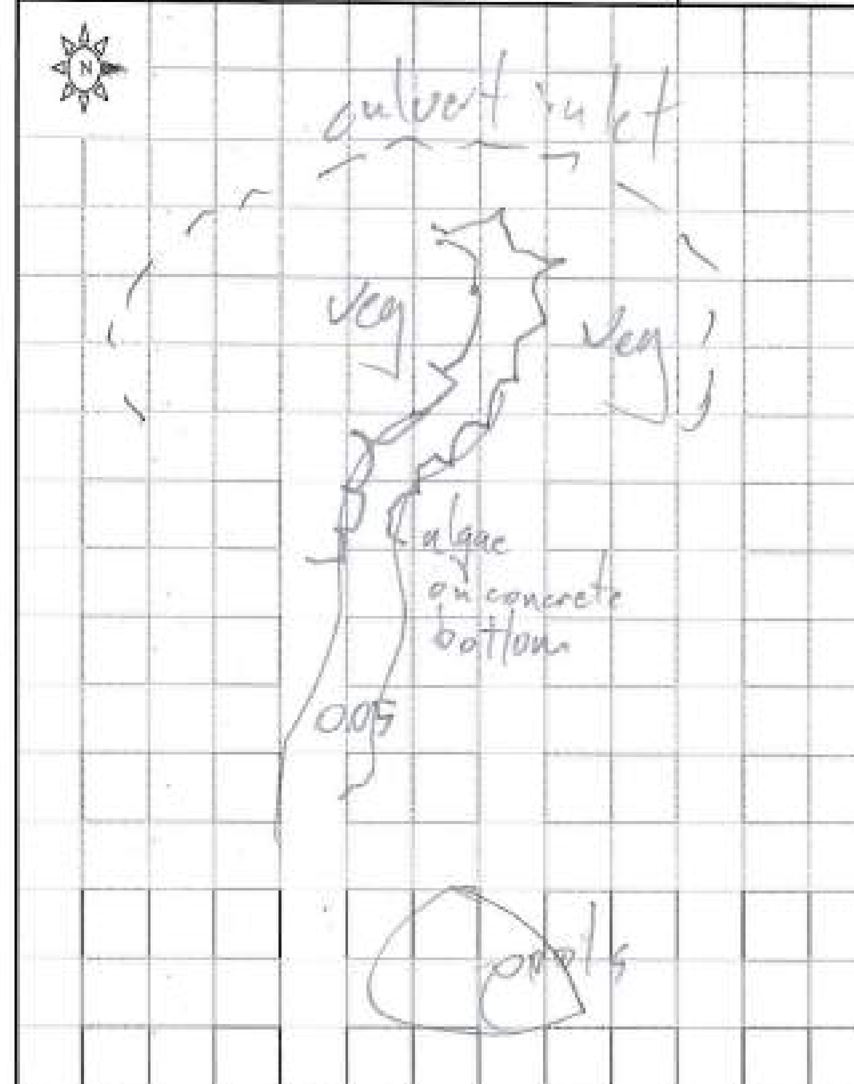
PROJECT NO.:   **STATION NO.:** (2) Innisfil Creek @ 400

NO.	SCIENTIFIC NAME / COMMON NAME	PHYSICAL CONDITION		TOP PREDATOR	
		# fish with blackspot	# fish with lesions, tumours, maturity etc.	Length (mm) F= total fork or L = total length	AGE CLASS YOY / Adult
2	Stickleback (brook)				

Circle number if a sample was kept

PAGE 1 **of** _____   **Number all pages**

SECTION IDENTIFIER:	SECTION LOCATION:	SECTION LENGTH (m):	SCALE (cm / m):



PROJECT #: BTE

MAPPER: R Warmi

NAME OF WATERBODY: Innisfil Cr.

CROSSING #:

STATION #: (2)

DATE: DD-MMM-YY 20-Aug-16

LEGEND

10d depth (cm)
6w width

➡ Riffle
⇨ Run/Glide
⬭ Pool
▮ Island/Bar
░ Fine Substrate
Gravel Substrate
oOooO Cobble /Boulder
* * * Debris
CT Cattail
SV/FV Submerg/Float Veg
EV Emergent Vegetation
W Watercress
Fe Iron Staining
////// Eroded Bank
XXX Riprap / Other Stabilization
Instream Log/Tree
^^^ Dam/Weir/Obstruction
® Riparian Tree
|► Seep/Spring
-------- Undercut Bank
— Barrier to Fish Movement
-S- Seasonal Barrier
-x--x- Fence line
Culvert

PROFILE: **Horz. Scale**   **Vert. Scale**

Attachment C
Fish Station Photographs

BT Eng Project XXX

Station Photographs

Station 1, Innisfil Creek at 6th Line West of Highway 400

Innisfil Creek immediately downstream of the CSP under the 6th Line west of Highway 400 – April 20, 2016

Again, Innisfil Creek immediately downstream of the 6th Line west of Highway 400 – August 20, 2016

1.7 m diametyer culvert conveying Innisfil Creek (left). Smaller CSP conveys flow from north ditch (across) – note deposits at outlet

North ditch of 6th Line west of Highway 400 (in distance) conveying runoff from MTO culvert C-56 just north of the intersection

Station Photographs

Innisfil Creek channel immediately downstream of Station 1 – April 20, 2016

Innisfil Creek channel immediately upstream of the Highway 400 culvert arch – August 20, 2016

Innisfil Creek south of 6th Line as it enters the woodlands

West slope of Highway 400 embankment. Culvert arch located behind woodlands in foreground

Station Photographs

Station 2, Innisfil Creek at Highway 400 south of 6th Line

Highway 400 Concrete Arch culvert C-55 – upstream face. The Creek flows cross the concrete invert slab as a thin film

The watercourse upstream of the culvert is lined with algae. Fish collection was difficult with the very shallow depths

Station Photographs

At the downstream end of the concrete arch culvert the stream drops 300 cm from the base slab

From the MTO culvert C-55 the watercourse entersa dense woodlot

Appendix H
Land Use Planning Report

6th Line Interchange Environmental Assessment Study
Municipal Class EA Study

Land Use Planning Report

Prepared By:

BT Engineering

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April 2016

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1.0 Introduction

BT Engineering (BTE) was retained by the Town of Innisifil to prepare a Land Use Planning Report as part of the 6th Line Interchange Class Environmental Assessment (EA) Study. The land use review examined the current and future land uses in the study area, which include agricultural land and residential properties.

The project location is illustrated in **Figure 1**.

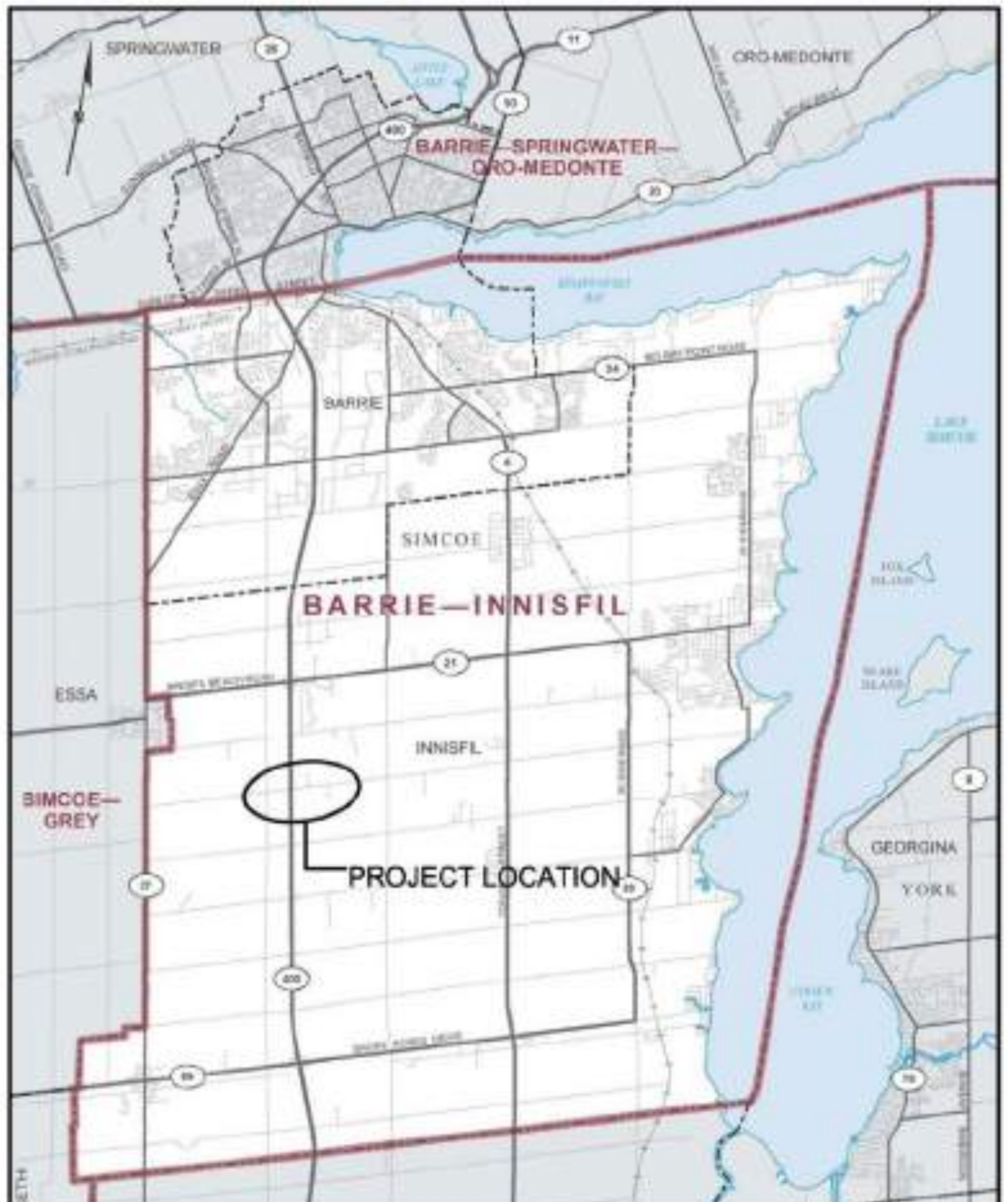

Figure 1: Project Location

2.0 Study Area

The area under study is located east of the Town of Innisfil. The study area encompasses the Highway 400 and 6th Line overpass.

The land uses in the study area are agricultural with natural environment areas. **Section 2.1** includes a detailed overview of the current land uses in the project vicinity. The study area can be seen in **Figure 2**.

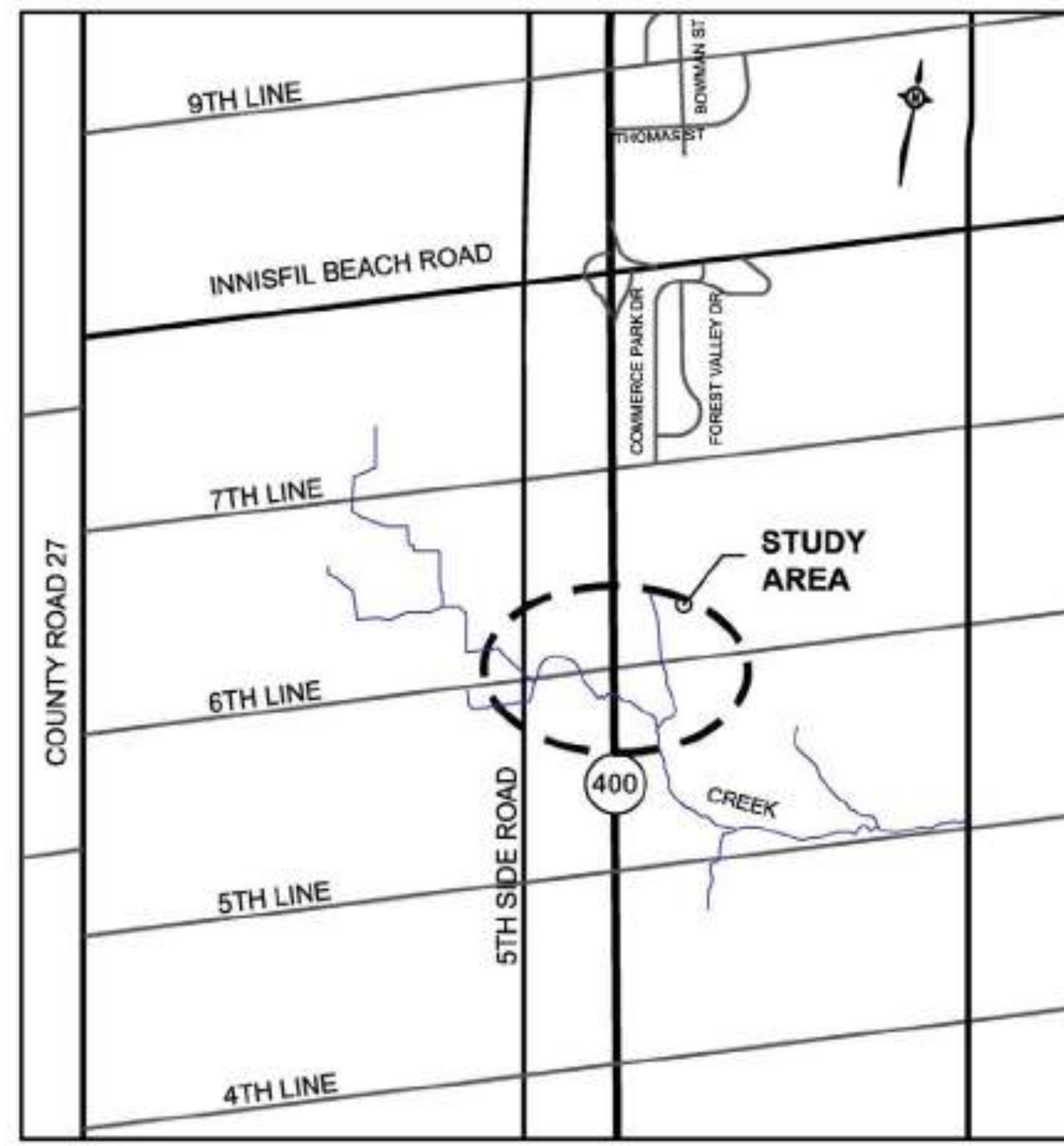

Figure 2: Study Area

3.0 Land Uses in Study Area

3.1 Town of Innisfil Official Plan

The Official Plan (OP) of the Town of Innsifil is intended to provide the long term vision for the Town, delineate a municipal structure as the framework for future growth, set out goals and objectives which will contribute to the achievement of the vision and municipal structure, and provide land use policies of a local nature to facilitate decision making by Council, public agencies and private interests with regard to the use and development of land within the Town[1]. There are four schedules for the land uses, as per the OP, as follow:

- Schedule 'A' – Municipal Structure
- Schedule 'B' – Land Use: Innisfil Official Plan
- Schedule 'C' – Transportation
- Schedule 'D' – Serviced Area

The lands within and surrounding the Study Area are designated agricultural lands by the Town of Innisfil's Official Plan (OP) Schedule B, as shown in **Figure 3**. A closer view of the Study Area is shown in **Figure 4**. There are a number of residential properties on 6th Line along with active farms. Innisfil Creek is within the study area and intersects with 6th Line in three locations and Highway 400 once. The path of Innisfil Creek is illustrated in **Figure 2: Study Area** and the creek is shown in **Photo 1**, **Photo 2** and **Photo 3**.

Refer to the Official Plan for permitted uses and policies pertaining to agricultural lands.

3.2 Town of Innisfil's Transportation Master Plan

Currently only two roads connect to Highway 400: County Road 89 and Innisfil Beach Road. To provide better access to Innisfil Heights and the Sleeping Lion development in Alcona, a new interchange at Highway 400 has been proposed.

Alcona is projected to grow by 10,000 persons by 2031 plus an additional 5,000 in the Sleeping Lions lands [2] (south of Alcona).

[1] Town of Innisfil Official Plan (2011)
http://www.innisfil.ca/sites/all/files/uploads/Planning/Innisfil_OP_April_8_2011_Text.pdf
[2] Town of Innisfil Transportation Master Plan (2013)
http://www.innisfil.ca/sites/all/files/uploads/Engineering/2013-08%20Innisfil%20TMP%20Final%20Report.pdf

Figure 3: Town of Innisfil Official Plan Schedule B

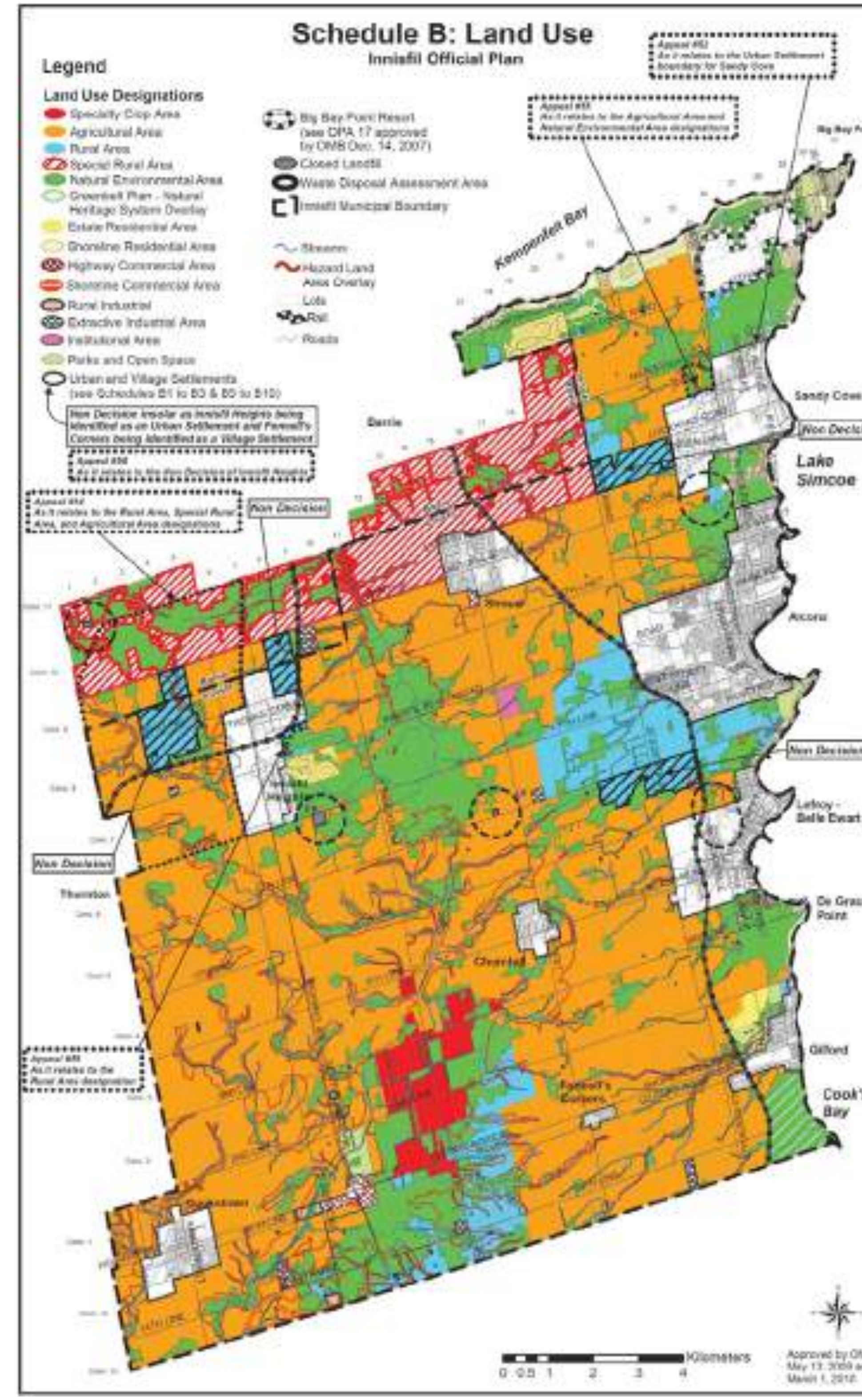

Figure 4: OP Schedule B in vicinity of Study Area

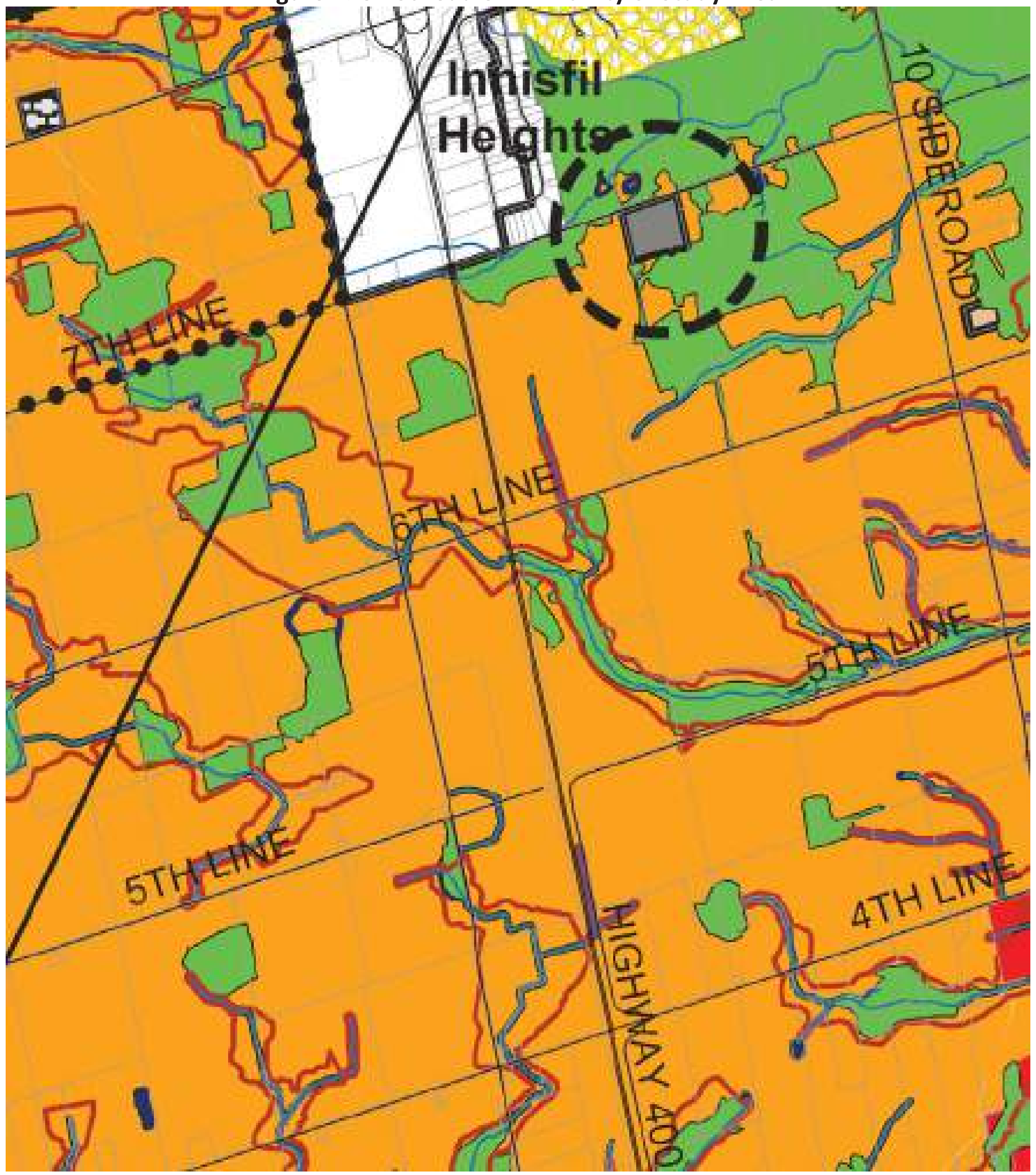

Photo 1: Innisfil Creek along 6th Line

Photo 2: Innisfil Creek crossing 6th Line

Photo 3: Innisfil Creek crossing 6th Line (north)

3.3 6th Line Land Uses

The land surrounding the Highway 400/6th Line proposed interchange is farmland owned by private property owners. An active farm is located in the northwest quadrant of the study area and is illustrated in **Photo 4**.

Photo 4: Active Farmland on 6th Line

Along 6th Line are residential properties, as shown in **Photo 5** to **Photo 7**. An unoccupied barn and farmhouse can be found on 6th Line, as shown in **Photo 8**. On the west side of 5th Sideroad on 6th Line are two residential properties that were previously a post office and a schoolhouse, shown in **Photo 9** and **Photo 10**, respectively. A description of the history of the naming of the area and the schoolhouse is illustrated in **Photo 11**.

Photo 5: 3368 6th Line

Photo 6: 3573 6th Line

Photo 7: 3581 6th Line

Photo 8: Unoccupied farmhouse and barn

Photo 9: Residential dwelling (previously a Post Office)

Photo 10: Residential dwelling (previously a Schoolhouse)

6th Line Interchange Class EA
Land Use Planning Report
April 2016

Photo 11: History of Killyleagh (and schoolhouse)

Appendix I
Noise Report

Noise Report

6th Line Interchange – Innisfil, ON

July 25, 2016

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Executive Summary

BT Engineering (BTE) was retained by the Town of Innisfil to conduct a noise assessment for the 6th Line Interchange Environmental Assessment (EA) Study. A new interchange on Highway 400 at 6th Line will increase the traffic on 6th Line. Two residential dwellings are located within 500 m of the proposed interchange and therefore a noise assessment is required to determine the effects of a new interchange at 6th Line and Highway 400.

The analysis was conducted using acoustical modelling software, STAMSON Version 5.1. Specifically, the analysis included: determination of the characteristics of the Noise Sensitive Area (NSA); noise modelling; and an assessment of the need for mitigation measures required to meet the appropriate noise criteria for developments adjacent to existing transportation corridors.

Two residential dwellings (receiver sites) are currently on the south side of 6th Line to the west of Highway 400 within 500 m of the proposed interchange. Receiver site 1 was determined to have a noise level of approximately 61 dBA without the interchange in place and it is projected to increase to 62 dBA following construction of the interchange. By 2031, receiver site 2 was determined to have a noise level of approximately 60 dBA without the addition of the interchange and is projected to increase to 62 dBA with the interchange. With a sound level increase of less than 5 dBA, a noise barrier is not recommended.

1.0 Introduction

BT Engineering Inc. (BTE) was retained by the Town of Innisfil to conduct a noise assessment for the residential dwellings in the vicinity of the proposed 6th Line and Highway 400 interchange.

The following report summarizes the technical analysis of sound level changes that are predicted as a result of the construction of the 6th Line/Highway 400 interchange. The report has been prepared following the methodology of the MTO Noise Manual, MOECC/MTO Noise protocol and MTO Directive A-1.

The new interchange is planned to accommodate the future growth in the area. Within the planning horizon (2031), 6th Line will consist of a two-lane cross-section: one (1) eastbound land and one (1) westbound lane.

For the purpose of this review, 6th Line is aligned east/west and Highway 400 is aligned north/south.

There are no rail lines located within 100 metres of the proposed development; therefore no railway noise feasibility study is required. See **Figure 1.1** for the study area of the proposed interchange location.

Two residential properties, 3573 6th Line (receiver site 1) and 3581 6th Line (receiver site 2), front the south side of 6th Line to the west of Highway 400. The lands surrounding the residential properties are a combination of woodlots and farmland. The two receiver sites are illustrated in **Figure 1.2**.

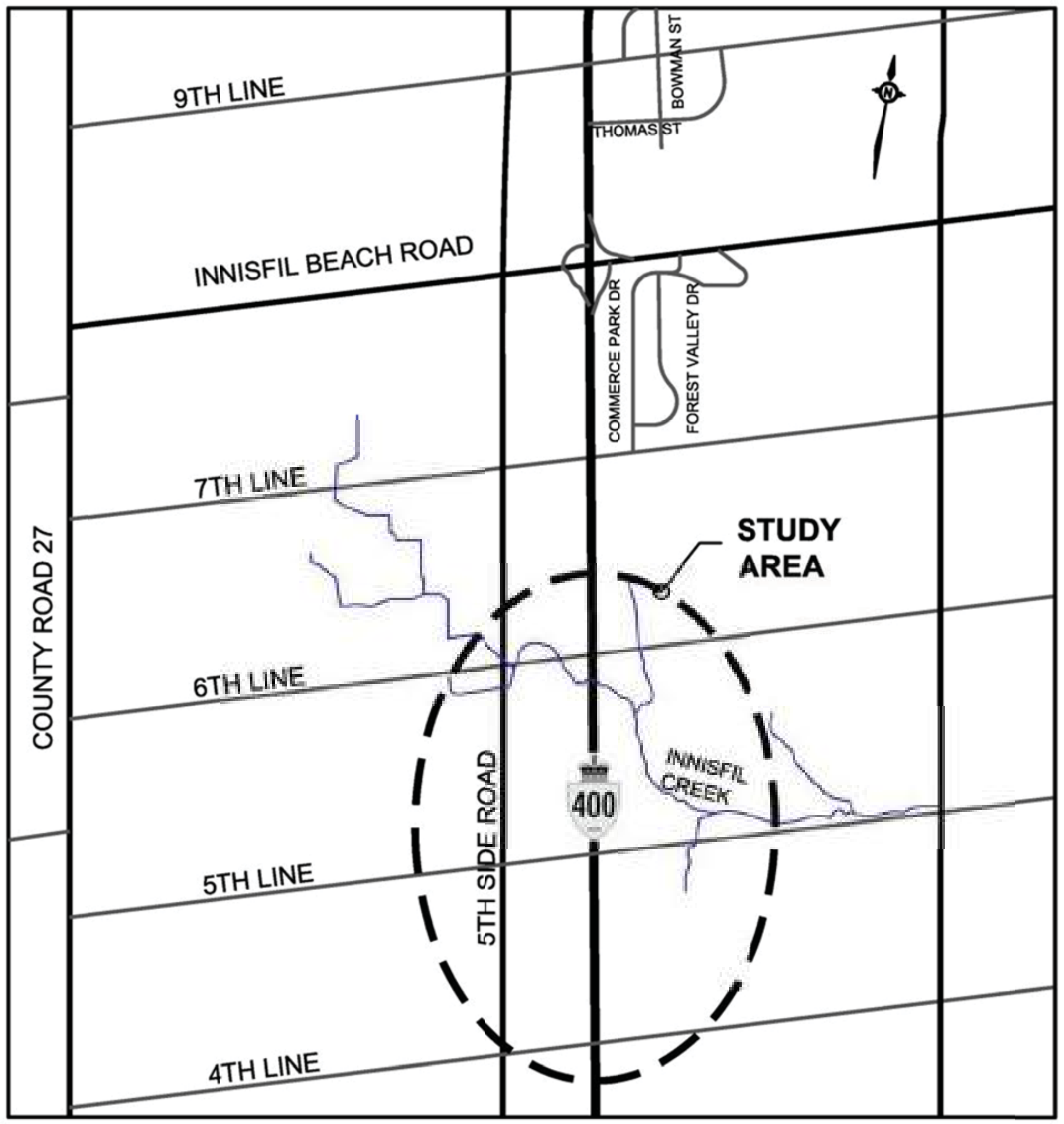

Figure 1.1: Study Area

Figure 1.2: Receiver Sites

2.0 Existing Data

The limits of the Study Area, as shown in **Figure 1.1**, were defined by assessing impacts associated with a new interchange at 6th Line/Highway 400.

The noise source considered was vehicular traffic noise on 6th Line and Highway 400. No other noise sources, such as rail and aircraft, were considered for the Study Area. The assessment was performed in accordance with the MTO Environmental Guide for Noise and MOECC/MTO Noise protocol.

The traffic data used, such as posted speed limits, and traffic volumes and characteristics, are summarized in **Table 2.1**. The traffic volumes used in the analysis were derived from the County of Simcoe's travel demand forecasting model, modified for use for the 2013 Innisfil Transportation Master Plan (TMP). The traffic assignments and distribution are included in **Appendix A**. The year 2031 was selected for analysis as it represents the horizon year for the Town's TMP and is the longest horizon for which development projections are available on which to base traffic forecasts.

Table 2.1: Traffic Characteristics

Street Name	Posted Speed Limit (km/h)	Year 2031 SADT		Truck Traffic %	
		Without Interchange	With Interchange	Medium Trucks	Heavy Trucks
6th Line	80	2,000	10,000	6	2
Highway 400	100	170,000	170,000	10	5

6th Line Interchange EA Study, Town of Innisfil
Noise Assessment Report
July 25, 2016
Page 1

3.0 Methodology

The STAMSON 5.1 noise software program, which is approved for use on projects requiring noise assessments, was utilized to determine sound levels. The sound levels were calculated using STAMSON with the input of data such as traffic and topographical characteristics (i.e. presence of dense trees).

The general overall procedure followed in the noise analysis included:

1. Identification and location of receiver sites within the NSA. See **Figure 4**.
2. Prediction of equivalent sound levels.
3. Assessment of the need for mitigation measures required to meet the appropriate noise criteria.

Acoustic modelling projected future 2031, 24 hour equivalent sound levels (Leq's) within the study area at the two specific receiver sites having a noise sensitive land use (residential property). Sound levels were generated for year 2031 conditions in the Study Area for the following two cases:

1. Without the interchange; and
2. With the interchange.

<u>**Traffic Input Data**</u>

6th Line

Approximately 2,000 vehicles/day are projected to use to use 6th Line by 2031. With the new interchange, approximately 10,000 vehicles/day are projected to use the 6th Line by 2031.

Highway 400

Approximately 170,000 vehicles/day are projected to use Highway 400 by 2031, with or without the interchange.

3.1 Additional Input Variables

In addition to traffic volumes, the following STAMSON input variables were used or considered for the calculation of future sound levels:

- Topography (hills, flatlands) – the site is generally flat
- The intermediate ground surface (hard surface reflects sound, soft surface absorbs sound)
- Distance, in metres, from source to receiver, using the centreline of the road as the source
- The angle at which the receiver (building) intercepts the source (road), measured relative to the perpendicular line between the source and the receiver
- Receiver height, in metres
- Posted speed limit (6th Line is 80 km/h, Highway 400 is 100 km/h)
- Depth of woods (0-30 m, 30-60 m, 60 m or more)
- Roadway grade (slope)
- The percentage of commercial vehicles on 6th Line was estimated from traffic movements on Innisfil Beach Road from Highway 400: 6 % medium/2 % heavy trucks

- The percentage of commercial vehicles on Highway 400 was estimated from traffic counts provided by MTO: 5 % medium/10 % heavy trucks

4.0 Conclusion

The sound levels at each of the receiver sites are shown in **Table 4.1**. The STAMSON outputs for each receiver site and each condition are included in **Appendix B**.

Table 4.1: Sound Level at Receiver Sites

	Without Interchange	With Interchange	Sound Level Increase
Receiver Site 1	61.0[1] dBA	62.4 dBA	1 dBA
Receiver Site 2	60.1 dBA	62.3 dBA	2 dBA

The assessment of the impact of the predicted sound levels utilized the MTO/MOECC Protocol. The required mitigation effort is based on the change in future noise levels if the 6th Line/Highway 400 interchange is constructed, and is shown in **Table 4.2** below. Based on the sound level increases at receiver sites 1 and 2 being less than 5 dBA, no mitigation is required.

Table 4.2: Impact Criteria and Corresponding Mitigation Effort

Change in Noise Level Above Ambient	Mitigation Effort Required
0-5 dBA	- None
> 5 dBA	- Investigate noise control measure on right-of-way. - If project cost is not significantly affected, introduce noise control measure within the right-of-way. - Noise control measures, where introduced, should achieve a minimum of 5 dBA attenuation, averaged over first row receivers. - Mitigate to ambient, as economically and technically feasible.

[1] Decimal place shown for reference purposes only.

BT ENGINEERING BTE

Appendix A
Traffic Assignments and Distributions

Technical Memorandum

Date:	Tuesday, January 27, 2015
Project:	6th Line Municipal Class Environmental Assessment
To:	Scott MacKenzie, Town of Innisfil
From:	Tyrone Gan - HDR
Subject:	Needs Analysis: Travel Demand Forecasting

As part of the 6th Line Municipal Class Environmental Assessment, it is necessary to determine the required number of lanes for 6th Line so that future growth can be sufficiently served. This technical memorandum summarizes the forecasting efforts that ultimately justify the widening of 6th Line Road to support forecast 2031 travel demand.

Utilizing a detailed travel demand forecasting model, and incorporating the Town of Innisfil's ("the Town's") latest population and employment forecasts to the 2031 horizon year (including the development of the Sleeping Lion lands and the Alcona North and South Secondary Plan areas), the need for infrastructure improvements on 6th Line between County Road 27 and St. John's Road were assessed.

A summary of the recommendations detailed in this memorandum are as follows

- Without construction of the 6th Line / Highway 400 interchange:
  - County Road 27 to Sideroad 20 - reconstruction to 2 lanes
  - Sideroad 20 to St. John's Road- reconstruction and widening to 4 lanes

- With construction of the 6th Line / Highway 400 interchange:
  - County Road 27 to Sideroad 20 - widening to 4 lanes
  - Sideroad 20 to St. John's Road- reconstruction and widening to 4 lanes

The following memorandum documents the travel demand model forecasting procedure, assumptions and analysis which led to the recommendations for infrastructure improvements. The memo structure includes the following sections:

- Model Background
- Land Use Assumptions
- Transportation (Road) Network Assumptions
- Results Analysis for 3 scenarios tested

Model Background

To assess future traffic conditions, a travel demand forecasting model was utilized. The Simcoe County TransCAD model used for the 2008 Simcoe TMP was obtained and modified for use for the 2013 Innisfil Transportation Master Plan (TMP) study. The model forecasts daily traffic and is meant to be used as a tool to guide decisions on the future needs of the Town.

The Simcoe model covers the entire Greater Toronto Area plus Simcoe County, and is comprised of 150 traffic zones, 6 of which are within Innisfil. For the TMP, traffic zone disaggregation was undertaken, and 26 new zones were added within Innisfil. Within the Alcona Urban Growth node, 8 new zones were added including two expansion areas (Alcona North and Alcona South).

The model was modified for the purposes of the 6^{th} Line Road Needs Analysis. Key inputs and modifications to the model are discussed later in this document and include population and employment forecasts and transportation network assumptions.

Land Use Assumptions

The model's land use assumptions were updated to account for new developments in Alcona South and Alcona North, specifically the Sleeping Lion settlement proposed in Alcona South. **Exhibit 1** illustrates the Town's settlement areas which were used as a basis to develop a traffic zone system for the Town of Innisfil. Zones 5 and 6 in Alcona were further disaggregated to produce more robust trip patterns within Alcona. **Exhibit 2** illustrates the disaggregated zone system employed for Zones 5 and 6. Zones A, B and C in **Exhibit 1** are the lands annexed by the City of Barrie which are accounted for in the model. Further discussion on these zones is provided below.

Table 1 presents the population and forecast assumptions by traffic zone with a comparison with the forecasts assumed for the 2013 TMP. The population forecast used for the EA increases by nearly 17,000 residents compared to the TMP, while employment forecasts increase by about 3,350. This is all due to growth in Alcona, specifically Alcona South and the Sleeping Lion development.

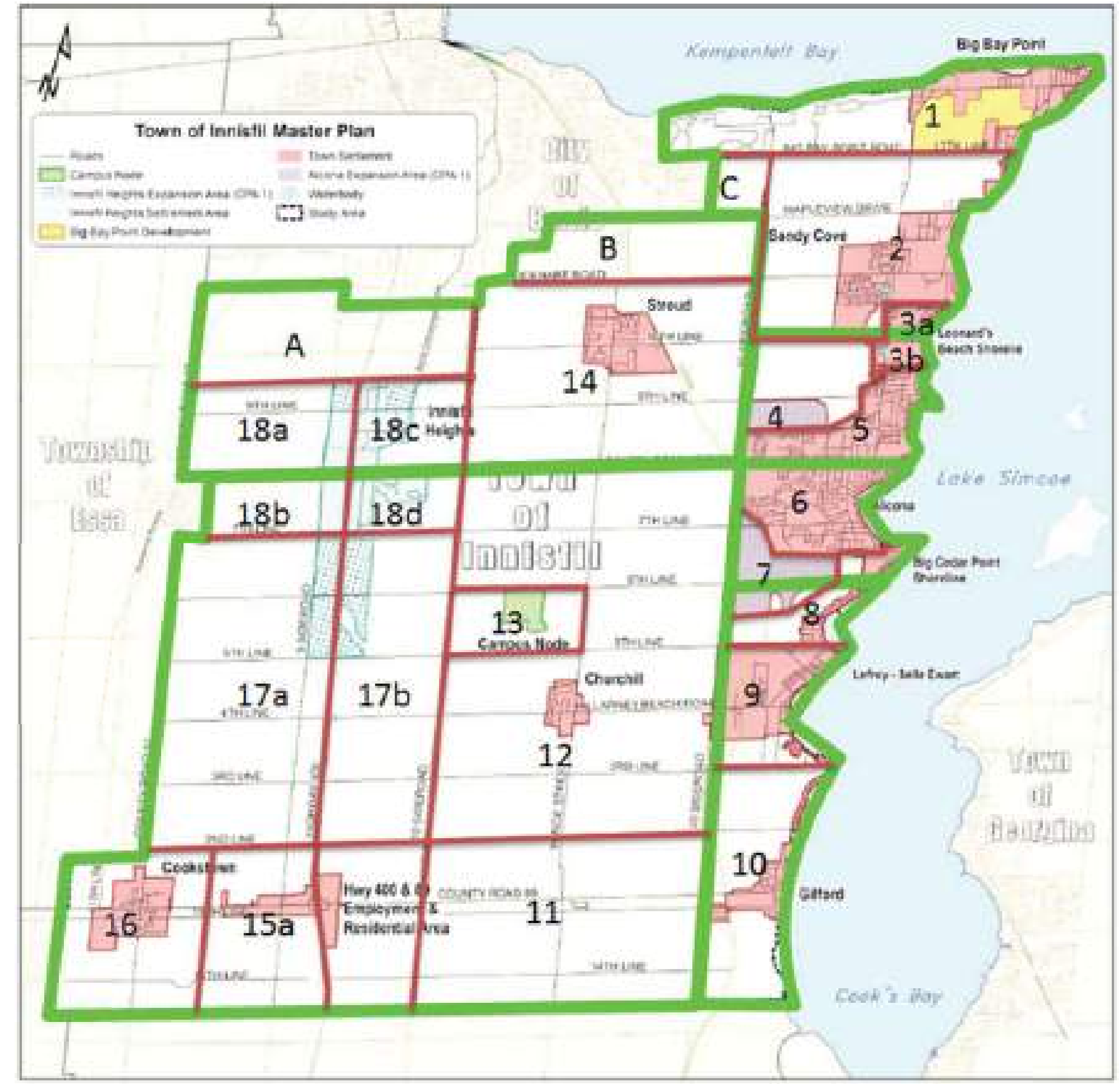

Exhibit 1: Town of Innisfil Settlement Areas

Exhibit 2: Alcona Traffic Zone Disaggregation

6th Line Municipal Class Environmental Assessment
Needs Analysis: Travel Demand Forecasting

Table 1: Town of Innisfil 2031 Land Use Projections

Traffic Zone	Settlement Area	Population		Employment	
		2031 TMP Forecast	2031 New Forecast	2031 TMP Forecast	2031 New Forecast
1	Big Bay Cove	7,356	7,356	1,233	1,233
2	Sandy Cove	9,551	9,551	303	303
3a	Leonard's Beach , north	619	619	0	0
3b	Leonard's Beach , south	619	619	0	0
4	Alcona North Expansion Area	0	5,460	0	850
5a	Alcona North Existing Settlement, west	2,385	2,385	173	173
5b	Alcona North Existing Settlement, central	1,908	1,908	138	138
5c	Alcona North Existing Settlement, east	1,431	1,431	104	104
5d	Alcona North Existing Settlement, Alderslea	1,908	1,908	138	138
5e	Alcona North Existing Settlement, northeast	1,908	1,908	138	138
6a	Alcona South Existing Settlement, west	2,385	2,385	173	173
6b	Alcona South Existing Settlement, central	4,055	4,055	294	294
6c	Alcona South Existing Settlement, east	2,147	2,147	156	156
6d	Alcona South Existing Settlement, south	4,532	4,532	329	329
6e	Alcona South Existing Settlement, Nantyr Park	1,193	1,193	86	86
7	Alcona South Expansion Area	5,000	16,500	0	2,500
8	Big Cedar Point	819	819	0	0
9	Lefroy – Belle Ewart	8,218	8,218	534	534
10	Gilford – Degrassi Point	2,141	2,141	139	139
11	Fennel's Corners	196	196	0	0
12	Churchill	760	760	155	155
13	Campus Node	0	0	0	0
14	Stroud	2,494	2,494	509	509
15a	Hwy 400 & 89 Employment Area, west	0	0	0	0
15b	Hwy 400 & 89 Employment Area, east	0	0	0	0
16	Cookstown	3,477	3,477	709	709
17a	Innisfil Heights Expansion Area, west	0	0	1,200	1,200
17b	Innisfil Heights Expansion Area , east	0	0	1,200	1,200
18a	Innisfil Heights, northwest	48	48	808	808
18b	Innisfil Heights, southwest	48	48	808	808
18c	Innisfil Heights, northeast	112	112	1,886	1,886
18d	Innisfil Heights, southeast	112	112	1,886	1,886
	Total	**65,420**	**82,380**	**13,100**	**16,450**

It should be noted that a planned institutional centre (identified as either community college or healthcare) located at 6th Line and Yonge Street is in its planning stages; however, the number of jobs and students projected at this facility was not available prior to the forecasting work. Therefore the Campus was not included in these forecasts. However, if the analysis of the forecast results determines that widening is required without the facility, then it can be surmised that the need for widening would be strengthened with the introduction of the campus.

Barrie Annexed Lands

Traffic zones A, B and C presented in **Exhibit 1** represent lands annexed by the City of Barrie and slated for future development. During the TMP model build process, these lands were removed from the Innisfil Traffic Zone system and reallocated to adjacent Simcoe TMP traffic zones located in Barrie as illustrated in **Exhibit 3.** The updated land use projections for these zones are provided in **Table 2.**

Exhibit 3: Annexed Barrie Lands Traffic Zone System

Table 2: Annexed Barrie Lands Land Use Projections

Traffic Zone	Area	2031 Population	2031 Employment
3824	Barrie Annexed Lands, west	14,856	5,186
3827	Barrie Annexed Lands, west-central	0	0
3829	Barrie Annexed Lands, east-central	12,802	1,709
3830	Barrie Annexed Lands, east	13,129	506

Transportation (Road) Network Assumptions

The assumed road network used to produce the demand forecasts for 6th Line is the preferred road network as identified in the Town's TMP.

Exhibits Exhibit 4 **to Exhibit** 6 illustrate the assumed number of lanes, daily link capacities and free flow speeds respectively for the road network. Links shaded in grey denote centroid connectors. These plots are also provided separately, and are attached to this memorandum. It is noted that the speeds coded into the model do not represent actual posted speed limits. Free flow speeds have been adjusted in the transportation model for calibration against observed traffic volume data.

In order to determine the need for improvements to 6th Line, a "Do Nothing" future horizon scenario was tested first. In this scenario, the model forecasted traffic on 6th Line with one lane in each direction with an assumed daily capacity of 5,000 vpdpl (vehicles per day per lane) with a free-flow speed of 40 km/h between Highway 27 and 20 Sideroad. Although the actual free flow speed today is 80 km/h, as noted above the Simcoe county model is calibrated to 40 km/h speeds on all of Innisfil's local roads / lines.

6th Line Municipal Class Environmental Assessment
Needs Analysis: Travel Demand Forecasting

Innisfil Beach Road is currently the main east-west arterial road connecting the Alcona Community to Highway 400. It was assumed that Innisfil Beach Road will operate with two lanes in each direction with a daily capacity of 10,000 vpdpl east of Highway 400 and a free-flow speed of 80 km/h west of 20 Sideroad and 60 km/h east of 20 Sideroad.

In total, seven scenarios were tested for 6th Line, and are summarized in **Table 3**.

Table 3: Analysis Scenarios

Scenario #	Scenario	Speed (west of 20 Sdrd / east of 20 Sdrd)	Lanes (per direction)	Capacity - vpdpl (west of 20 Sdrd / east of 20 Sdrd)	Highway 400 IC?
1A	Do Nothing	40 km/h / 40 km/h	1	5,000 / 5,000	No
1B	Reconstruction	40 km/h / 40 km/h	1	6,500 / 5,000	No
1C	Base Case / Currently Planned	60 km/h / 40 km/h	1	6,500 / 5,000	No
2	Higher Speed and Capacity	80 km/h / 60 km/h	1	10,000 / 6,500	No
3	Base case plus Highway 400 IC	60 km/h / 40 km/h	1	6,500 / 5,000	Yes
4	Higher Speed and Capacity plus Highway 400 IC	80 km/h / 60 km/h	1	10,000 / 6,500	Yes
5	Widening, Higher Speed and Capacity, and Highway 400 IC	80 km/h / 60 km/h	2	10,000 / 6,500	Yes

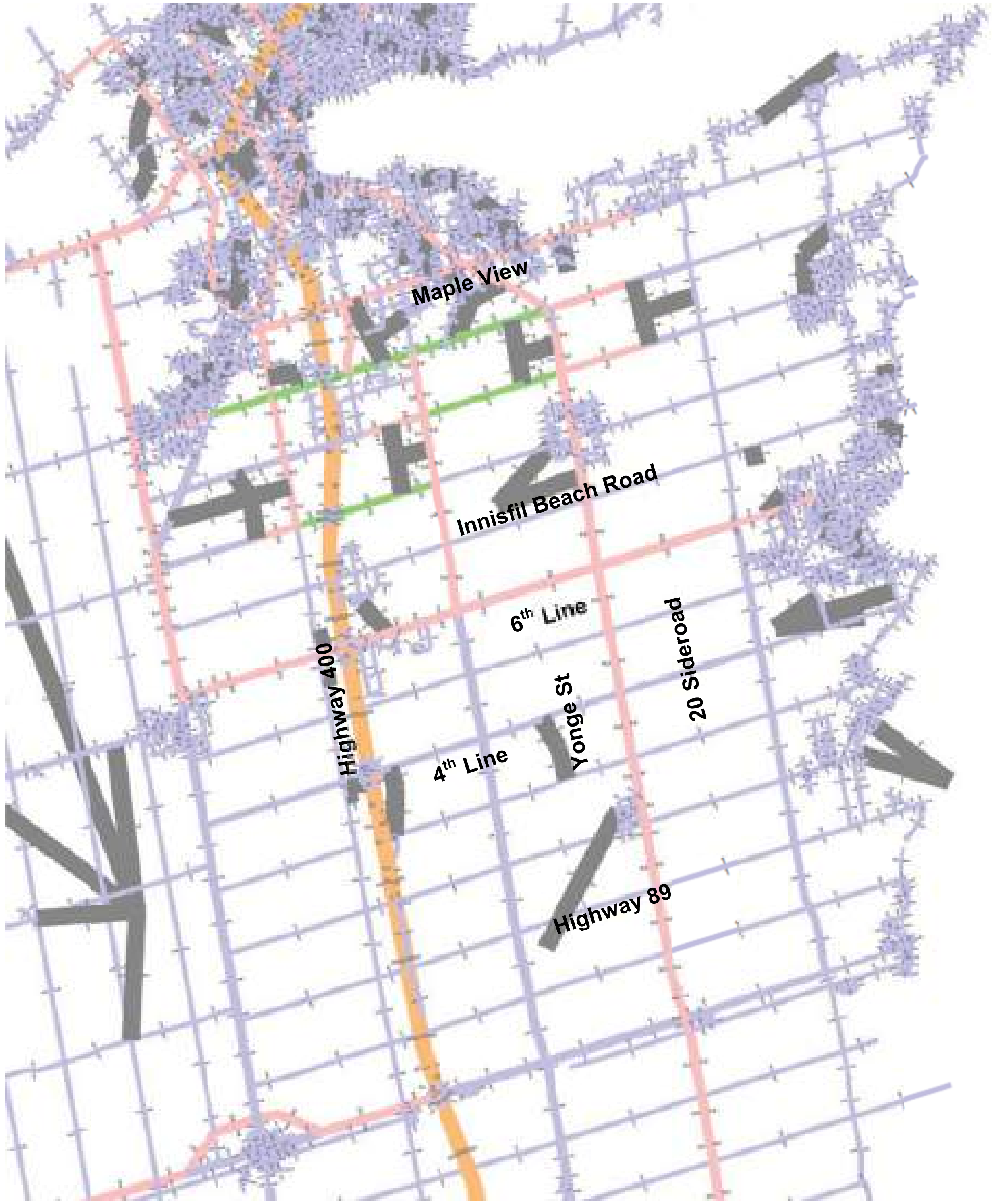

Exhibit 4: Number of Lanes - Base Case Scenario

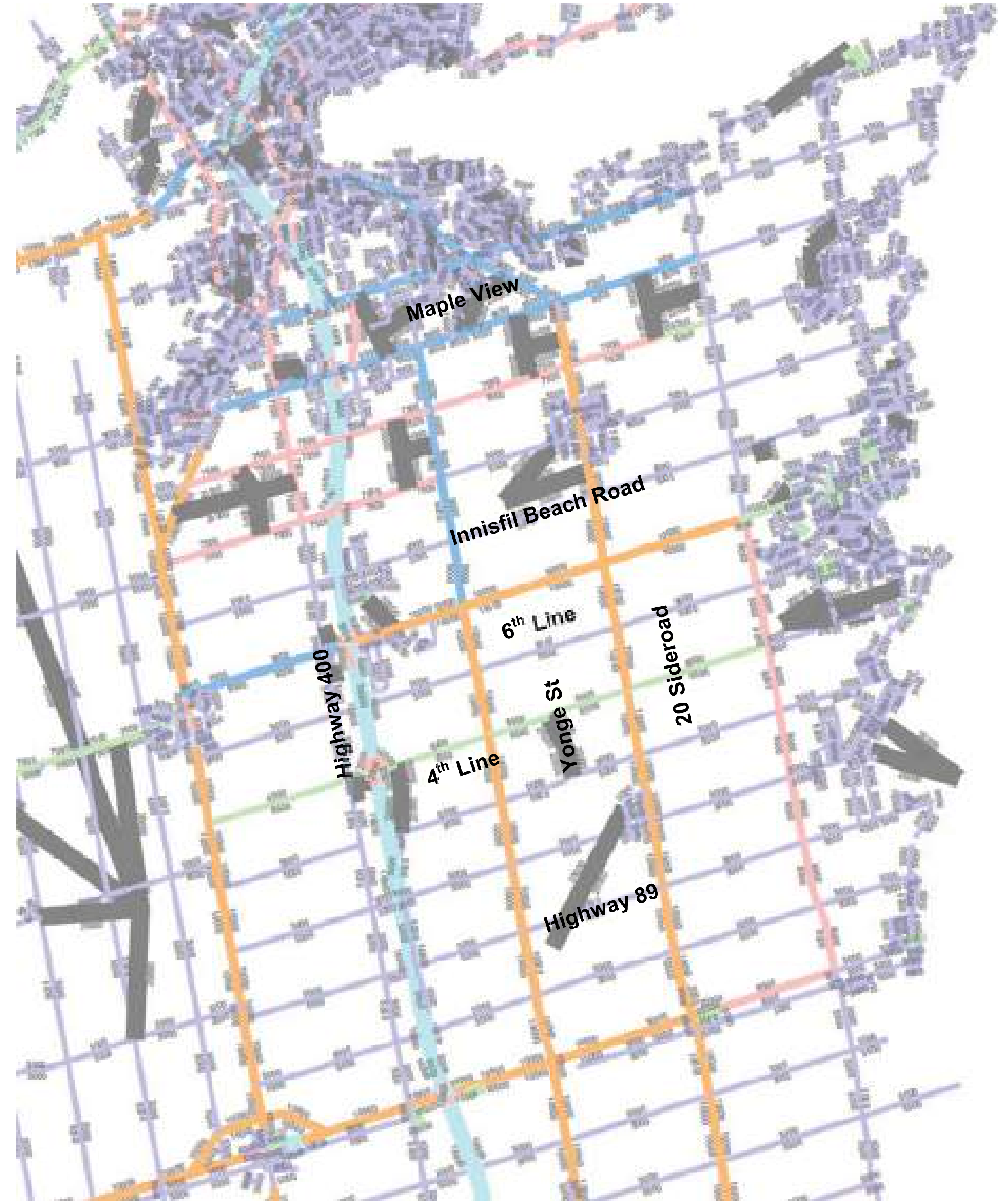

Exhibit 5: Daily Lane Capacities - Base Case Scenario (Vehicles per Lane per Day)

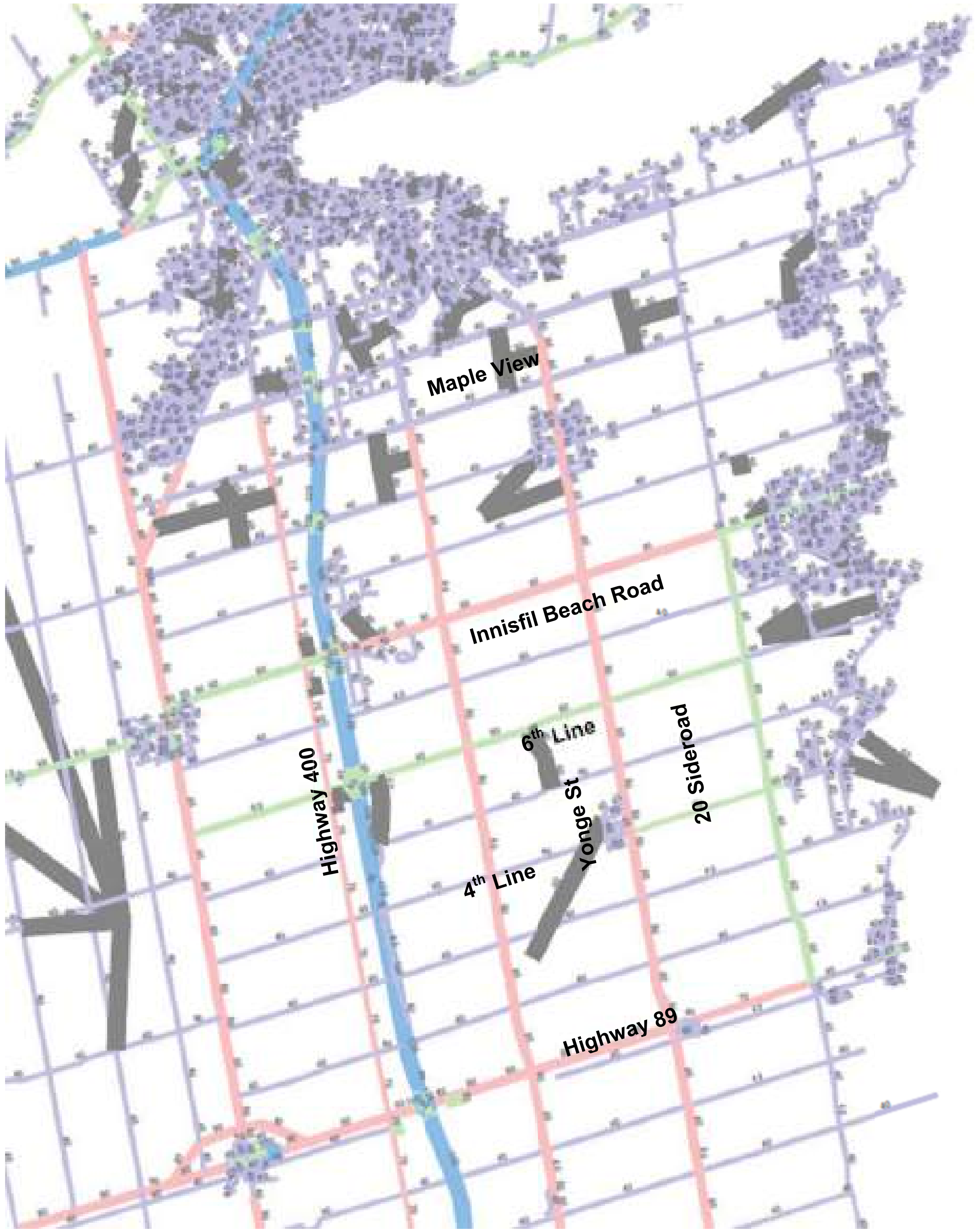

Exhibit 6: Free-flow Speeds - Base or Do Nothing Scenario (Kilometres per Hour)

Results Analysis

Results for the seven scenarios are provided in the following sections.

Scenario 1A: Do Nothing

Exhibit 7 is a plot containing the results for Scenario 1A, which is the Do Nothing scenario. The links are coloured to illustrate their projected volume / capacity ratio in 2031 while the text indicates the forecast daily auto volume. With no change to the roadway, traffic from the Sleeping Lion development and other Alcona South development areas adjacent to 6th Line will increase traffic on 6th Line beyond capacity east of Yonge Street. Innisfil Beach Road volumes exceed capacity for the entire length between Highway 400 and Webster Blvd.

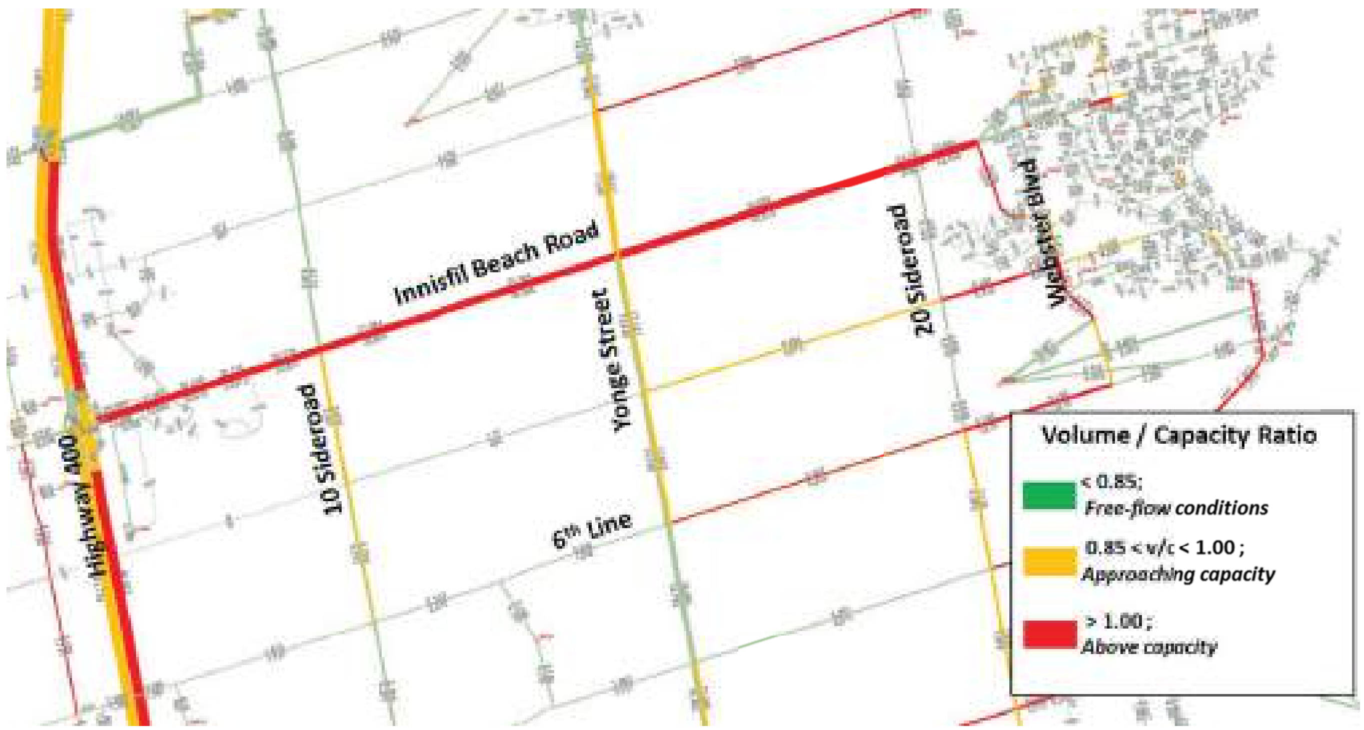

Exhibit 7: Scenario 1A – Do Nothing Auto Volume and Volume / Capacity Results

Scenario 1B: Reconstruction

Exhibit 8 is a plot containing the results for Scenario 1B, which proposes to reconstruct 6th Line through the Study Area. The reconstruction could increase capacity by providing wider lanes and paved shoulders. With this improved capacity, 6th Line is still

approaching capacity east of Yonge Street, but operations are improved over Scenario 1A on 6th Line, while Innisfil Beach Road remains above capacity.

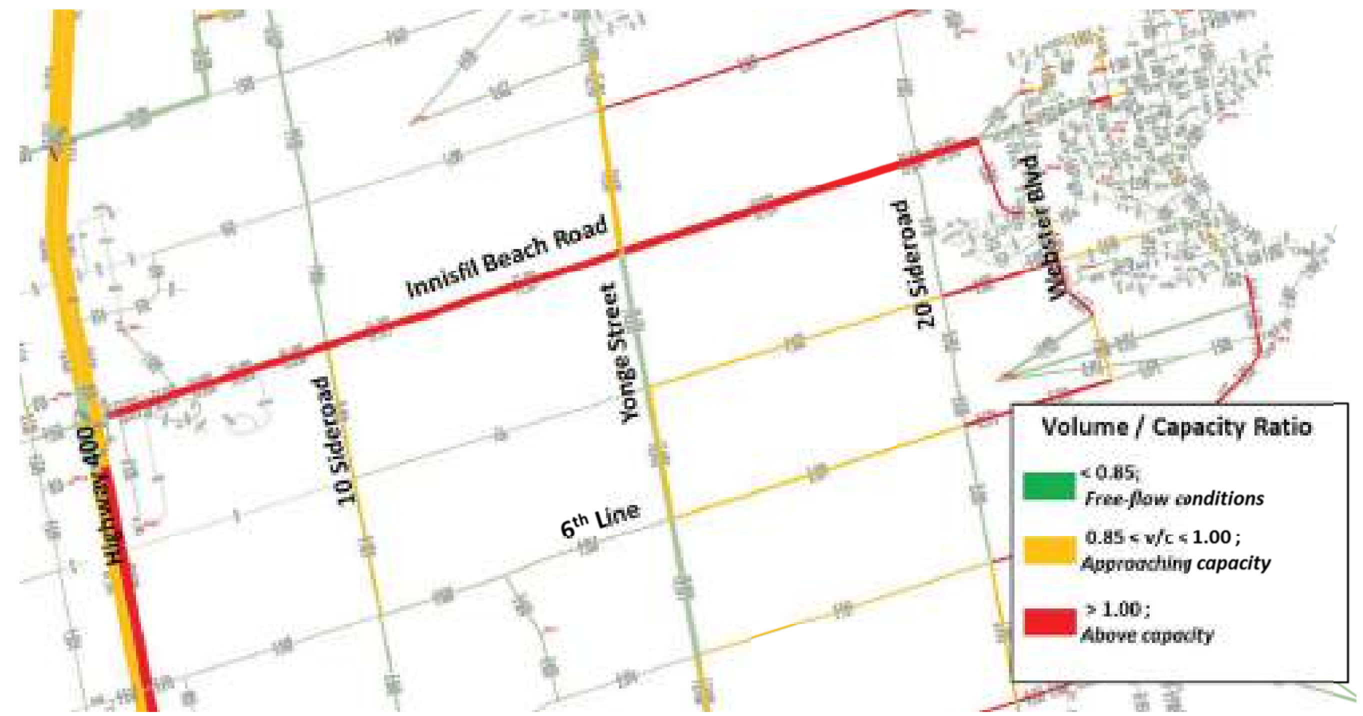

Exhibit 8: Scenario 1B – Reconstruction Auto Volume and Volume / Capacity Results

Scenario 1C: Base Case / Currently Planned

Exhibit 9 is a plot containing the results for Scenario 1C, and as per TMP recommendations, the assumed travel speed on 6th Line is increased to 60km/h which results in demand exceeding capacity east of Yonge Street and approaching capacity between Yonge Street and 10 Sideroad. Innisfil Beach Road also remains above capacity for nearly the entire length between Highway 400 and Webster Blvd.

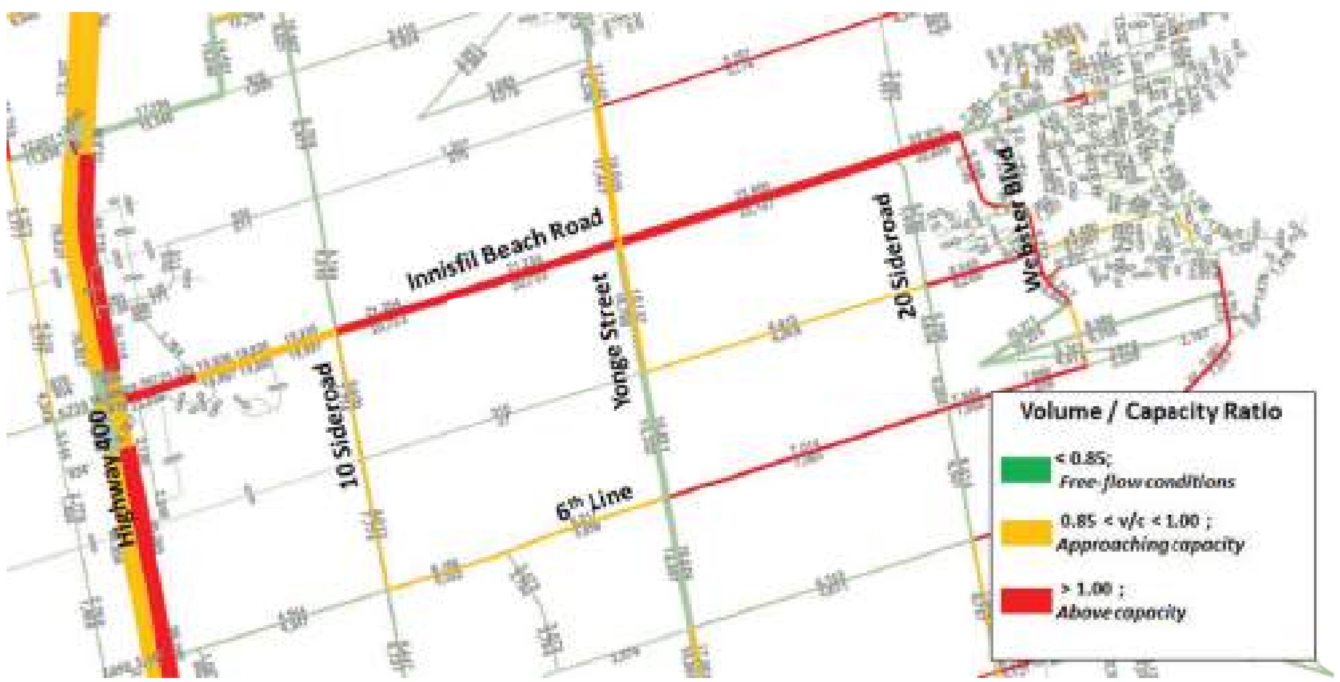

Exhibit 9: Scenario 1C – Base Case / Currently Planned Auto Volume and Volume / Capacity Results

6th Line Municipal Class Environmental Assessment
Needs Analysis: Travel Demand Forecasting

Scenario 2: Capacity and Speed Improvements

The plot for Scenario 2, which assumed improved lane capacity and free-flow speed on 6th Line, is presented in **Exhibit 10.** 6th Line becomes a more attractive travel route between Alcona and Highway 400 due to the travel time savings that arise with a higher free-flow speed. However due to the increase in demand, 6th Line is projected to operate above the assumed two-way daily capacity between 10 Side Road and 20 Side Road. Meanwhile Innisfil Beach Road will also continue to operate above its capacity; however, there is some diverted traffic forecasted from Innisfil Beach Road to 6th Line.

In summary, the results of Scenarios 1 and 2 reveal that even if the interchange at Highway 400 is not constructed, 6th Line will continue to be congested if not widened to 4 lanes with even worse congestion occurring on Innisfil Beach Road.

Exhibit 10: Capacity and Speed Improvements - Auto Volume and Volume / Capacity Results

Scenario 3: Base Case plus Highway 400 IC

Exhibit 11 is a plot containing the results for Scenario 3, which is the base case where 6th Line Road has an interchange to connect to Highway 400. From Yonge Street to Webster Blvd, 6th Line is projected to carry demand above its capacity, while west of Yonge Street it is projected to be at or near capacity all the way to Highway 400. Meanwhile Innisfil Beach Road is projected to be above its capacity for nearly the entire length between Highway 400 and Webster Blvd.

The benefit of the interchange at Highway 400 and 6th Line can be observed in that traffic volumes are projected to significantly decrease on 10 Side Road and Yonge Street. Traffic will not need to use these north/south roads in order to access Highway 400 at Innisfil Beach Road.

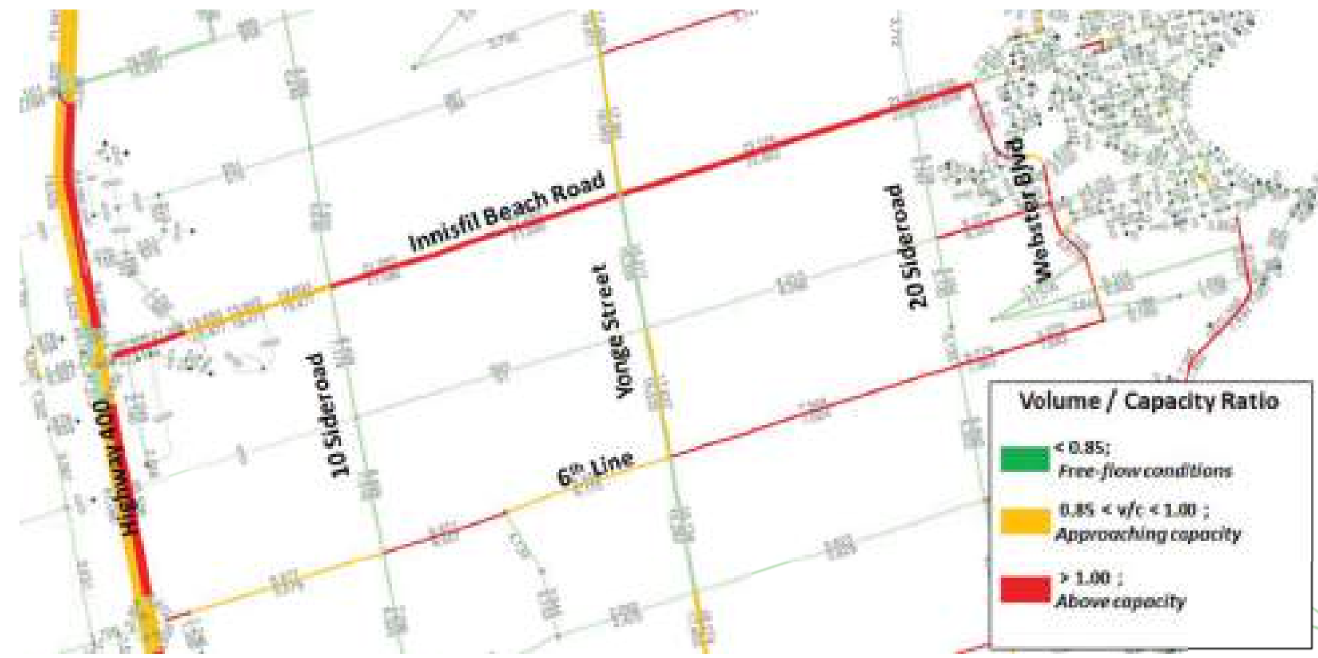

Exhibit 11: Scenario 3 - Base/Do Nothing plus Highway 400 IC Auto Volume and Volume / Capacity Results

Scenario 4: Capacity and Speed Improvements plus Highway 400 IC

The results for Scenario 4, which assumed increased lane capacity and free-flow speed on 6th Line are illustrated in **Exhibit 12.** Due to the increased free-flow speed as a result of cross-sectional improvements, nearly the entire length of 6th Line is at or above its practical daily capacity, even if the capacity per lane is also increased. The travel time savings that arise due to improved free-flow speeds make 6th Line an attractive route compared to parallel rural roads. There is also some reduction in traffic projected along Innisfil Beach Road.

Exhibit 12: Scenario 4 - Capacity and Speed Improvements with Highway 400 IC Auto Volume and Volume / Capacity Results

Scenario 5: Widening with Capacity and Speed Improvements and Highway 400 IC

Scenario 5, which assumes two lanes per direction on 6th Line, capacity and speed improvements on 6th Line and the Highway 400 interchange, performs the best from both a corridor and network perspective as shown in **Exhibit 13.** 6th Line is projected to carry about 18,000 vehicles per day per direction by 2031, which is below its capacity of 20,000 vehicles per day between Highway 400 and 20 Sideroad. However the portion east of 20 Sideroad will be above its capacity.

Meanwhile Innisfil Beach Road from east of Highway 400 to Yonge Street will also be relieved such that it will operate below its practical capacity as it is likely vehicles will be diverting to the widened 6th Line Road.

Therefore, not only does a 4-lane 6th Line improve operations along 6th Line, it will also provide a network benefit.

Exhibit 13: Scenario 5 – Widening with Capacity and Speed Improvements Auto Volume and Volume / Capacity Results

Summary Tables

Table 4, **Table 5** and **Table 6** summarize the results discussed above in tabular screenline format for eastbound traffic. Westbound traffic tables are similar as the model represents daily traffic which is typically similar for different directions. It is noted in all 6th Line improvement scenarios, Innisfil Beach Road will likely be very congested in the future if all planned developments in the Town of Innisfil are built. The widening of 6th Line to 4 lanes plus a Highway 400 interchange (Scenario 5) provides the greatest amount of relief to Innisfil Beach Road while improving 6th Line to carry a high volume of traffic.

Should the Highway 400 interchange not be built, traffic volumes will still increase on 6th Line, particularly between Yonge Street and 20 Sideroad, but given the number of alternative routes to access Yonge Street, there isn't a strong need to widen 6th Line west of 20 Sideroad until a major piece of infrastructure such as a Highway 400 Interchange is built on 6th Line.

East of 20 Sideroad it is clear that an improvement such as road widening of 6th Line is needed to support development.

It is noted that in the West of Yonge Screenline, 7th Line is projected to have very little demand since it does not cross Highway 400. Even though the roadway capacity is there in the screenline, very little traffic will use this Road west of Yonge Street to divert away from congestion on Innisfil Beach Road and 6th Line.

Table 4: Screenline Capacity Summary Table

Eastbound	Total Capacity (vehicles per day)						
	Scenario 1A	Scenario 1B	Scenario 1C	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Link / Screenline	**East of 400**						
Innisfil Beach Road	20,000	20,000	20,000	20,000	20,000	20,000	20,000
6th Line	5,000	6,500	6,500	10,000	6,500	10,000	20,000
TOTAL	**25,000**	**26,500**	**26,500**	**30,000**	**26,500**	**30,000**	**40,000**
Link / Screenline	**West of Yonge**						
Innisfil Beach Road	20,000	20,000	20,000	20,000	20,000	20,000	20,000
7th Line	5,000	5,000	5,000	5,000	5,000	5,000	5,000
6th Line	5,000	6,500	6,500	10,000	6,500	10,000	20,000
TOTAL	**30,000**	**31,500**	**31,500**	**35,000**	**31,500**	**35,000**	**45,000**
Link / Screenline	**East of Yonge**						
Innisfil Beach Road	20,000	20,000	20,000	20,000	20,000	20,000	20,000
7th Line	5,000	5,000	5,000	5,000	5,000	5,000	5,000
6th Line	5,000	6,500	6,500	10,000	6,500	10,000	20,000
TOTAL	**30,000**	**31,500**	**31,500**	**35,000**	**31,500**	**35,000**	**45,000**
Link / Screenline	**East of 20 Sideroad**						
Innisfil Beach Road	13,000	13,000	13,000	13,000	13,000	13,000	13,000
7th Line	5,000	5,000	5,000	5,000	5,000	5,000	5,000
6th Line	5,000	6,500	6,500	6,500	5,000	6,500	13,000
TOTAL	**23,000**	**24,500**	**24,500**	**24,500**	**23,000**	**24,500**	**31,000**

Table 5: Screenline Auto Volume Summary Table

Eastbound	Auto Volume						
	Scenario 1A	Scenario 1B	Scenario 1C	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	East of 400						
Innisfil Beach Road	23,666	23,674	23,038	22,869	22,518	22,010	20,960
6th Line	1,281	2,325	5,292	7,241	6,618	11,008	18,902
TOTAL	**24,947**	**25,999**	**28,330**	**30,110**	**29,136**	**33,018**	**39,862**
Link / Screenline	**West of Yonge**						
Innisfil Beach Road	20,928	21,017	20,753	20,149	21,080	20,051	18,843
7th Line	324	226	27	0	51	4	0
6th Line	1,840	3,528	5,959	9,865	6,175	10,938	19,395
TOTAL	**23,092**	**24,771**	**26,739**	**30,014**	**27,306**	**30,993**	**38,238**
	East of Yonge						
Innisfil Beach Road	23,516	23,128	23,147	22,599	22,822	22,166	21,440
7th Line	4,570	4,304	4,269	3,539	4,096	3,488	1,398
6th Line	4,454	6,097	7,065	11,317	7,024	11,229	19,065
TOTAL	**32,540**	**33,529**	**34,481**	**37,455**	**33,942**	**36,883**	**41,903**
Link / Screenline	**East of 20 Sideroad**						
Innisfil Beach Road	22,438	22,574	22,875	22,896	22,955	22,955	19,888
7th Line	8,419	8,255	8,269	8,320	8,333	8,501	7,166
6th Line	7,876	8,213	7,858	7,968	7,883	8,044	17,141
TOTAL	**38,733**	**39,042**	**39,002**	**39,184**	**39,171**	**39,500**	**44,195**

Table 6: Screenline Volume to Capacity Ratio Summary Table

Eastbound	Volume / Capacity Ratio						
	Scenario 1A	Scenario 1B	Scenario 1C	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	East of 400						
Innisfil Beach Road	1.18	1.18	1.15	1.14	1.13	1.10	1.05
6th Line	0.20	0.36	0.81	0.72	1.02	1.10	0.95
TOTAL	1.00	0.98	1.07	1.00	1.10	1.10	1.00
Link / Screenline	West of Yonge						
Innisfil Beach Road	1.05	1.05	1.04	1.01	1.05	1.00	0.94
7th Line	0.06	0.05	0.01	0.00	0.01	0.00	0.00
6th Line	0.28	0.54	0.92	0.99	0.95	1.09	0.97
TOTAL	0.73	0.79	0.85	0.86	0.87	0.89	0.85
Link / Screenline	East of Yonge						
Innisfil Beach Road	1.18	1.16	1.16	1.13	1.14	1.11	1.07
7th Line	0.91	0.86	0.85	0.71	0.82	0.70	0.28
6th Line	0.89	0.94	1.09	1.13	1.08	1.12	0.95
TOTAL	1.03	1.06	1.09	1.07	1.08	1.05	0.93
Link / Screenline	East of 20 Sideroad						
Innisfil Beach Road	1.73	1.74	1.76	1.76	1.77	1.77	1.53
7th Line	1.68	1.65	1.65	1.66	1.67	1.70	1.43
6th Line	1.58	1.26	1.21	1.23	1.58	1.24	1.32
TOTAL	1.68	1.59	1.59	1.60	1.70	1.61	1.43

Conclusion and Recommendations

Based on the 2031 horizon year analysis conducted for the 6th Line Environmental Assessment the following recommendations are made for improving 6th Line:

- Without the construction of the 6th Line / Highway 400 interchange:
  - County Road 27 to Sideroad 20 - reconstruction to 2 lanes
  - Sideroad 20 to St. John's - reconstruction and widening to 4 lanes

- With construction of the 6th Line / Highway 400 interchange:
  - County Road 27 to Sideroad 20 - widening to 4 lanes
  - Sideroad 20 to St. John's - reconstruction and widening to 4 lanes

BT ENGINEERING

Appendix B
STAMSON Outputs

BT ENGINEERING BTE

Receiver Site 1
Without Project

```
STAMSON 5.0        NORMAL REPORT        Date: 01-09-2005 21:07:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rs1.te               Time Period: 1 hours
Description:


Road data, segment # 1: 6th RS1
-------------------------------
Car traffic volume  :    77 veh/TimePeriod
Medium truck volume :     5 veh/TimePeriod
Heavy truck volume  :     2 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: 6th RS1
-----------------------------
Angle1   Angle2            : -90.00 deg   -35.00 deg
Wood depth                 :      2       (Wood depth 60 metres or more)
No of house rows           :      0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 103.00 m
Receiver height            :   1.20 m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00


Road data, segment # 2: 6th RS1
-------------------------------
Car traffic volume  :    77 veh/TimePeriod
Medium truck volume :     5 veh/TimePeriod
Heavy truck volume  :     2 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     5 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 2: 6th RS1
-----------------------------
Angle1   Angle2            : -35.00 deg   35.00 deg
Wood depth                 :      2       (Wood depth 60 metres or more)
No of house rows           :      0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 103.00 m
Receiver height            :   1.20 m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00
```

Road data, segment # 3: 6th RS1

```
-------------------------------
Car traffic volume  :    77 veh/TimePeriod
Medium truck volume :     5 veh/TimePeriod
Heavy truck volume  :     2 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 3: 6th RS1
-----------------------------
Angle1   Angle2           :  35.00 deg   90.00 deg
Wood depth                :      2       (Wood depth 60 metres or more)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 103.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Road data, segment # 4: Hwy RS1

```
-------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 4: Hwy RS1
-----------------------------
Angle1   Angle2           : -90.00 deg   -20.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 284.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Road data, segment # 5: Hwy RS1

```
-------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 5: Hwy RS1
-----------------------------
Angle1   Angle2           : -20.00 deg   25.00 deg
Wood depth                :      2       (Wood depth 60 metres or more)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 284.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Road data, segment # 6: Hwy RS1

```
-------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 6: Hwy RS1
-----------------------------
Angle1   Angle2           :  25.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 284.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Results segment # 1: 6th RS1

```
---------------------------

Source height = 1.24 m

ROAD (0.00 + 32.70 + 0.00) = 32.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
   -90    -35   0.38  60.92   0.00 -11.52  -6.71 -10.00   0.00   0.00
32.70
------------------------------------------------------------------------
---

Segment Leq : 32.70 dBA
```

Results segment # 2: 6th RS1

```
---------------------------

Source height = 1.24 m

ROAD (0.00 + 35.85 + 0.00) = 35.85 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
   -35     35   0.38  61.58   0.00 -11.52  -4.21 -10.00   0.00   0.00
35.85
------------------------------------------------------------------------
---

Segment Leq : 35.85 dBA
```

Results segment # 3: 6th RS1

```
---------------------------

Source height = 1.24 m

ROAD (0.00 + 32.70 + 0.00) = 32.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
    35     90   0.38  60.92   0.00 -11.52  -6.71 -10.00   0.00   0.00
32.70
------------------------------------------------------------------------
---

Segment Leq : 32.70 dBA
```

Results segment # 4: Hwy RS1

```
---------------------------

Source height = 1.78 m

ROAD (0.00 + 57.66 + 0.00) = 57.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
   -90    -20   0.66  84.92   0.00 -21.20  -6.06   0.00   0.00   0.00
57.66
------------------------------------------------------------------------
---

Segment Leq : 57.66 dBA
```

Results segment # 5: Hwy RS1

```
---------------------------

Source height = 1.78 m

ROAD (0.00 + 51.48 + 0.00) = 51.48 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
   -20     25   0.36  84.92   0.00 -17.38  -6.06 -10.00   0.00   0.00
51.48
------------------------------------------------------------------------
---

Segment Leq : 51.48 dBA
```

Results segment # 6: Hwy RS1

```
---------------------------

Source height = 1.78 m

ROAD (0.00 + 57.17 + 0.00) = 57.17 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
    25     90   0.66  84.92   0.00 -21.20  -6.55   0.00   0.00   0.00
57.17
------------------------------------------------------------------------
---

Segment Leq : 57.17 dBA

Total Leq All Segments: 60.98 dBA
```

BT ENGINEERING BTE

Receiver Site 1
With Project

```
STAMSON 5.0        NORMAL REPORT        Date: 05-09-2005 22:46:13
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rs1with.te           Time Period: 1 hours
Description:
```

Road data, segment # 1: 6th RS1w

```
--------------------------------
Car traffic volume  :   383 veh/TimePeriod
Medium truck volume :    25 veh/TimePeriod
Heavy truck volume  :     8 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: 6th RS1w
------------------------------
Angle1   Angle2            : -90.00 deg   -35.00 deg
Wood depth                 :      2       (Wood depth 60 metres or more)
No of house rows           :      0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 103.00 m
Receiver height            :   1.20 m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00
```

Road data, segment # 2: 6th RS1w

```
--------------------------------
Car traffic volume  :   383 veh/TimePeriod
Medium truck volume :    25 veh/TimePeriod
Heavy truck volume  :     8 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     5 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 2: 6th RS1w
------------------------------
Angle1   Angle2            : -35.00 deg   35.00 deg
Wood depth                 :      2       (Wood depth 60 metres or more)
No of house rows           :      0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 103.00 m
Receiver height            :   1.20 m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00
```

```
Road data, segment # 3: 6th RS1w
--------------------------------
Car traffic volume  :   383 veh/TimePeriod
Medium truck volume :    25 veh/TimePeriod
Heavy truck volume  :     8 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 3: 6th RS1w
------------------------------
Angle1   Angle2           :  35.00 deg   90.00 deg
Wood depth                :      2       (Wood depth 60 metres or more)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 103.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 4: 400 RS1w
--------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 4: 400 RS1w
------------------------------
Angle1   Angle2           : -90.00 deg   -20.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 284.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 5: 400 RS1w
--------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 5: 400 RS1w
------------------------------
Angle1   Angle2           : -20.00 deg   25.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 284.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Road data, segment # 6: 400 RS1w
--------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 6: 400 RS1w
------------------------------
Angle1   Angle2           :  25.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 284.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Results segment # 1: 6th RS1w

Source height = 1.18 m

ROAD (0.00 + 39.36 + 0.00) = 39.36 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	-35	0.38	67.61	0.00	-11.54	-6.71	-10.00	0.00	0.00	39.36

Segment Leq : 39.36 dBA

Results segment # 2: 6th RS1w

Source height = 1.18 m

ROAD (0.00 + 42.44 + 0.00) = 42.44 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-35	35	0.38	68.18	0.00	-11.54	-4.21	-10.00	0.00	0.00	42.44

Segment Leq : 42.44 dBA

Results segment # 3: 6th RS1w

Source height = 1.18 m

ROAD (0.00 + 39.36 + 0.00) = 39.36 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
35	90	0.38	67.61	0.00	-11.54	-6.71	-10.00	0.00	0.00	39.36

Segment Leq : 39.36 dBA

Results segment # 4: 400 RS1w

Source height = 1.78 m

ROAD (0.00 + 57.66 + 0.00) = 57.66 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	-20	0.66	84.92	0.00	-21.20	-6.06	0.00	0.00	0.00	57.66

Segment Leq : 57.66 dBA

Results segment # 5: 400 RS1w

Source height = 1.78 m

ROAD (0.00 + 57.62 + 0.00) = 57.62 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-20	25	0.66	84.92	0.00	-21.20	-6.10	0.00	0.00	0.00	57.62

Segment Leq : 57.62 dBA

Results segment # 6: 400 RS1w

Source height = 1.78 m

ROAD (0.00 + 57.17 + 0.00) = 57.17 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
25	90	0.66	84.92	0.00	-21.20	-6.55	0.00	0.00	0.00	57.17

Segment Leq : 57.17 dBA

Total Leq All Segments: 62.35 dBA

Receiver Site 2 Without Project

```
STAMSON 5.0        NORMAL REPORT        Date: 01-09-2005 21:26:16
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename:                      Time Period: 1 hours
Description:


Road data, segment # 1: 6thRS2wo
--------------------------------
Car traffic volume  :    77 veh/TimePeriod
Medium truck volume :     5 veh/TimePeriod
Heavy truck volume  :     2 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: 6thRS2wo
------------------------------
Angle1   Angle2            : -90.00 deg   25.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  45.00 m
Receiver height            :   1.20 m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   3.00


Road data, segment # 2: 6thRS2wo
--------------------------------
Car traffic volume  :    77 veh/TimePeriod
Medium truck volume :     5 veh/TimePeriod
Heavy truck volume  :     2 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     5 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 2: 6thRS2wo
------------------------------
Angle1   Angle2            :  25.00 deg   80.00 deg
Wood depth                 :      1       (Wood depth 30 to less than 60
metres)
No of house rows           :      0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  45.00 m
Receiver height            :   1.20 m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00
```

Road data, segment # 3: 6thRS2wo

```
-------------------------------
Car traffic volume  :    77 veh/TimePeriod
Medium truck volume :     5 veh/TimePeriod
Heavy truck volume  :     2 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
Data for Segment # 3: 6thRS2wo
------------------------------
Angle1   Angle2           :  80.00 deg   90.00 deg
Wood depth                :      1       (Wood depth 30 to less than 60
metres)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  45.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Road data, segment # 4: 400RS2wo

```
-------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
Data for Segment # 4: 400RS2wo
------------------------------
Angle1   Angle2           : -90.00 deg   -5.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 365.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Road data, segment # 5: 400RS2wo

```
-------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
Data for Segment # 5: 400RS2wo
------------------------------
Angle1   Angle2           :  -5.00 deg   30.00 deg
Wood depth                :      2       (Wood depth 60 metres or more)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 365.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Road data, segment # 6: 400RS2wo

```
-------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
Data for Segment # 6: 400RS2wo
------------------------------
Angle1   Angle2           :  30.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 365.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Results segment # 1: 6thRS2wo

```
----------------------------

Source height = 1.24 m

ROAD (0.00 + 49.94 + 0.00) = 49.94 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
   -90     25   0.66  60.92   0.00  -7.92  -3.07   0.00   0.00   0.00
49.94
------------------------------------------------------------------------
---

Segment Leq : 49.94 dBA
```

Results segment # 2: 6thRS2wo

```
----------------------------

Source height = 1.24 m

ROAD (0.00 + 43.91 + 0.00) = 43.91 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
    25     80   0.38  61.58   0.00  -6.57  -6.11  -5.00   0.00   0.00
43.91
------------------------------------------------------------------------
---

Segment Leq : 43.91 dBA
```

Results segment # 3: 6thRS2wo

```
----------------------------

Source height = 1.24 m

ROAD (0.00 + 32.56 + 0.00) = 32.56 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
    80     90   0.38  60.92   0.00  -6.57 -16.80  -5.00   0.00   0.00
32.56
------------------------------------------------------------------------
---

Segment Leq : 32.56 dBA
```

Results segment # 4: 400RS2wo

```
----------------------------

Source height = 1.78 m

ROAD (0.00 + 57.09 + 0.00) = 57.09 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
   -90     -5   0.66  84.92   0.00 -23.01  -4.82   0.00   0.00   0.00
57.09
------------------------------------------------------------------------
---

Segment Leq : 57.09 dBA
```

Results segment # 5: 400RS2wo

```
----------------------------

Source height = 1.78 m

ROAD (0.00 + 48.88 + 0.00) = 48.88 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
    -5     30   0.36  84.92   0.00 -18.86  -7.17 -10.00   0.00   0.00
48.88
------------------------------------------------------------------------
---

Segment Leq : 48.88 dBA
```

Results segment # 6: 400RS2wo

```
----------------------------

Source height = 1.78 m

ROAD (0.00 + 54.83 + 0.00) = 54.83 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
------------------------------------------------------------------------
---
    30     90   0.66  84.92   0.00 -23.01  -7.08   0.00   0.00   0.00
54.83
------------------------------------------------------------------------
---

Segment Leq : 54.83 dBA

Total Leq All Segments: 60.08 dBA
```

Receiver Site 2
With Project

```
STAMSON 5.0        NORMAL REPORT        Date: 05-09-2005 22:47:37
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: rs2with.te           Time Period: 1 hours
Description:


Road data, segment # 1: 6thRS2w
-------------------------------
Car traffic volume  :   383 veh/TimePeriod
Medium truck volume :    25 veh/TimePeriod
Heavy truck volume  :     8 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1: 6thRS2w
-----------------------------
Angle1   Angle2            : -90.00 deg   25.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  45.00 m
Receiver height            :   1.20 m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00


Road data, segment # 2: 6thRS2w
-------------------------------
Car traffic volume  :   383 veh/TimePeriod
Medium truck volume :    25 veh/TimePeriod
Heavy truck volume  :     8 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     5 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 2: 6thRS2w
-----------------------------
Angle1   Angle2            :  25.00 deg   80.00 deg
Wood depth                 :      1       (Wood depth 30 to less than 60
metres)
No of house rows           :      0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  45.00 m
Receiver height            :   1.20 m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00
```

Road data, segment # 3: 6thRS2w

```
-------------------------------
Car traffic volume  :   383 veh/TimePeriod
Medium truck volume :    25 veh/TimePeriod
Heavy truck volume  :     8 veh/TimePeriod
Posted speed limit  :    80 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
Data for Segment # 3: 6thRS2w
-----------------------------
Angle1   Angle2           :  80.00 deg   90.00 deg
Wood depth                :      1       (Wood depth 30 to less than 60
metres)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  45.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Road data, segment # 4: 400RS2w

```
-------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
Data for Segment # 4: 400RS2w
-----------------------------
Angle1   Angle2           : -90.00 deg   -5.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 365.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Road data, segment # 5: 400RS2w

```
-------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
Data for Segment # 5: 400RS2w
-----------------------------
Angle1   Angle2           :  -5.00 deg   30.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 365.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Road data, segment # 6: 400RS2w

```
-------------------------------
Car traffic volume  :  6020 veh/TimePeriod
Medium truck volume :   354 veh/TimePeriod
Heavy truck volume  :   708 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)
```

```
Data for Segment # 6: 400RS2w
-----------------------------
Angle1   Angle2           :  30.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 365.00 m
Receiver height           :   1.20 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Results segment # 1: 6thRS2w

Source height = 1.18 m

ROAD (0.00 + 56.63 + 0.00) = 56.63 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	25	0.66	67.61	0.00	-7.92	-3.07	0.00	0.00	0.00	56.63

Segment Leq : 56.63 dBA

Results segment # 2: 6thRS2w

Source height = 1.18 m

ROAD (0.00 + 50.49 + 0.00) = 50.49 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
25	80	0.38	68.18	0.00	-6.58	-6.11	-5.00	0.00	0.00	50.49

Segment Leq : 50.49 dBA

Results segment # 3: 6thRS2w

Source height = 1.18 m

ROAD (0.00 + 39.21 + 0.00) = 39.21 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
80	90	0.38	67.61	0.00	-6.58	-16.82	-5.00	0.00	0.00	39.21

Segment Leq : 39.21 dBA

Results segment # 4: 400RS2w

Source height = 1.78 m

ROAD (0.00 + 57.09 + 0.00) = 57.09 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	-5	0.66	84.92	0.00	-23.01	-4.82	0.00	0.00	0.00	57.09

Segment Leq : 57.09 dBA

Results segment # 5: 400RS2w

Source height = 1.78 m

ROAD (0.00 + 54.68 + 0.00) = 54.68 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-5	30	0.66	84.92	0.00	-23.01	-7.23	0.00	0.00	0.00	54.68

Segment Leq : 54.68 dBA

Results segment # 6: 400RS2w

Source height = 1.78 m

ROAD (0.00 + 54.83 + 0.00) = 54.83 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
30	90	0.66	84.92	0.00	-23.01	-7.08	0.00	0.00	0.00	54.83

Segment Leq : 54.83 dBA

Total Leq All Segments: 62.28 dBA

Appendix J
Archaeology Report

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Stage 1 Archaeological Assessment
6th Line Interchange Class Environmental Assessment
Part of Lots 6 and 7, Concessions 5 and 6
Geographic Township of Innisfil, Simcoe County

ORIGINAL REPORT

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Stage 1 Archaeological Assessment
6th Line Interchange Class Environmental Assessment
Part of Lots 6 and 7, Concessions 5 and 6
Geographic Township of Innisfil, Simcoe County

ORIGINAL REPORT

January 24, 2017

Submitted to:

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BT Engineering
41 Adelaide Street North
Unit 71
London, ON N6B 3P4

Ph: 613.228.4813
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PIF No. P248-0269-2016
Laura McRae (License No. P248)

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2401 5th Line East
Campbellford, ON K0L 1L0
Phone: 705.201.1066
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Email: lmcrae@centralarchaeology.ca

CAGI Project No. CAGI-2016-LM4

Distribution: BT Engineering
Ministry of Tourism, Culture and Sport

Bringing the past to the present for the future

PROJECT PERSONNEL

Project Director

Laura McRae, P248

Client Contact

Steven Taylor, President

Archival Research

Derek Paauw

Mapping

Laura McRae

Site Inspection

Laura McRae

Derek Paauw

Report Preparation

Laura McRae

Report Reviewer

Derek Paauw

Administration

Deb Coit

Rick Coit

ACKNOWLEDGEMENTS

The Central Archaeology Group Inc. would like to extend their gratitude to the following individuals and parties.

- Steven Taylor and Darcie Dillon, BT Engineering.
- Rob von Bitter, Ministry of Tourism, Culture and Sport.
- The Simcoe County Land Registry Office, Barrie.
- The staff at the Trent University Maps and Geospatial Resources section of the Thomas, J. Bata Library, Peterborough.

ACRONYMS

a.s.l.	above sea level
AP	Archaeological Potential
BTE	BT Engineering
cm	centimeters
CAGI	Central Archaeology Group Inc.
CR	County Road
GToI	Geographic Township of Innisfil
m	metres
MTCS	Ministry of Tourism, Culture and Sport
NAP	No Archaeological Potential
SC	Simcoe County
ToI	Town of Innisfil

EXECUTIVE SUMMARY

The Central Archaeology Group Inc. (CAGI) was contracted by Darcie Dillon with BT Engineering (BTE) to conduct a Stage 1 archaeological assessment for a Class Environmental Assessment for a proposed interchange at 6th line and Highway 400. The project area is located within Part of Lots 6 and 7, Concessions 5 and 6 in the Geographic Township of Innisfil (GToI), Simcoe County (SC).

As an initial requirement of land use planning and development, the Ontario Ministry of Tourism, Culture and Sport (MTCS) has stated that three objectives must be met by way of a Stage 1 archaeological study: 1) provide information on the subject property's geography, history, previous archaeological fieldwork and current land condition; 2) evaluate the archaeological potential for the property and support recommendations for a Stage 2 survey; and, 3) recommend appropriate strategies for future assessments within the property. Therefore, the main purpose of the Stage 1 assessment is to investigate the cultural land use, archaeological history and the present conditions of the property. The majority of this process is background research conducted in the company office and other libraries and involves the examination of records such as historic settlement maps, land titles and documents, historical land use and ownership records, primary and secondary sources and the Ministry of Tourism, Culture and Sport's archaeological sites database.

Permission to access the area and to carry out the activities necessary for the completion of the Stage 1 background study was granted by Darcie Dillon, BTE. Based on the results of the archaeological assessment, the following recommendations are provided for consideration to the MTCS and the Proponent, and are subject to approval by the MTCS:

1) A Stage 2 archaeological assessment will be conducted by a licensed consultant archaeologist using the pedestrian survey method at 5 m intervals in areas along the corridor which have been recently ploughed and are in appropriate condition at the time of survey (as illustrated by the areas marked in orange on Map 10);

2) A Stage 2 archaeological assessment will be conducted by a licensed consultant archaeologist using the test pit survey method at 5 m intervals in all areas along the corridor which have not been recently ploughed or do not have appropriate conditions for pedestrian survey at the time of the Stage 2 assessment (as illustrated by the areas marked in yellow on Map 10);

3) No further archaeological assessments are recommended for areas which have been determined to be disturbed including the following intersections; Highway 400 and 6th Line (as illustrated by the areas marked in green on Map 10);

4) The Stage 2 archaeological assessment will follow the requirements set out in the 2011 Standards and Guidelines for Consultant Archaeologists (MTC 2011).

5) Notwithstanding the results and recommendations presented in this study, The Central Archaeology Group Inc. notes that no archaeological assessment, no matter how thorough or carefully completed, can necessarily predict, account for, or identify every form of isolated or deeply buried archaeological deposit. Therefore, in the event that archaeological remains are found during subsequent construction and development activities, the consultant archaeologist, approval authority, and the Cultural Programs Unit of the Ministry of Tourism, Culture and Sport should be immediately notified.

The MTCS is requested to review, and provide a letter indicating their satisfaction with, the results and recommendations presented herein, with regard to the 2011 Standards and Guidelines for Consultant Archaeologists and the terms and conditions for archaeological licenses, and to enter this report into the Ontario Public Register of Archaeological Reports.

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PLANS

MAPS

IMAGES

TABLES

1.0 PROJECT CONTEXT

1.1 Objectives

The objectives of a Stage 1 background study, as outlined by the *Standards and Guidelines for Consultant Archaeologists* (2011:13), are as follows:

- provide information on the subject property's geography, history, previous archaeological fieldwork and current land condition;
- evaluate the archaeological potential for the property and support recommendations for a Stage 2 survey
- recommend appropriate strategies for future assessments within the property

1.2 Development Context.

The Central Archaeology Group Inc. (CAGI) was retained by BT Engineering on behalf of the Town of Innisfil (ToI) to conduct a Stage 1 archaeological assessment for the proposed 6th Line Interchange in the GToI. This study is being undertaken as part of a Class EA to assess the options for a new interchange in the central area of Simcoe County (SC). This interchange will provide better access to proposed development area (Innisfil Heights and Alcona). The project area is located within Part of Lots 6 and 7, Concessions 5 and 6 in the GToI, SC (Plan 1; Map 1; Image 1).

This archaeological assessment was triggered by the *Environmental Assessment Act*. This project is in the pre-approval stage.

Permission for access to conduct the archaeological assessment was granted by Steven Taylor. Private property was not accessed for this project. Photographs were taken from along each road right-of-way with public property access.

The archaeological assessment was undertaken in accordance with the requirements of the Ontario Heritage Act (R.S.O. 1990), the Standards and Guidelines for Consultant Archaeologists (2011) and the Planning Act (R.S.O. 1990). All archaeological consulting activities were performed under the Professional Archaeological License of Laura McRae (P248). The Ontario Ministry of Tourism, Culture and Sport has designated this assessment as PIF P248-0269-2016. This project is further identified as CAGI-2016-LM4 under CAGI records.

1.3 Historical Context.

1.3.1 Historic Documentation

Libraries abound with historic literary documentation on the settlement and development of the Simcoe County, from its use by the pre-contact First Nations peoples through to Euro-Canadian settlement. Some of the more useful documents include: *Secrets of the Lakes: Stories from the History: Lake Simcoe and Lake Couchiching* (Frim 2002), *Huronia - A History and Geography of the Huron Indians, 1600-1650.* (Heidenrich 1971), *Soil Survey of Simcoe County, Ontario* (Hoffman et al. 1962), *A History of Simcoe County: Part I and Part II* (Hunter 1989), *Preliminary Report on an Archaeological Assessment of the Barrie Area* (Hunter 1977), *Sainte-Marie Among the Hurons* (Jury and Jury 1954) and *The Iroquoian Occupation of Southern Simcoe County: Results of the Southern Simcoe County Archaeological Project* (Warrick 1986).

There are also a significant number of consultant reports (archaeological and built heritage) available for consultation from the SC, the Ministry of Tourism, Culture and Sport and various museums and historical societies in the area.

The study area is situated within the eastern portion of SC in the GToI. The GToI, along with a north section of the Township of West Gwillimbury and the Village of Cookstown were amalgamated on January 1, 1991 and incorporated as the Town of Innisfil.

1.3.2 Pre-Contact Period

The Palaeoamerican Period. The Palaeoamerican Period represents the arrival of First Nations groups in Ontario around 11,5000 years ago following the retreat of the Laurentide ice sheets that covered most of Canada and the northern United States beginning approximately 95,000 years ago. Although there is considerable debate about whether the Palaeoamerican people were the first to cross into the Americas from Asia via Beringia, they are most likely the first culture to inhabit Ontario. The Palaeoamerican Period is represented by two distinct cultures based on the use of different tools. The Clovis culture comprised the early Palaeoamerican Period, whereas the Plano culture occupied the latter half of the Period.

The Clovis culture is defined by distinctive fluted chipped stone projectile points that are generally lance-shaped or lanceolate that lack notches or stems with a concave base and a grinding of the lower side edges. Although it is certain that these points were used as projectiles based on evidence of distinctive tip damage, it is unknown whether they were hafted onto long shafts and used as a thrusting spear or if they were mounted onto smaller shafts and used as hand-propelled spear or in combination with a spear-thrower.

Plano projectile points differ in that they lack the Clovis flute and they exhibit fine ripple flaking that is distinctive for the latter half of the Palaeoamerican Period. A number of sites dating to approximately 9,000 years ago have been found along the north shore of Lake Superior and on Manitoulin Island. High quality siliceous stone quarries exploited by Plano people have also been found along the shore of Lake Huron.

The Clovis and Plano cultures likely shared a similar subsistence strategy. They hunted migrating herds of caribou (*Rangifer tarandus*) along the shores of glacial lakes that appeared as the massive

ice sheets receded. They also hunted large mammals such as mammoth (*Mammuthus primigenious*) and mastodon (*Mammut americanum*). Palaeoamerican groups likely hunted smaller mammals and fish as well, and gathered wild fruits and berries.

The Archaic Period. Solid evidence for the beginning of the Archaic Period in Ontario dates to around 4,000 years ago with the advent of the Laurentian Archaic. The early Archaic culture likely evolved from the Palaeoamerican Period. However, there was probably an introduction of new ideas and technology as more people migrated into the region. The elaborately manufactured points representative of the Palaeoamerican Period were abandoned in favour of cruder manufacturing techniques but with a greater variety of stone being exploited. This likely represents a change in the types of flora and fauna available for consumption. There is certainly a shift in subsistence practices by early Archaic groups from long seasonal migration movements to a focus on regionally available food sources.

The Archaic Period also represents a technological shift in the methods used in the manufacturing of stone tools with the introduction of grinding and pecking. A wide variety of axe forms are introduced indicating a shift from a ore sub-arctic environment to a temperate climate. It is also during the Archaic Period that the atlatl superseded the use handheld thrusting spears predominately used during the Palaeoamerican Period. Elaborately polished and decorated stone tools believed to be atlatl counterweights appear in the archaeological record. Archaic people were also producing tools and ornaments manufactured from native copper found along the north shore of Lake Superior.

Based on evidence from discarded animal bones, the Laurentian Archaic people hunted predominately large mammals, such as deer, elk, and bear. However, smaller game like the beaver was also exploited. The Laurentian Archaic people also fished and gathered shellfish and plant material. The religious beliefs during the Archaic Period can also be discerned from the burial methods practiced. This included the internment of burial goods with the deceased and sprinkling of the body with red ochre.

The Woodland Period. The Woodland Period is generally associated with the introduction of ceramic technology. Early Woodland sites in the region surrounding the project area are scarce due to the shorter duration of the period and the low visibility of sites (Ellis et al. 1990b:78). Jackson (1980) suggests that subsistence and settlement patterns during the Early Woodland Period were similar to those of the Laurentian Archaic, but with greater emphasis on processing nuts and perhaps experimentation with plant cultivation.

The Middle Woodland Period in the region is defined by a number of burial mound sites located around Rice Lake with numerous associated middens and villages (Boyles 1897; Johnston 1968; Spence and Harper 1968; Stothers 1974). The mound sites tend to be located on promontories near river mouths and may have been used to define ancestral territory. Based on the wealth and variety of burial goods, the Middle Woodland people also had access to a wide-spread network of exotic goods, which extended as far away as Ohio and Indiana (Spence et al. 1990).

During the Late Woodland Period there was a shift in the subsistence and settlement patterns which included the occupation of seasonal hunting and fishing camps on Rice Lake, often on former Middle Woodland village sites, and larger interior longhouse villages, where early domesticated corn, beans, and squash were cultivated.

The end of the Woodland Period is well known in the region due to the discovery of a number of Huron village sites (Damkjar 1990; Ramsden 1989; Ramsden 1990; Sutton 1990). These sites seem to represent both Huron and St. Lawrence Iroquois occupation, but the exact origin of the occupants is still unknown (Sutton 1990:54; Ramsden 1990). The Huron abandoned the region as a centre of occupation sometime during the late sixteenth century and afterwards it was used as a buffer zone between the Huron and New York Iroquois.

The Huron. The Huron, or the Wendat as they called themselves, are a seventeenth-century Iroquoian-speaking group that occupied an area known as Huronia between Lake Simcoe and Georgian Bay (Map 2). however, archaeologists have also extended the "Huron" designation to include pre-contact period sites found in south-central Ontario, where subsistence and settlement patterns and similar material culture indicates cultural affiliation. Pre-contact period Huron sites dating to between 1,400 and 1,600 CE have been found along the north shore of Lake Ontario, from west of Toronto to Belleville, and to the north bounded to the east by the Trent River system and to the west by the Niagara escarpment.

The Hurons of Huronia, as encountered by the French in the 1600s, consisted of a confederacy of five nations or groups. The *Attignawantan,* who occupied the region encompassing the Penetanguishene Peninsula, appear to have been the largest group, and the *Arendarhonon,* the second largest group, occupied the eastern extent of Huronia, west of Lake Simcoe. Between these two groups lived the *Attigneenongnahac*, the *Arendaronnon* and the *Tahontaenrat.*

Huronia was connected to other Iroquoian-speaking groups to the south, such as the *Neutral* and the *Tionnontate,* by an extensive network of trails. Using Jesuit chronicles, late nineteenth century settler accounts, and personal observations, in 1906 Andrew F. Hunter pieced together a map outlining the probable locations of the major trails. However, no trails run through or near the project area. Heidenreich (1971:156) suggests that the trails followed high ground to avoid swamps.

The Huron had readily adopted agriculture, cultivating corn, beans, squash, sunflowers and tobacco. Aside from these cultigens, the Huron gathered wild plants and berries, such as plum and raspberry. Hunting and fishing supplemented the diet. The Huron hunted such animals as the white tail deer, black bear, elk, beaver and raccoon. Common bird bones found on archaeological sites include different varieties of duck, geese, grouse and pigeons (Ramsden 1990:380). Although fish are often overlooked in the archaeological record, Trigger (2000:31) suggests that it accounted as the second most exploited subsistence resource next to agriculture. Common fish species included perch, bass, sucker and catfish.

The Huron lived in longhouses, which were elongated rectangular structures made of wood beams and bark coverings, built to house several families, related matrilineally. Although internal design was related to the number and size of families and construction methods, which varied between groups, longhouses did share similar key characteristics, such as axially aligned hearths and storage pits, sleeping compartments and storage areas along the walls and communal storage areas at either end for casks of corn and other foods.

Large-scale archaeological investigations have provided information on typical characteristics associated with Huron village sites. Some common features include multiple-row palisades encircling the village and a single longhouse located outside the defensive wall to accommodate visitors or traders (Ramsden 1988). Longhouses within the village tended to be arranged around one or more

larger longhouses that were associated with different areas of the village, suggesting perhaps kin-based grouping (Warrick 1984). Village sites also tended to have several phases of expansion, where the palisades were enlarged several times over (Finlayson 1985). However, sites did not expand to any great size as the Huron periodically (every 8 to 30 years) moved settlement sites as soil fertility became depleted.

Huron villages tended to have large middens that contained large amounts of food refuse and discarded artifacts. Therefore, they are readily identifiable in areas that have been ploughed and often contain mounded middens when undisturbed (Ramsden 1990:373). Smaller middens also occur throughout the village and against the palisades. Village sites are typically located in areas with sandy soil that is easily defensible and in close proximity to a permanent streams. However, variation in location and preference for other geographical features is common. A visual inspection of the project area did not reveal any unnatural mounded features or the presence of large artifact scatters on the surface that would indicate the presence of a village site. Furthermore, the relatively poor soil and absence of a permanent water source would account for this finding. Non-village settlements used by the Huron include temporary hunting and fishing camps, and cabin sites associated with the tending of corn fields during the summer (Ramsden 1990:373). Small hamlets likely associated with larger village sites have also been found. These often include two or three longhouses and one to two middens (Ramsden 1990:376). By 1650, the Iroquois had driven the Huron off their territory and many fled to the security of the Algonquian-speaking groups to the north or were held captive by the Iroquois.

Table 1. Summary of the First Nations archaeological sequence in southern Ontario.

Period	Date	Characteristics
Palaeoamerican	11,500 - 9000 BP	first evidence of human occupation in Ontario
		family groups hunting large game
		seasonal occupation along lakeshore environments
Archaic	9000 - 3000 BP	hunting and gathering subsistence economy
		seasonal occupation of resource rich environments
		territorial band level society
		groundstone tool technology
Early Woodland	2200 - 3000 BP	hunting and gathering subsistence economy
		seasonal occupation of resource rich environments
		extensive trade networks for exotic raw material
		crude pottery vessels with little decoration
Middle Woodland	2200 - 1300 BP	hunting and gathering subsistence economy
		seasonal occupation of resource rich environments

Period	Date	Characteristics
		band level society with well defined territory
		elaborate mortuary ritual with mound burials
		extensive trade networks for exotic raw material
		elaborately decorated, coiled pottery vessels
Late Woodland	1300 - 300 BP	first evidence of corn, squash, and tobacco
		complex socio-political structure
		large, palisaded longhouse villages
		subsistence economy based on horticulture
		rapid population growth
		elaborately decorated ceramic vessels and pipes
Historic	300 BP - Present	

1.3.3 Post-Contact Period

In the early seventeenth century, French explorers such as Samuel de Champlain and Étienne Brûlé, encountered groups of people speaking an Algonquian language along the Ottawa River Valley. These were the Weskarini, Onotchataronon, Kichesipirini, Matouweskarini, and Otaguotouemin Algonquians (Trigger 1976: 279). The loosely aligned First Nations groups subsisted by hunting, fishing, and gathering, and undertook limited horticulture. Champlain first met the Algonquians in 1603 at the trading centre of Tadoussac near the mouth of the St. Lawrence River (Hessel 1993:14). Searching for the Northwest Passage in 1613, Champlain entered Algonquin territory and explored the Ottawa Valley as far north as Morrison's and Allumette Islands. The main body of the Kichesipirini lived on Morrison's Island and controlled the portages at the base of Allumette Lake. From their strategic location, the Kichesipirini collected tolls from all French trade to and from the interior nations such as the Nipissing, Huron, Ottawa, and Ojibway (Hessel 1993; Trigger 1976). In 1615, after Champlain's return from France, he extended his explorations to Lake Nipissing, down the French River, and along the east shore of the Georgian Bay, visiting several Huron villages, with whom he allied himself to war against their enemies, the Iroquois, thus gaining their trust (Belden 1975 [1881]: 3).

There was little game in Huron country, and the principal food of the Nation was maize (Belden 1975 [1881]: 3). As there was no concept as individual ownership of land, each family cultivated a portion until the soil was exhausted and no longer fertile and firewood became scare. Once this occurred, the village was abandoned and a new one was built in a different area. Some of the Huron villages were left open, but others located closer to the Iroquois Nations, were fortified by a trench, earthen bank, and wooden palisade.

Such was the Huron lifestyle when Champlain reached their territory in 1615. Upon his return from France, Champlain brought with him four friars of the Recollets - one of the three branches of the

Franciscan brotherhood - to undertake mission work among the First Nations groups of the country. One of these Franciscans, Joseph Le Caron, journeyed into Huron country with Champlain, likely landing somewhere on the northeast shore of what is now known as Tiny Township in Simcoe County (Hunter 1998 [1909]: 1).

Joseph Le Caron has the distinction of being the first missionary priest to live among the Huron Nation. His decision to live among the Attignaouantans Huron was made due to his desire to learn their language so as to more effectively preach the word of God. Le Caron left Huron territory after a few years but continued his missionary work in New France until the capitulation of New France to England in 1629. Le Caron was the first of many Catholic missionary priests to inhabit and convert First Nations peoples.

The 1640s was a time of great upheaval in the region. The introduction of European trade had turned skirmishes between the Huron and the Iroquois Nations into a ruthless struggle for survival. Raiding parties of Iroquois became commonplace in Huron country. They would lie in ambush along river routes, attack, and carry off rich Huron flotillas; the travel routes were extremely dangerous places (Jury and Jury 1954). Surprise attacks, massacres, capture, and torture occurred more and more frequently in Huron country. In combination with European diseases, this dramatically reduced the population of the Huron Nation by the 1650s.

Unfortunately, given the dedication to archaeological and historical research of the Huron, a paucity of information exists for period between 1650 and the Euro-Canadian settlement of Simcoe County. However, given the close proximity and friendly relations the Huron had with the Algonquian speaking groups to the north, it is likely that these groups, such as the Ojibway, moved into the region. There was a French mission to the Algonquian speaking groups around Orillia at this time (Hunter 1998 [1909]: 10).

Government land surveys of the vast interior of Upper Canada began as a military endeavor to find water or an overland route through the Huron Tract to bypass the vulnerable lower Great Lakes. Lieutenant Henry Briscoe of the Royal Engineers crossed by the Madawaska Highlands from Georgian Bay to the Ottawa River in 1826, and has the distinction of being the first Euro-Canadian recorded to pass within the confines of the future Algonquin Park area (Briscoe 1826 in Wyatt 1971). Briscoe concluded that a suitable canal route was not present through the Canadian Shield, but others, notably Charles Shirreff, believed that the interior could be settled by farmers and serviced by a canal (Wyatt 1971: 4). Alexander Shirreff, the son of Charles, searched for a possible canal route across the uplands in 1829 (Shirreff 1831 in Wyatt 1971). In his subsequent report, Alexander considered hardwood stands to reflect fertile soils, and thus promoted the Lake Opeongo area as suitable for farming settlements. In 1836, the government passed legislation to survey the Ottawa River and the waterways of bordering lands (Wyatt 1971: 22). David Thompson, the surveyor of the Thompson River in British Columbia, examined the area from Penetanguishene on Georgian Bay through the Muskoka-Madawaska region. In 1827, Thompson found evidence of previous campers, likely Alexander Shirreff, on a bay at the northeastern corner of Canoe Lake, in what would become Algonquin Park (Wyatt 1971: 4).

Simcoe County (Map 3)**.** Simcoe County is located in the northwestern part of Southern Ontario. It is bordered to the northeast by Ontario County, the southwest by Dufferin, and Grey Counties, the south by Peel County, the east by Lake Simcoe and York County, and the northwest by Georgian Bay. The total land area is 429,986 hectares of which approximately 71% is utilized as farmland (Hoffman et al.

1962:9). Originally the county was composed of the Townships of Adjala, Essa, Flos, Innisfil, Matchedash, Medonte, Mono, Mulmur, Nottawasaga, North Orillia, South Orillia, Oro, Sunnidale, Tay, Tecumseth, Tiny, Tossorotio, Vespra, and West Gwillimbury. However, the Townships of Mono and Mulmur detached from Simcoe County to become part of Dufferin County.

Simcoe was initially part of the Nassau District, created in 1788, which was renamed to the Home District in 1792. The district boundaries originally were bounded to the east by a line running north from the Trent River and to the west by a line running north from Long Point on Lake Erie. As such, the first district town was Newark (Niagara-on-the-Lake), but was changed to York (Toronto) following district reorganization in 1798. The reorganization resulted in the creation of the separate districts of Newcastle and Niagara, thus leaving the Home District to comprise York and Simcoe Counties alone. In 1837, Simcoe County became part of a separate Simcoe District (Stephenson 2010, accessed August 25, 2011). Lake Simcoe and Simcoe County were both named by John Graves Simcoe after his father, Captain John Graves Simcoe of the Royal Navy. The Lake had a number of earlier names, aboriginal and French, with the current appellation given in 1793 (Frim 2002: viii).

Unfortunately, there is a relative paucity of information for the period between 1650 and the Euro-Canadian settlement of Simcoe County. During the late eighteenth century and early years of the nineteenth, the region at the south end of Georgian Bay was strategically important to fur traders. The route to the east, by way of Lake Simcoe, was a preferred route to the Upper Lakes for many fur traders over the Ottawa River route. . In 1785, Deputy Surveyor General John Collins made a survey of the connections between the Bay of Quinte and Lake Huron, by way of Lake Simcoe (Hunter 1998 [1909] I:23). Several small fur trading posts sprang up around Lake Simcoe, of particular note are those at Holland Landing (near the south end of the lake) and the Atherley Narrows, between Lake Simcoe and Lake Couchiching (Frim 2002: viii). The Narrows was a favoured location due to First Nations groups frequenting the area, and a trading post was established as early as 1802 by Quetton St. George. Several other firms maintained posts and carried out profitable trade at the Narrows and Orillia, including the Hudson's Bay Company, who established a post there in 1862.

Euro-Canadian settlement began in Simcoe County after the War of 1812 when military authorities of Canada decided to establish a fort near the mouth of the Nottawasaga River. This decision was made due to continuing British/American hostilities and the British fear of invasion by American soldiers. Samuel S. Wilmot began to survey a road for communication between Kempenfelt Bay and Penetanguishene Harbour, portion lots for settlement, and mark the outlines of town plots at Kempenfelt Bay and Penetanguishene Harbour (Hunter 1998 [1909] I:39).

Settlement in Simcoe County did not occur at a quick pace. According to Hunter (1998 [1909] I: 55), of all the land granted to patent holders, less than one-tenth was occupied by actual settlers. The first settlers were Donald Sutherland, James Wallace, and John Armstrong who took up land in the southern part of West Gwillimbury in 1815 (Belden 1975 [1881]: 4). Along the Penetanguishene Road there was an influx of settlers after 1815, but the shores of Lake Simcoe and Kempenfelt Bay saw few settlers before 1831.

The first groups of settlers in Simcoe County are as follows (taken from Hunter 1998 [1909] I: 65):

1. French-Canadians, beginning in 1828, settled in Tiny and Tay Townships;
2. English, from northern counties of England beginning in 1820, settled in Oro and Vespra (25 families at first), Medonte, Tecumseth, and West Gwillimbury Townships;

3. Scots, from Sutherlandshire at first and immigrants with Lord Selkirk's Red River Colonists (17 families) located here in 1819, settled in West Gwillimbury Township;
4. Scots, from Islay, Argyleshire beginning in 1832, settled in Oro and Nottawasaga chiefly, and a few families of the same migration into Medonte, Orillia, and Sunnidale Townships;
5. Scots, from Lanarkshire and Renfrewshire, via Dalhousie Township, Ont. In 1832 (many Glasgow and Paisley weavers were among these), settled in Innisfil and Essa Townships;
6. Scots, Dumfriesshire from 1832 to 1850, settled in Innisfil Township;
7. Irish, beginning in 1830, Protestants from Ulster, settled in West Gwillimbury, Tecumseth, Innisful, Essa, and Tossorontio Townships;
8. Irish Palatines, about 10 families in 1831, settled in West Gwillimbury;
9. Irish Catholics, beginning in 1828, settled in Adjala, Vespra, Flos, Medonte, and Nottawasaga Townships;
10. Irish, from Londonderry in 1850, settled in Innisfil Township;
11. Germans, begun with 10 families in 1834, settled in Nottawasaga Township;
12. African Americans, begun in 1828, settled in Oro (20 families) and Sunnidale Townships, and;
13. First Nations, Ojibways (about 266), settled on Beausoleil and Christian Islands.

Eight colonization roads encouraged the settlement of Simcoe County. The first colonization road was the Nine-Mile Portage. This road ran from Kempenfelt Bay to Willow Creek and it was once the most important road in the County. The road dates back as a portage over which First Nations peoples used to carry their canoes (Hunter 1998[1909]I: 80,81). During the War of 1812, the road was widened in order to allow supply wagons to pass through, unrestrained by the forst wilderness, to deliver goods to government posts on the upper lakes. This road was in active use until the construction of the Northern Railway, built to Collingwood in 1855 (Hunter 1998[1909]I: 82). The second colonization road, the Penetanguishene Road, wasopened by Dr. Dunlop in December 1814 and completed in the fall of 1825 (Hunter 1998[1909]I: 84,86). This road linked Kempenfelt with Penetanguishene Bay. The thirs colonization road was the Coldwater Road. Originally a long, First Nations portage from Lake Couchiching to Coldwater on Matchedash Bay, it was cleared in 1830 and became a very important highway. The Gloucester Road, the fourth colonization road, ran from Penetanguishene Road at Hillsdale to Gloucester Bay (part of Matchedash Bay). This road opened as a government road in the winter of 1832-33 and became a leading highway through Medonte in the early years of its settlement (Hunter 1998[1909]I: 91). The fifth colonization road was the Sunnidale Road. The first Sunnidale Road was surveyed by Charles Rankin from Kempenfelt Bay to the Nottawasaga River, and through Sunnidale Township to Nottawasaga Bay in 1833 (Hunter 1998[1909]I: 92). The First Ridge Road, the sixth colonization road, traversed along the lakeshore through Oro Township from the head of Kempenfelt Bay as far as Shanty Bay. It was one of the first roads in the district to be opened for vehicular use (Hunter 1998[1909]I: 93). The seventh colonization road of the County was the Hawkestone Pioneers' Trail. This trail began at Hawkestone Creek and ran along the west side of the stream. Hunter (1998[1909]I: 94) states that First Nations people used it from the earliest times and it was also a deer path; then the early settlers used it on their way to upper Oro from Hawkestone, where there was a landing place for settlement purposes. Finally, the eighth colonization road is the Centre Road or Hurontario Street, initially surveyed in 1837.

After the decline of the fur trade, the economy of the early settlers was focused on clearing the land for agriculture, removing trees and rocks from the land and draining swamps. The first agricultural fairs were held in Barrie and Orillia in the 1840s. Timber was an important export industry, particularly in masts for the ships of the British Navy (Hunter 1998[1909]II: 324,327). Shipbuilding, logging, farming, fishing, and quarrying were the primary industries of the day. Once these declined, the leisure and hospitality industry became the mainstay of Simcoe's economy as cottages began to appear on the shores of many of its lakes (Frim 2002: viii).

Innisfil Township (Map 3). Encompassing a total of 68,653 acres, Innisfil is located immediately to the south of the city of Barrie. It is bounded to the north by Kempenfelt Bay (Lake Simcoe) and to the east by Lake Simcoe. The historic township was also bordered by Vespra Township to the northwest, Essa Township to the west and the Township of West Gwillimbury to the south.

The Township of Innisfil was first surveyed between February 1st and March 15th, 1820 by James Pearson (Hunter 1998 [1909]: 42). Prior to 1830, only a few families had arrived and begun clearing land. One of these early settlers to the township, Francis Hewson, settled at Big Bay Point in the year 1819 [Hunter 1998[1909]: 62). Another early arrival was David Soules, the second settler in Innisfil, who became Hewson's neighbor in 1822 at Cedarmont. In 1923, a third family, the Warnicas settled nearby. George and John Warnica were instrumental in the expansion of the Penetanguishene Road (Yonge St.) from Churchill to Barrie in 1825 (Frim 2002: 45-46).

In general, settlers of the township were largely of British origin. In the southwest of Innisfil there was a large settlement of protestant Irish from Northern Ireland which began in 1830. This settlement eventually resulted in the community of Cookstown. In the southeast of the township there were numerous small settlements of lowland Scots who arrived between 1832 and 1850 (Hunter 1998 [1909] I: 63). The two settlement areas were separated from each other by the "Big Swamp" (Holland Marsh) which extended a significant distance north into Innisfil Township.

Other settlers also arrived in the Innisfil area in the early nineteenth century. A number of pioneers who originally settled in Markham Township (near Thornhill) re-settled the northern part of Innisfil near Kempenfelt Bay (Hunter 1998 [1909] II: 68). Following the Markham settlers, a group of colonists from England also settled in northern Innisfil, clustered around Big Bay Point.

The first school in Innisfil was erected in 1837 or 1838 at Gimby's Corners (Churchill). This was the first and only school for many years in the township, and thus almost all the children born to families living in the south attended. One of the earliest churches, St. Paul's, was of the Christian Episcopalian denomination. It was built in 1851 on the Twelfth Line on land donated by John Pratt (Hunter 1998 [1909]: 307). The first Presbyterian services were held in 1836, with the construction of a church following soon after on the Sixth Line in 1844. The first post office, then called Innisfil, was located at what is now Barclay's Corners.

Penetanguishene Road, a route by which many settlers arrived into Simcoe County, was expanded through Innisfil to the 12th Line of West Gwillimbury (Churchill). York (Toronto) and Barrie were connected by the road once it was completed in 1825. This section of the road was later identified as Highway 11 and later still, Yonge St.

Tollendal. The hamlet of Tollendal, located on the southern shore of Kempenfelt Bay, east of Barrie, had its origin with the erection of a sawmill in 1829 or 1830, the first in Innisfil Township (Hunter 1998 [1909] II:72). A grist mill was added beside the sawmill in 1835. The proximity of the mills to Kempenfelt Bay rendered them readily accessible to a large number of settlers in the surrounding area, making it easier for them to obtain supplies like

ground meal. At one time the community of Tollendal rivaled Barrie in size and competed for the honour of becoming the county seat. Once Barrie secured the seat of county government in 1845 it quickly outgrew its rival communities, Tollendal and Kempenfelt Village (in present-day Oro-Medonte Township) (Hunter 1998 [1909]II: 75).

The settlement's lyrical name was bestowed by Edmund Lally, who bought the Tollendal sawmill in the late 1830s. The name derived from his family's castle, in County Galway, Ireland (Frim 2002: 46).

Allandale. William Allan, for whom the settlement is named, was a prominent Toronto businessman who received a one thousand acre grant on Kempenfelt Bay in 1821. The property was initially developed by his son, George William Allan, who built a country house there. The house and surrounding acreage were largely used as a summer retreat and operating farm. In 1892 he deeded some of the acreage to his daughter, who, with her husband, built her own summer home there (Frim 2002:47).

The Ontario, Simcoe and Huron Railway from Toronto extended its operations from Bradford to Allandale in 1853, with the first station house constructed in that same year. That station house burned down in the 1890s and was replaced by another structure in 1894. In 1905 the current three building station was built, but was closed in the 1980s (Frim 2002: 48-49). Allandale was annexed by the rapidly expanding city of Barrie in 1897 (Frim 2002: 48).

Barrie. The area which became known as Barrie rose to prominence due to two factors: the War of 1812, and the Nine-Mile Portage, an aboriginal trail which linked the head of Kempenfelt Bay with Willow Creek, a tributary of the Nottawasaga River that, in turn, flowed into Georgian Bay. The portage trail was important in for early Euro-Canadian voyageurs and settlers, but became crucial to the transport of troops and supplies to and from Fort Willow and Georgian Bay during the War of 1812 (Frim 2002: 50). The head of Kempenfelt Bay (the future location of Barrie)I, the starting point of the Nine-Mile Portage route, thus became an important supply depot for the British forces during the war.

The first, albeit temporary, resident of Barrie was Sir George Head, a British military officer that was in charge of developing a naval base at Penetanguishene during the war. He moved to Kempenfelt Village in 1815, later moving to Barrie where he built the first dwelling on the site, a log home. The first permanent resident was Alexander Webster who arrived in 1825, settling in a building later used as a barn. The second resident David Edgar, chose to reside in abandoned military supply depot (Frim 2002: 51).

The first businesses in Barrie were two taverns, at a time when a mere thirty people occupied the area. By 1832 Barrie's first store was opened in a shanty which had once housed settlers arriving along the Nine-Mile Portage. In the same year William Hawkins began surveying the land for town lots (Frim 2002: 52). The first streets in the town, reflecting its British military presence, were named after British officers: Collier, Bayfield, Owen and Poyntz (www.downtownbarrie.ca 2007). Likewise, shortly after the survey was completed, the town was named Barrie in 1833 after Sir Robert Barrie, the admiral in command of the naval forces in Canada (1818-1835).

Barrie became the county town of Simcoe in 1837, over the competing villages of Kempenfelt and Tollendal, however, it did not function in this capacity until 1843, when the County of Simcoe was fully established as a new district (Frim 2002: 53). This was the impetus for rapid expansion within the town during the 1840s. The county courthouse and accompanying jail was erected in 1842, and the first school was built in 1849. A brewery, tanning company, flour mill, woolen mill, and a lumber company were also established during the mid-1800s. Barrie continued to expand through the export of local resources, particularly once the railway was extended to connect the town to York in 1867. Trees were logged and shipped out, to be used as the masts for British ships, the largest of which, 118 feet long, was obtained in Innisfil (Hunter 1998 [1909] I: 323). In the winter huge blocks of ice were cut from Kempenfelt Bay and shipped to Toronto, New York, and Buffalo for refrigeration (www.tourismbarrie.com 2010).

Many of the historic buildings were destroyed by fires in the 1870s and 1880s. One such fire destroyed the entire north side of Dunlop Street from Bayfield to Owen. This led to a prohibition in the construction of wooden-sided buildings downtown, therefore indirectly leading to the brick streetscape still apparent today (www.downtownbarrie.ca 2007).

Other Communities. Other historic communities in Innisfil in close proximity to the project area include Thornton, Killyleagh, Churchill, Vine and Innisfil.

1.3.4 Study Area Specific History

Lot 6, Concession 5. The patent for Lot 6, Concession 5 in the Geographic Township of Innisfil (now Town of Innisfil), totaling 200 acres, was first granted by the Crown to James Scroggie, Jr. in August 1865. The Scroggie family had immigrated to Canada from County Sligo, Ireland sometime between 1832 and 1835. They arrived in Lower Canada (Quebec) with two other families with the last names of Grey and Sharpe. Initially settling on farms near the town of Rawdon (now in the Regional Municipality of Matawinie in Quebec), the land proved unproductive. The three families set out for the Township of Innisfil in Upper Canada, where they settled in the sixth concession. James Scroggie became the first post office administrator (Innisfil Township Council 1951:96).

It is not known whether the first owner of the Lot 6, Concession 5, identified as James Scroggie, Jr., was the James Scroggie, the elder, who had emigrated from Ireland to Canada or his son, James Scroggie, or his grandson, James H. Scroggie, all who resided in the Township of Innisfil when the patent for Lot 6, Concession 5 was first issued. A search of the historical record in Ireland revealed that aside from his father and grandfather being named James, James H.'s great grandfather and great great grandfather were also called James. Nonetheless, James Scroggie, James H.'s grandfather, the family patriarch who brought the Scroggie family to Canada, was born in Killyleagh, County Sligo, Ireland about 1790 to James Scroggie and Mary Irwin. James married his first wife, Prudence Ferguson, on January 2, 1810 in County Down, Ireland. Together they would have at least six children. Prudence died on January 10, 1825 in Ireland. James remarried in Ireland to Agnes Hamilton sometime between 1825 and 1832. Together they would have at least two children. Agnes died in Rawdon, Lower Canada on September 30, 1835. James never remarried. Upon moving to the Township of Innisfil, James settled his family on Lot 4, Concession 6, where he farmed.

James' son, James, was born in Killincy, County Down, Ireland on August 22, 1819. James was married in Ireland to Margaret Blackstock and together they had at least twelve children. Like his father, James was also a farmer. James was the father of James H. Although the Scroggie family are considered one of the earliest families to settle in the Township of Innisfil and a plethora of information exists in the historical record regarding some of its members and achievements, little information could be found about James H. Scroggie in the documents consulted, including census data, birth, baptism, marriage, and death certificates, tax assessment rolls, and township papers. James H. died

at the age of 21. On March 26, 1866, James Scroggie sold the north half and the southeast quarter of the property, totaling 150 acres, to the Reverend William McKee of Gwillimbury for $800.

The Reverend William McKee was born in Drumbo, County Down, Ireland in 1821. William served as the minister of the Presbyterian Church in West Gwillimbury from 1857 to 1871 and school inspector from 1871 to 1881. It is unlikely that the Reverend William McKee ever lived on the property as his main residence was just outside of Bradford. On January 3, 1873, the Reverend William McKee sold the property to a Francis S. B. Unfortunately the last name is illegible in the land registry documents for the property and it may be "Wood." A search for a resident in the township by the name Francis S. B. Wood did not produce any results. Nonetheless, the property, including the project area, was sold to Richard Hill of Innisfil on January 17, 1887.

Richard Hill was born in the Township of Tecumseh, Upper Canada, on June 6, 1829 and was a farmer. Together, Richard and his wife, Priscilla, had at least ten children. According to his death certificate, at the time of his death, on October 8, 1908, Richard resided on nearby Lot 5, Concession 3 in the Township of Innisfil. Based on the 1901 Census of Canada, at the time, he was living with his son, Maurice, who had taken over the farm from his father. After his death the north half and southeast quarter of Lot 6, Concession 5 was sold to William Reynolds and George Reed, both farmers in the Township.

The owner, nor any buildings are identified on Lot 6, Concession 5 in the 1881 *Illustrated Historical Atlas of the County of Simcoe, Ont. (*H. Belden & Co. 1881). Today, the north half and southeast quarter of Lot 6, Concession 5, including the project area, is largely forested. It is likely that the property had never been utilized for agricultural pursuits, nor is there any evidence in the historical documents to suggest that it had been occupied until the latter half of the twentieth century.

Lot 7, Concession 5. The original patent for Lot 7, Concession 5, totaling 200 acres, was first granted by the Crown to George McGinniss, Jr. of Amherst Island on July 28, 1829. The property changed hands between investors and speculators several times throughout the first half of the nineteenth century, including Simon Washburn and George Munro of York and John Torrance of Montreal. Edward Houghton of Innisfill acquired the property from Allan Neil McLean on November 2, 1862. Unfortunately no information could be found on the Houghton family, including derivations of the spelling or misspellings, including Haughton and Naughton. On March 1, 1888, John A. Houghton sold the north half of the property, including the project area, to Adelaide Smith, wife of John Smith.

John and Adelaide Smith arrived in the Township of Innisfil in 1888, settling in the fourth concession, where they farmed. Little else is known about the Smiths. On November 9, 1893, they sold the north half of Lot 7, Concession 5 to William Rogerson. William's father, James was from Lochmaben, Scotland and arrived in Canada in 1831, where he began to build the family homestead on Lot 19, Concession 2 in the Township of Innisfil. James' family arrived the following year from Scotland to join him. James passed away in 1850 and his family, comprising his wife, and ten children, continued to farm.

William was the youngest child, born in Innisfil around 1842 (Innisfil Township Council 1951:92). William married Sarah Roberston and together they had at least seven children. William continued to farm until his death in 1926. William's farm was located on Lot 21, Concession 4. On March 2, 1912, William sold the north half of Lot 7, Concession 5 to Andrew Crawford. Today, much of the north half of Lot 7, Concession 5 is forested for the exception of the northwest corner and a strip along the eastern edge, which remains active agricultural fields. There is no evidence in the historical record to indicate that the north half of the property, including the project area, was ever settled.

Lot 6, Concession 6. The original patent for Lot 6, Concession 6, totaling 200 acres, was first granted by the Crown to James Pearson of Whitchurch (near Stouffville) on May 2, 1820. On October 7, 1822, James Pearson sold the property to Amos West of West Gwillinbury for £300. On July 3, 1830, Amos West sold the property to Oliver P. West of West Gwillinbury, but the property was returned to Amos West in 1843 after Oliver P. West failed to pay his taxes. Upon Amos West's death, the deed was transferred to Sylvia and Robert Playter, who in turn sold the property to Richard Vanderburgh on July 29, 1858. Until 1858, there is no evidence within the historical record to suggest that Lot 6, Concession 6 had been occupied. After Richard Vanderburgh acquired the property, he immediately sold it to his son, John Vanderburgh.

John Vanderburgh settled Lot 6, Concession 6, where he farmed until his death in 1904, when the property was inherited by his son, John Sibbley Vanderburgh. Although John, Sr. acquired the property in 1858, he continued to reside on his nearby parent's farm until at least 1861. John Vanderburgh, Sr. was born in Richmond Hill on October 7, 1830. On January 30, 1862, John married Jane Wright and together they would have at least nine children. John Sibbley Vanderburgh was born on September 23, 1882 and after his father's death he continued to work the family farm with his mother. John Sibbley Vanderburgh died on June 18, 1916 from heart failure. He never married. Upon his death, ownership of the property passed to his sister, Clarissa.

Today, the majority of the south half of the property, including the project area, is comprised of active agricultural fields. Lot 6, Concession 6 remains forested near the centre of the property and in the southwest corner. Although the Vanderburgh homestead is no longer standing, a cattle shed and silo are found nearby along 6th Line road.

Lot 7, Concession 6. The original patent for Lot 7, Concession 6, totaling 200 acres, was first granted by the Crown to Mary Ann Hopper of Indiana in the United States on July 28, 1829. The property changed hands among investors and speculators throughout much of the first half of the nineteenth century. It was finally purchased by Robert Little from Thomas Perkins of York on June 2, 1853.

Robert Little was born in Scotland on May 28, 1828. In 1846, Robert traveled alone to Canada, where he settled in the Township of Innisfil. Robert married Susannah Cross after he arrived in the Township. Robert built his homestead on Lot 7, Concession 6, initially building his first house out of pine logs. The location of this first house in unknown. Robert and Susannah had eight children and together they farmed the property (Innisfil Township Council 1951:67). Robert sold the property to an individual from Toronto (John, last name illegible) on July 17, 1890, who in turn immediately sold it to William McKnight.

William McKnight was born in Ireland around 1835. Married to Catherine, together they had at least seven children. The McKnight family originally farmed in the Township of Essa, but moved to Innisfil after acquiring the property from Robert Little. After William's death in 1905, his son, John, took over the farm. Today, for the exception of the northern boundary, which is forested, the property is comprised of active agricultural fields and pasture. A cattle farm now occupies the property near the east property boundary, approximately 360 m north of the 6th Line road. The farm consists of two cattle barns, a cattle shed, and farmhouse, which is possibly abandoned given its state of repair that is visible from the road.

1.3.6 Summary

Background research conducted for this project illustrated that the study area had been occupied for thousands of years by various First Nations group. It is specifically the ancestral territory of the Huron-Wendat which was utilized by the Seneca and Ojibway Nations for hunting and various resource procurement.

The land registries, census records and historic maps show that this area was mainly rural agricultural with a low level of occupancy throughout the eighteenth and nineteenth centuries. The land registry information, census records and historic map show that this area was settled at a relatively early date, during the initial settlement of the township and county, in the early eighteenth century.

1.4 Archaeological Context

1.4.1 Current Conditions

The project area straddles Highway 400 and 6th Line and includes the road right-of-ways, shallow ditches and gravel shoulders. The majority of the study area was comprised of undulating agricultural fields with associated outbuildings (house, barn, stables, drive sheds) and lightly wooded areas. Primarily secondary growth vegetation was noted. This included willow, staghorn sumac, birch, elm, Queen Anne's lace, common yarrow, dandelion, vetch, purple loosestrife, bladder campion, oxeye daisy, butter and eggs, dog strangling vine, alfalfa, wheat, oats.

Maps and orthographic images were provided to CAGI for the purposes of this assessment. Site conditions are delineated on Map 10 and photographs can be found in Section 9.0.

1.4.2 Physiography

The assessment of physical and environmental conditions of a region is important to the analysis of past human settlement behavior as well as for the interpretation of features and site patterns on the landscape. The cultural development of every society is strongly influenced by the surrounding natural environment which provides a finite set of resources that humans use to fulfill a variety of needs. Geomorphology, soils, water sources, climate, and vegetation are all significant factors in understanding patterns on the landscape. Changes in the landscape over time influences the types of cultural materials found during an archaeological assessment as well as their visibility.

Location. The project area is located in Simcoe County which is situated within south-central Ontario between Georgian Bay and Lake Simcoe. It is bounded to the south by Peel County, to the southwest by Dufferin County, to the west by Grey County and Nottawasaga and Georgian Bays, to the north by the District of Muskoka, to the east by Ontario County and to the southeast by York County. Innisfil Township is located within the southern portion of the county and is situated on the south shore of Kempenfeldt Bay on Lake Simcoe (Image 1).

Glacial History and Geomorphology. Landscape features seen today are the result of the most recent period of glaciation. Beginning with the Illinoian glacier and ending with the Wisconsinan, the ice masses advanced as far south as Ohio and as far east as the continental shelf edges. The first interstadial period, the Sangamonian, witnessed ice retreat of the Illinoian glacier as far north as

Hudson Bay. At this time, Easton (1992) posits that global temperatures were warmer or similar to that which we experience today. This period extended until approximately 75,000 years BP with the onset of the Wisconsinan glaciation.

The Wisconsinan glaciation is characterized by a series of advances (stadials) and retreats (interstadials), scouring, transporting and depositing surface materials across Ontario. Seven major stadials and six interstadials, along with several minor phases, have been recorded (Table 2).

Table 2. Major stadial and interstadial periods, including timelines and features, of the Wisconsinan glaciation (taken from Remmel 2009:20-23).

Period	Stadial / Interstadial	Years BP	Feature / s
Nicolet	Stadial	70,000	-blocked the St. Lawrence River -caused water to dam into Lake Scaborough -created the Scarborough Bluffs
St. Pierre	Interstadial	67,000	-St. Lawrence River is free of ice -Great Lakes waters drain towards the Atlantic Ocean
Guildwood	Stadial	55,000	-ice covers all of Ontario and extends into northern US
Port Talbot	Interstadial	48,000-36,000	-two warm intervals separated by a cold phase -palynological studies indicate boreal tree taxa -meltwaters drain through present-day New York
Cherrytree	Stadial	35,000-28,000	-ice sheet covers most of Southern Ontario -formation of Glacial Lake Thorncliffe
Plum Point	Interstadial	27,000	-ice retreats across Ontario
Nissouri	Stadial	20,000	-ice sheet reaches maximum extent
Erie	Interstadial	15,000	-ice retreats -Lake Erie drains eastward through the St. Lawrence River
Port Bruce	Stadial	14,000	-ice advances across Ontario and into US
Mackinaw	Interstadial	13,000	-ice retreat causes spliting of ice lobes -split exposes a dome of higher land called Ontario Island -Proglacial Lakes Arkona I, II, and III form at southern ice margins
Port Huron	Stadial	12,900	-short-lived advance -Glacial Lakes Lake Whittlesey, Warren I, Warren II, Wayne and Warren III form
North Bay	Interstadial	11,840-8,100	-warmer climate -ice retreats across Canadian Shield -drainage flows east -formation of Glacial Lake Grassmere
Driftwood	Stadial	8,200-8,100	-deposition of clay tills in the Lake Barlow-Ojibway region -about 8,000 Glacial Lakes Ojibway and Agassiz catastrophically drain into Hudson Bay

The North Bay Interstadial, as it retreated across the landscape, exposed our project area.

Retreat during this phase was quite rapid and a number of post glacial lakes developed as a result of meltwater flow and drainage, ice dams and glacial deposits (i.e., Lake Algonquin, Lake Iroquois, Lake Erie and the Champlain Sea). Consequently, substantial areas would have been inundated by the copious flow of meltwaters at elevations well above modern sea levels before the formation of drainage outlets. Three major drainage outlets formed during this period: the Kirkfield Outlet (~11,500 BP) which drained Lake Algonquin into Lake Iroquois across the Kawarthas; the Fossmill Outlet (~10,800) which drained Lake Algonquin into the Champlain Sea to the Atlantic Ocean through Algonquin Park by way of the Petawawa and Barron Rivers; and, the Mattawa Outlet was exposed as the glacier receded northward and exposed lower outlets (~10,000) which continued to drain Lake Algonquin into the Champlain Sea via the Mattawa River (Chapman and Putnam 1984:25-39; Larsen 1987:19; and Kaszycki 1985).

As these glacial water sources drained, the zones created could have supported an extensive variety of animal, insect, bird, and vegetation species. Resource exploitation of these zones by early peoples is supported by the discovery of archaeological sites along the edges of ancient shorelines (palaeo-shorelines) across North America.

The project area lies within the Simcoe Uplands physiographic region. Characterized by a series of broad, curved ridges separated by steep-sided, flat-floored valleys, this region stands approximately 61 metres above the adjacent Simcoe Lowlands (Chapman and Putnam 1966:307). The total are this region encompasses is approximately 1,036 square kilometres and its sandy soils are usually well-drained, with low to moderate fertility. Although the origin of these ridges are still unknown, a number of theories have been posited. One theory suggests that the surface follows the bedrock topography which reflects paleo-stream valleys. Another is that the ridges are a result of glacial advancement and recession.

Palaeoecology. The last ice age completely disturbed vegetational patterns throughout the Eastern Ontario. Climatic warming marked an official end to the Pleistocene Period and caused an abrupt change in the composition of forests, woodlands and parklands south of the ice sheets.

With deglaciation, vegetation migrated northwards and different species populated the ice free margins. Palynological analysis of pollen grains (Pielou 1991; Remmel 2009:30; Wright 1964) illustrates that more diversified vegetation developed with slight differences noted between the west side of the continent and the lowlands and east side of the continent. Furthermore, the process of recolonization depended on the production rates of different species and their ability to grow on freshly exposed terrain which may have reduced pH levels (Matthews 1992:122). Initially, species more common to herbaceous tundra environs grew (i.e., herbs, mosses and lichens) followed by shrub tundra communities (i.e., sedges and small shrubs) and then to spruce (Picea ssp.) and poplar (Populus ssp.) woodlands. Warming temperatures also encouraged deciduous growth like hemlock and beech and also caused treelines to shift northward, terrestrial and marine species to increase their range northward, and in the mountains, caused the above to shift to higher elevations.

Taxa noted within the project area is today, not much different from that which it would have been thousands of years ago. The project area lies within the Northern Hardwood Forest, which is within the Great Lakes-St. Lawrence Forest ecoregion. This is a transitional forest which illustrates an overlap of northern needle-leaved trees and southern broad-leaved deciduous trees and produces a mosaic of various vegetative communities controlled by local climate and soils.

Climatic upheavals wrought diverse changes amongst terrestrial and marine animal and bird migration patterns and habitats. It may be assumed that mammals typically found today in these environments, would have been present during the late Pleistocene and early Holocene Periods in the project area (i.e., caribou, bear, fox, hare, chipmunk, squirrel, mouse, weasel, lemming, vole, moose, porcupine and bat) (Remmel 2009:32). Today, mammals such as black bear (*Ursus americanus*), moose (*Alces alces*), white-tailed deer (*Odocoileus virginianus*) and wolf (*Canis lycaon*) are commonly seen throughout the region. Furthermore, marine fossils in the vicinity of the former Champlain Sea indicate large mammals such as whale, walrus and seal inhabited the area during the open-water season (Chapman and Putnam 1984; Cronin 1977; Loring 1980). As these mammals would have migrated into the region following their food sources, it is also safe to assume that smaller marine life, whose skeletal existence may not have survived to become part of the archaeological record, were present.

Moreover, as the prevailing climate of the time would likely have meant that the Champlain Sea would have frozen over during the winter season, marine mammals would have been forced to migrate into the Gulf of St. Lawrence, where the waters were open. However, as hypothesized by Loring (1980:35), "local populations of belugas or seals might have been trapped in areas of open water surrounded by ice and would have been easily killed by hunters..." This suggests that marine as well as terrestrial exploitation of food resources would have been an important aspect of subsistence practices of the local indigenous populations. Therefore, the probability of at least a partial maritime-based economy in the region of the project area is high.

Physiography and Geology. The project area is located within the Mixed Wood Plains ecozone (Map 4). According to Natural Resources Canada (2011), the Mixed Wood Plains can be characterized by the following description:

> "... topography ranges from extremely flat areas in the southwest and southeast to rugged terrain of the Niagara Escarpment. Vegetation is diverse, characterized by mixed deciduous-evergreen forests and tolerant hardwood forests including those forests known as Carolinian forests. Alvars and tallgrass prairies also occur. Wetlands are numerous in certain areas, although many wetlands have been drained. Carolinian Canada (the most southerly portion of this ecozone) boasts the highest concentration of species in Canada. The number of species at risk is also high."

The entire project area is underlain with sedimentary strata from the Middle Ordovician period. The strata consists mostly of limestone, dolostone, shale, arkose and sandstone of the Ottawa Group, Simcoe Group and Shadow Lake Formations (Map 5). However, the western region of the county also includes chert formations.

One of the most common characteristics of Palaeoamerican material assemblages is the prevalence of cherts and similarities of lithic tools across wide ranging regions (Mason 1981, 1986; Goodyear 1989). Chert is a fine-grained, siliceous material which is easy to knap and therefore commonly used in the production of stone tools. In addition to chert use, quartz materials were also widely utilized, particularly in more northern regions or within the Canadian Shield, where quartz and quartzite materials were more locally available.

The project area is situated atop drumlinized till plains but the surrounding physiography encompasses five other main surficial geology types (Map 6). These include sand plains, peat and muck, drumlins, clay plains and kame moraines. These types are the result of glacial recession across the landscape and the deposition of various sand and gravel materials.

Soils. Soil, in terms of its morphological characteristics, is defined as unconsolidated surface material forming "natural bodies" made up of mineral and organic materials as well as the living matter within them. It is a dynamic entity with materials continually and simultaneously absorbed, released and transformed.

The formation of soils is heavily influenced by its parent material, climate, topography, bio-activity and time, however, it is mainly the combined effects of climate and living matter that convert a material to soil. For example, in moisture-rich environs, the dampness and rich vegetation may lead to deep, richly organic soils, good for agricultural production. However, in desert areas, where precipitation is low, the lack of moisture and vegetation may lead to sparse soil development and where soils exist, they may be thin and highly mineral. Furthermore, human disturbances such as grave sites, dwellings, agricultural activities and garbage dumps may also affect soil development, giving it other unique characteristics.

The soils of the project area are comprised of Guerin loam (Gul), Bondhead sandy loam (Bs) and Dundonald sandy loam (Ds) (Map 7) (Hoffman et al. 1962). The table below list the characteristics of each soil type found in the project area.

Table 3. Soil characteristics of the project area.

Soil Type	Topography	Drainage	Great Group
Guerin loam (Gul)	Smooth, moderately to steeply sloping	imperfect	Gray Brown Podzolic
Bondhead loam (Bs)	Smooth, moderately to steeply sloping	good	Gray Brown Podzolic
Dundonald sandy loam (Ds)	smooth to gently sloping	good	Gray Brown Podzolic

Soil Type	Topography	Drainage	Great Group
Smithfield silty clay loam (Smsc)	smooth to gently sloping	imperfect	Gray Brown Podzolic

Hydrology. The modern water courses we see today evolved as their ancestral waterways and their tributaries adjusted to the retreat of the Champlain Sea, and to a lesser degree, Lake Iroquois. During glacial melt and ice retreat at the end of the Pleistocene and beginning of the Holocene periods, there was a much larger flow of water through the project area than at present and on several occasions, rivers shifted into new channels. However, by approximately 8,000 years ago, modern drainage patterns were established (Kennedy 1970).

The project area is now located within the St. Lawrence watershed which is within the larger Atlantic Ocean drainage basin (Map 8) and is drained via a number of meandering waterways (Map 1; Image 1). Watersheds are typically defined by the topography of the surrounding landscape and includes such factors as shape, contours and elevations. They are comprised of streams, creeks, brooks, rivers, lakes, ponds, wetlands, estuaries, uplands, forests and meadows and also shorelines.

Present within, or within relative close vicinity to the project area today, are lakes (i.e., Lake Simcoe, Little Lake, etc.), rivers (i.e., Nottawasaga River, Mad River, Holland River, etc.), creeks and streams (i.e., Innisfil Creek, Lovers Creek, Wilson Creek, Bear Creek, Walkers Creek, Lisle Creek, etc.) and low-lying areas (i.e., wetlands, swamps, marshes) (Map 1).

Tributaries of the Nottawasaga and Holland Rivers were used to traverse the interior of the province prior to the construction of railways and roads. The potential for the discovery of archaeological resources increases drastically in particularly difficult areas along these routes, such as at rapids or chutes, where a portage was necessary. In addition, the shores of rivers and creeks were particularly attractive for temporary and semi-permanent settlement, especially in areas of the shore that were easily accessible by water. These areas were of particular interest, not only for their transportation value, but for access to potable water and foodstuffs, especially fish. The presence of secondary water sources, including permanently or seasonally inundated swamps, offered access to a variety of resources, including migratory birds, rice, and reeds for basket-making.

Climate. Modern climatic variation depends almost entirely upon location and human impacts on the environment. The project area, located in south-central Ontario, is influenced by the modifying factor of the Great Lakes; specifically Lake Huron. The Great Lakes tend to add moisture to the air in the autumn and winter in conjunction with protecting the region from the worst of the cold during the winter months, and during the spring and summer they act to moderate the temperature of the region. This produces an ideal environment for agricultural practices as the growing season tends to be longer and the cold months not as harsh as through the remainder of Canada.

1.4.3 Previous Archaeological Assessments

Archaeological research within southwest Ontario, close to the project area, is often limited to discoveries made during development activities. However, this does not necessarily reflect the known and unknown, yet unrecorded archaeological history of the area. Throughout the eighteenth, nineteenth and early twentieth centuries, as Euro-Canadian settlers and loggers penetrated the forests and lakes of the region, some would encounter and collect evidence of past First Nations

activities, in the form of stone and copper tools, or organic paraphernalia. This practice continued well into the twentieth century and is still carried out to this day by cottagers, tourists, and local residents, some who have amassed significant collections. Furthermore, there are oral references to evidence of pre-contact First Nations occupation made by the first Euro-Canadian settlers to the region, which sometimes results in sites being “recreationally” excavated by non-professional archaeologists.

With increased sensitivity towards the need to preserve cultural heritage within the Province, hundreds of archaeological projects have been recently undertaken within Ontario. Often initiated by development projects, including infrastructure development and improvement, subdivision applications, and construction activity, First Nations and early Euro-Canadian history of the region is being revealed.

A single Stage 1 Archaeological Assessment was conducted by Archaeological Services Inc. in 2015 on behalf of HDR Corporation for the Town of Innisfil. Entitled *Stage 1 Archaeological Assessment, 6th Line Class Environmental Assessment, Part A: 20 Sideroad to St. John’s Road, Town of Innisfil, County of Simcoe (Former Township of Innisfil, County of Simcoe), Ontario*, this report found areas of archaeological potential which are also included within the project currently being undertaken by CAGI (6th Line right-of-way and Highway 400 right-of-way). Further archaeological investigations were recommended (ASI 2015:i).

1.4.4 Registered Archaeological Sites

The Ontario Ministry of Tourism, Culture and Sport maintains a database (OASD) of all known registered archaeological sites in the Province. A search of the database within a one kilometre radius around the study area indicates the presence of one (1) archaeological site.

BbGv-46 is a pre-contact lithic scatter os 17 artifacts comprised of 12 lithic detritus, three utilized flakes and two bifaces. The site is located in an agricultural field and additional archaeological investigations were recommended by the archaeologist (Janusas 2007).

1.4.5 Historical Plaques

Aside from the presence of nearby registered archaeological sites, other indicators of the presence of extant archaeological remains are the proximity of historical plaques to the study area that commemorate important events in a region’s past, whether it be the birth of an individual, the site a specific battle, or the construction of a unique building. Generally, historical plaques and markers point to a specific locale on the landscape that can be visited by the public. Although plaques and markers may not be placed in the exact location that the event has occurred, generally it is in close proximity, taking into consideration access to the public. In Ontario, historical plaques may be erected by the federal government through the Historic Sites and Monuments Board of Canada (HSMBC), the Ontario Heritage Trust (OHT), and local heritage agencies or historical societies. There are no historical plaques located within the study area.

1.4.6 Summary

Archaeological and cultural heritage work conducted in this surrounding area has provided evidence of archaeological and historic structural remains. Furthermore, archaeological potential is increased by the proximity of known archaeological sites, specific topographic features (past and present water sources, presence of knappable lithic materials) and historic features (early settlement, historic concession road, historic buildings). All of these features increase the pre-contact and historic archaeological potential of the study area.

The project area retains archaeological potential based on these criteria alone.

2.0 FIELD METHODS

A property inspection was undertaken on July 19, 2016. The inspection was undertaken to determine if there were any areas of disturbance which would affect archaeological potential and to determine which survey strategies would be appropriate for a Stage 2 property survey, should one be required.

The site inspection covered most of the study area. Unfortunately, as portions of the study area were comprised of privately owned land, only those areas publicly accessible were visited. However, as the 6th Line and Highway 400 both traversed the project area, CAGI was able to visually assess the entire property.

The weather on July 19, 2016 was warm with some sun and an average temperature of 25^{o}C.

The property inspection started on Highway 400, at the southern end of the project area and moved northwards. After assessing the project area from the highway, CAGI moved to 6th Line. Starting at the eastern end of the project area, CAGI then moved in a westerly direction. A number of stops were made along the right-of-way to note vegetation, topography, soils, to make note of watercourses and disturbance and to take photographs of these physical characteristics. Topographic maps and orthographic images were examined to confirm if features of archaeological potential were present and if there were any areas of extensive disturbance which would have removed archaeological potential.

Through the course of the property inspection, no archaeological remains were noted within the proposed project area.

Field notes and photographs of the study areas were taken during the inspection by Laura McRae. Image locations and orientations were noted and are illustrated on the site conditions map (Map 9).

The archaeological assessment was carried out following project approval. Therefore, the Proponent was able to provide a schematic of the study area in advance of the stage 1 archaeological assessment. It was this plans and a .kmz file (google earth) that were used for base mapping of conditions and potential.

Table 4. Photo # and description.

Image #	Description
2	Corn field to the north of 6th Line and to the west of Highway 400. Viewing north.
3	Treed area to the south of 6th Line. Viewing southwest.
4	Treed area to the south of 6th Line and to the east of Highway 400. Viewing southeast.
5	Treed area to the south of 6th Line. Viewing east.
6	Watercourse to the north of 6th Line. This watercourse flows through the west portion of the project area. Viewing north.

Image #	Description
7	Viewing west along 6th Line to the overpass of Highway 400. Note the sloped right-of-ways to the north and south.
8	Viewing southwest into an alfalfa hay field to the south of 6th Line and to the west of Highway 400.
9	Viewing north from 6th Line into a freshly cut and baled hay field.
10	Viewing east along 6th Line to the east of Highway 400.
11	Viewing south along Highway 400.

3.0 ANALYSIS AND CONCLUSIONS

3.1 Archaeological Potential

Assigning levels of potential archaeological significance is employed by applying provincial environmental assessment guidelines (Weiler 1980). The information includes the identification and evaluation of any feature that has one or more of the following attributes:

- Potential can be determined via archaeological exploration, survey, or fieldwork. The information gleaned from these activities can provide answers to hypothesized questions (i.e., relate to particular times and places) regarding events and/or processes that occurred in the past, thereby adding to our knowledge and appreciation of history.

- Potential may be determined through archaeological exploration, survey, and fieldwork that may contribute to testing the validity of anthropological principles, cultural change and ecological adaptation, thereby contributing to the understanding and appreciation of our human-made heritage.

- The possibility that various technical, methodological, and theoretical advances might occur during archaeological investigation of a feature, alone or in association with other features exists. This therefore may contribute to the development of better scientific means of understanding and appreciating our human-made heritage.

The Ontario Ministry of Tourism, Culture and Sport also provide the *Archaeological Potential Checklist* which identifies land features that could indicate where archaeological resources are more likely to be located (Table 5).

Evaluating archaeological potential of an area involves the assessment of various criteria. The most common criteria used to evaluate archaeological potential relates to its physical setting which may include potable water sources, elevated landforms, and well-drained areas to which First Nations settlement was often oriented, as well as the presence of fertile soils suitable for cultivation.

Additional factors may include: the presence of known archaeological sites and whether they are located within a radius of 250 metres of the study area; the presence of watersources in the area (i.e., primary water source within 300 metres, secondary water source within 300 metres, ancient water source within 300 metres); the presence of elevated topography within or immediately adjacent to the project area; the presence of pockets of sandy soil within clay or rocky areas; the presence of particular land formations such as mounds, caverns, or waterfalls which may denote spiritual significance; the presence of resource rich areas such as primary, secondary, or ancient watersources, spawning fish, concentration of wild plants; the presence of Euro-Canadian colonization indicators such as cemeteries, standing structures; the presence of transportation routes within a 100 metres radius, such as portages, trails, colonization roads, railways, canals, harbours; whether the property has been designated a Heritage Property; and, that there is evidence from documentary sources, local knowledge, or oral histories concerning the property with historical events or activities.

Furthermore land registry and census records, historic maps, photographs, road and infrastructure plans and a property inspection all assist in determining historic archaeological potential.

Table 5. Checklist for determining archaeological potential.

	Feature of Archaeological Potential	Yes	No	NA	Comment
1	Known archaeological site within 250 m.	x			If Yes, potential determined.
	PHYSICAL FEATURES				
2	Is there water on or near the property?	x			If Yes, what kind of water?
2a	Primary water source within 300 m.		x		If Yes, potential determined
2b	Secondary water source within 300 m.	x			If Yes, potential determined
2c	Past water source within 300 m.			x	If Yes, potential determined
3	Elevated topography.		x		If Yes, and Yes for any of 4-9, potential determined
4	Pockets of sandy soil in a clay or rocky area.		x		If Yes, and Yes for any of 3, 5-9, potential determined
5	Distinctive land formations.		x		If Yes, and Yes for any of 3-4, 6-9, potential determined
	HISTORIC USE FEATURES				
6	Associated with food or scarce resource harvest areas.		x		If Yes, and Yes for any of 3-5, 7-9, potential determined
7	Indications of early Euro-Canadian settlement.	x			If Yes, and Yes for any of 3-6, 8-9, potential determined
8	Associated with historic transportation route within 100 m.	x			If Yes, and Yes for any of 3-7, 9, potential determined
9	Contains property designated under the Ontario Heritage Act.			x	If Yes, and Yes for any of 3-8, potential determined
	APPLICATION SPECIFIC INFORMATION				
10	Local knowledge.		x		If Yes, potential determined
11	Recent (post-1960) disturbance (confirmed extensive and intensive)	Some (roadways, etc.)			If Yes, no potential

3.2 Conclusions

Based on the above findings, archaeological potential can be derived from a number of sources within the project area. According to the above checklist, the project area does retain archaeological potential based on the presence of a watercourse, an historic transportation route and early Euro-Canadian settlement on L6C6. Therefore, although it was not possible to access the private properties within the study area, a Stage 2 property survey is recommended based on the above criteria. These areas are highlighted on Map 10.

4.0 RECOMMENDATIONS

Based on the background research and the results of the property inspection, none of the culvert locations have been determined to retain archaeological potential. The Stage 1 archaeological assessment has provided the basis for the following recommendations:

1) A Stage 2 archaeological assessment will be conducted by a licensed consultant archaeologist using the pedestrian survey method at 5 m intervals in areas along the corridor which have been recently ploughed and are in appropriate condition at the time of survey (as illustrated by the areas marked in orange on Map 10);

2) A Stage 2 archaeological assessment will be conducted by a licensed consultant archaeologist using the test pit survey method at 5 m intervals in all areas along the corridor which have not been recently ploughed or do not have appropriate conditions for pedestrian survey at the time of the Stage 2 assessment (as illustrated by the areas marked in yellow on Map 10);

3) No further archaeological assessments are recommended for areas which have been determined to be disturbed including the following intersections; Highway 400 and 6th Line (as illustrated by the areas marked in green on Map 10);

4) The Stage 2 archaeological assessment will follow the requirements set out in the 2011 Standards and Guidelines for Consultant Archaeologists (MTC 2011).

5) Notwithstanding the results and recommendations presented in this study, The Central Archaeology Group Inc. notes that no archaeological assessment, no matter how thorough or carefully completed, can necessarily predict, account for, or identify every form of isolated or deeply buried archaeological deposit. Therefore, in the event that archaeological remains are found during subsequent construction and development activities, the consultant archaeologist, approval authority, and the Cultural Programs Unit of the Ministry of Tourism, Culture and Sport should be immediately notified.

The MTCS is requested to review, and provide a letter indicating their satisfaction with, the results and recommendations presented herein, with regard to the 2011 Standards and Guidelines for Consultant Archaeologists and the terms and conditions for archaeological licenses, and to enter this report into the Ontario Public Register of Archaeological Reports.

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

This report is submitted to the Minister of Tourism and Culture as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act,* R.S.O. 1990, C. 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism, Culture and Sport, a letter will be issued by the ministry stating that there are no further concerns with regards to alterations to archaeological sites by the proposed development.

It is an offense under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeological Report referred to in Section 65.1 of the *Ontario Heritage Act*.

Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48 (1) of the *Ontario Heritage Act*.

The *Cemeteries Act,* R.S.O. 1990 C. 4 and the *Funeral, Burial and Cremation services Act,* 2002, S.O. 2002, C. 33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

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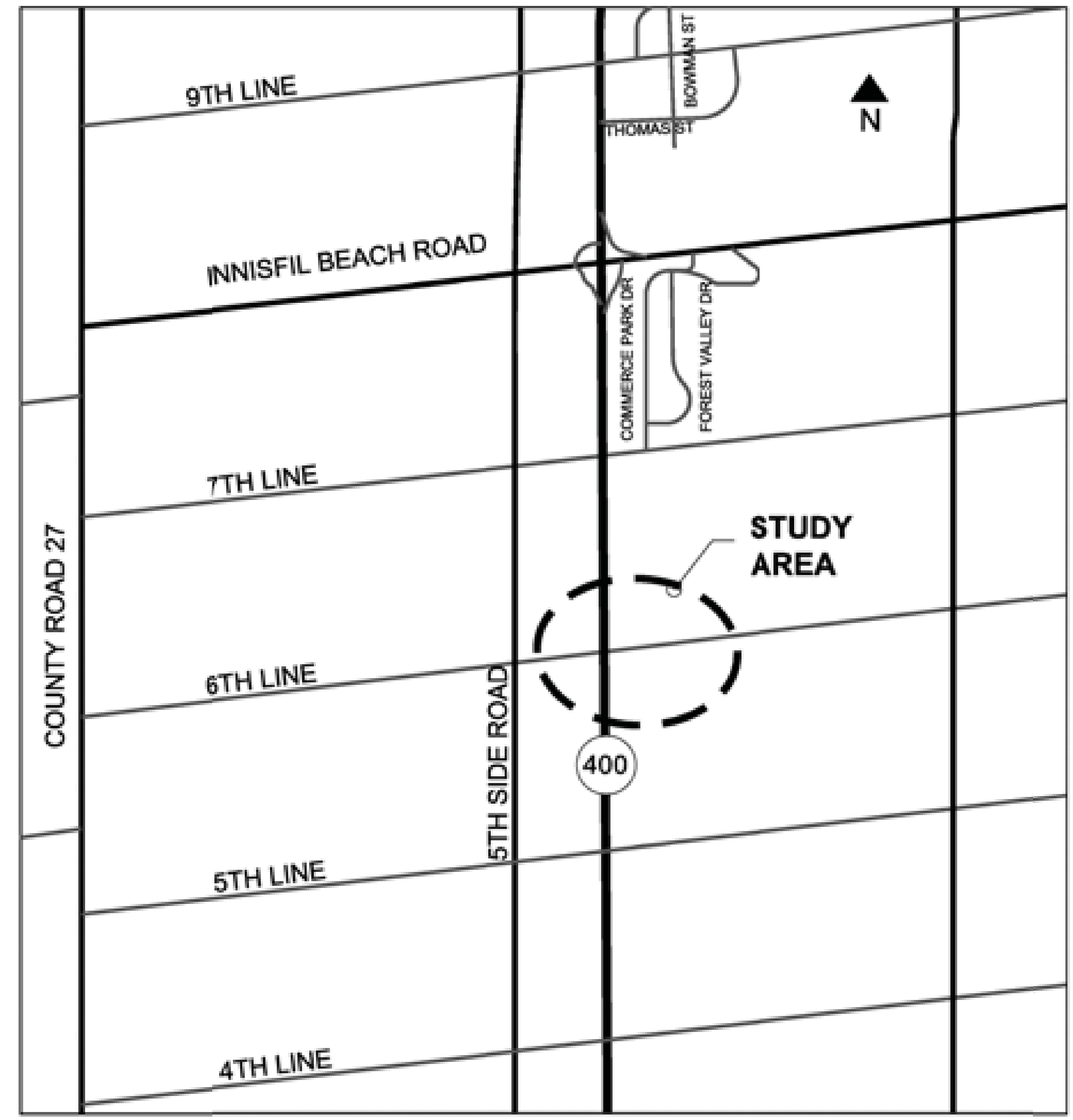
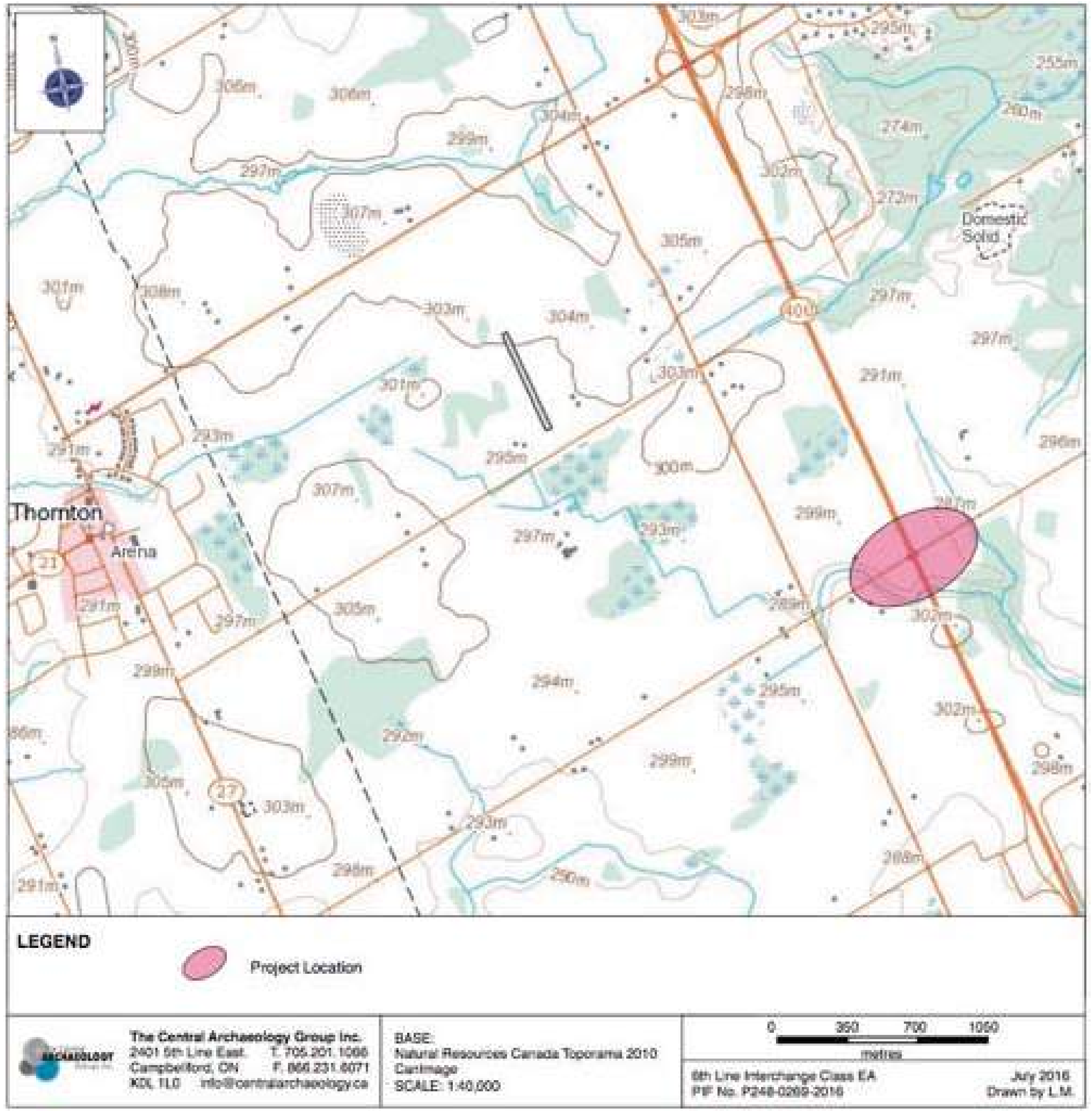
7.0 PLANS

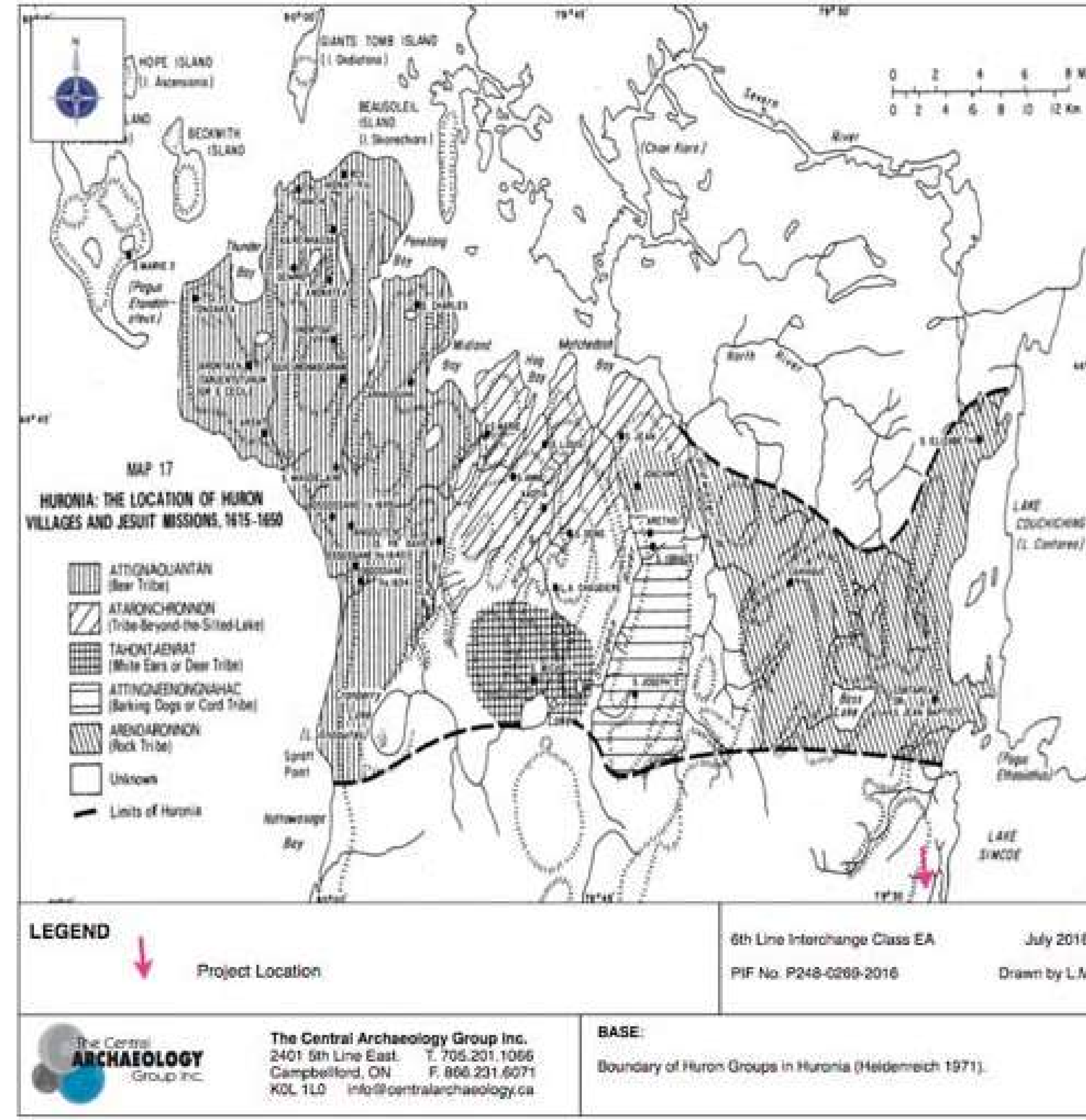


Plan 1. Schematic of the project area (courtesy of BT Engineering).

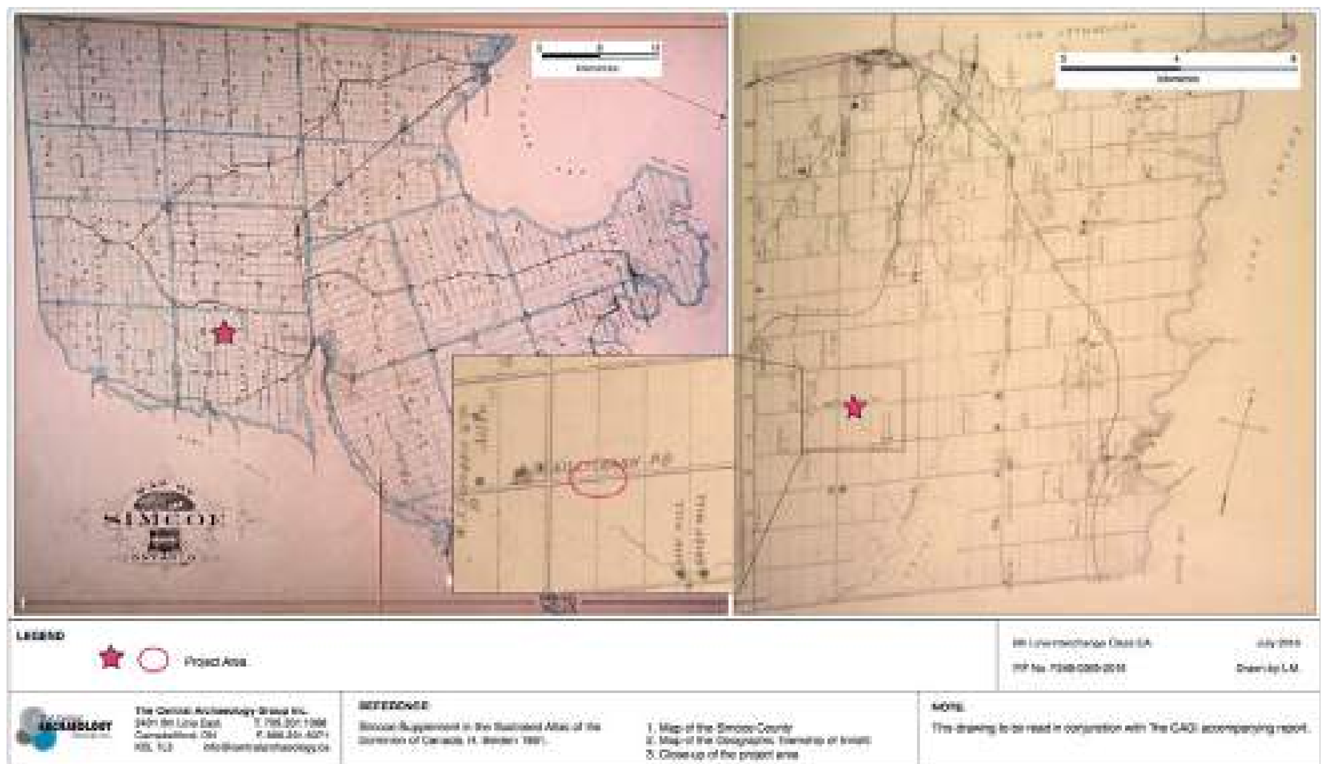
8.0 MAPS



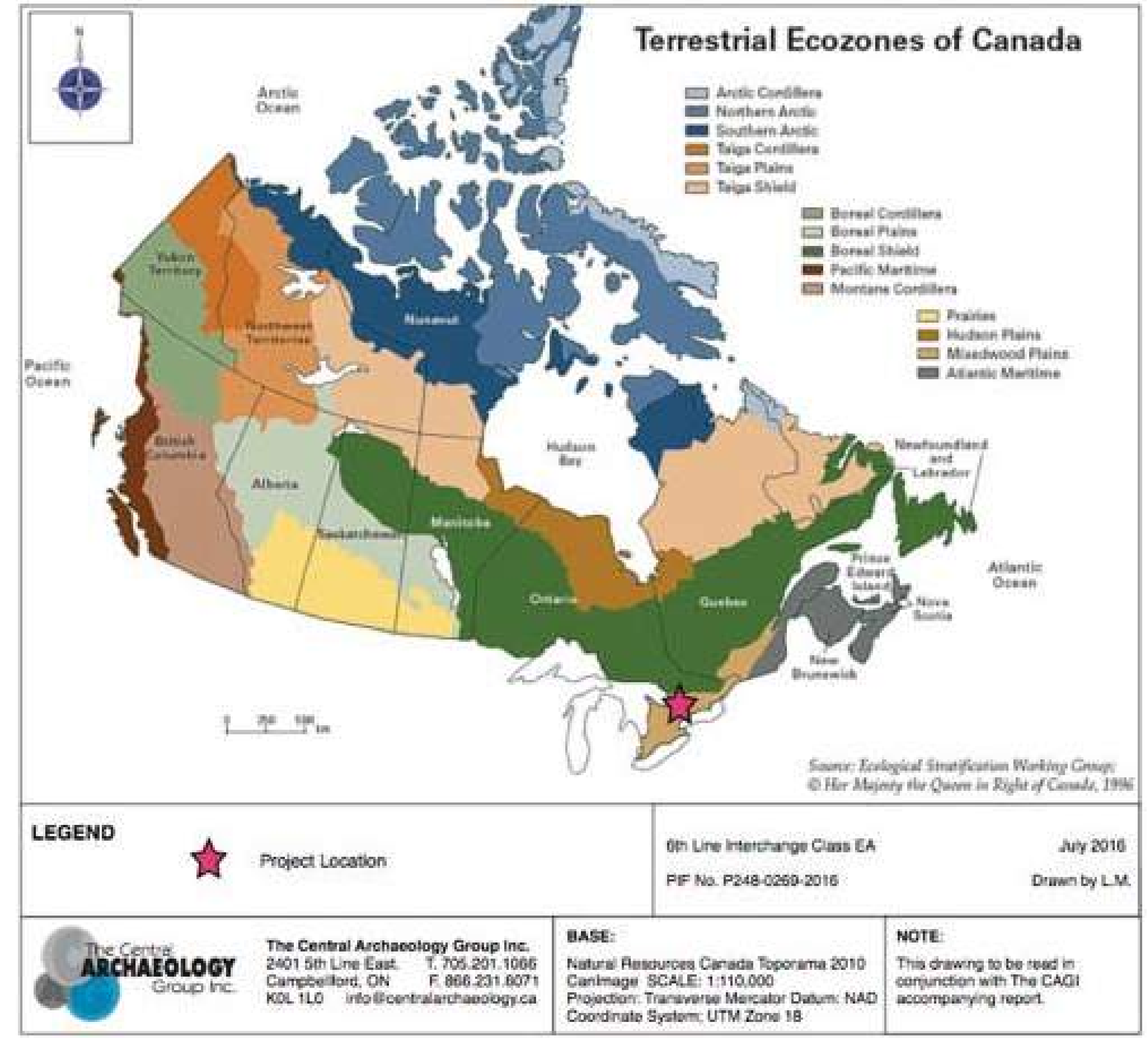
Map 1. Location of the project area.



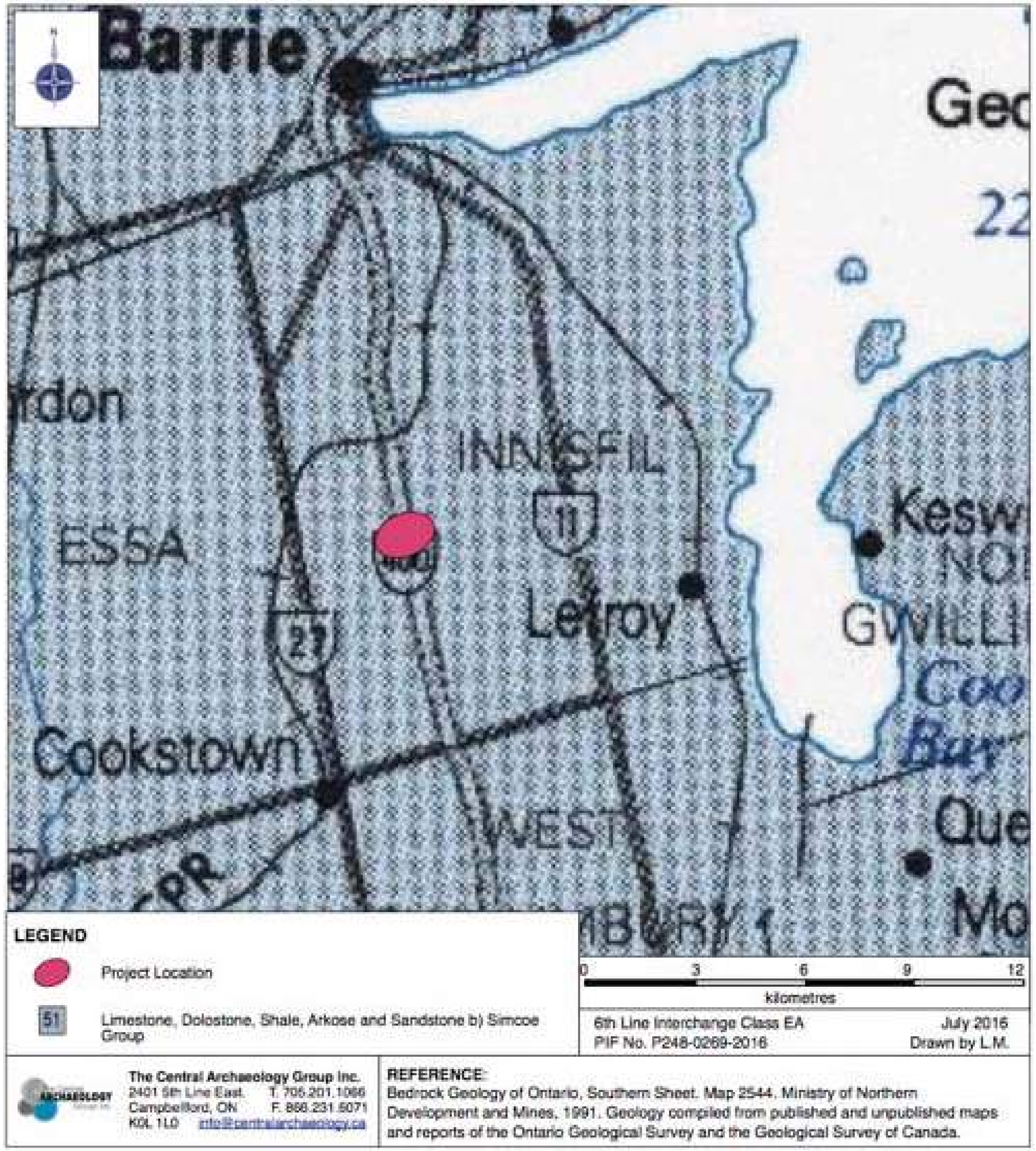
Map 2. Boundaries of Huronia (Heidenreich 1971).



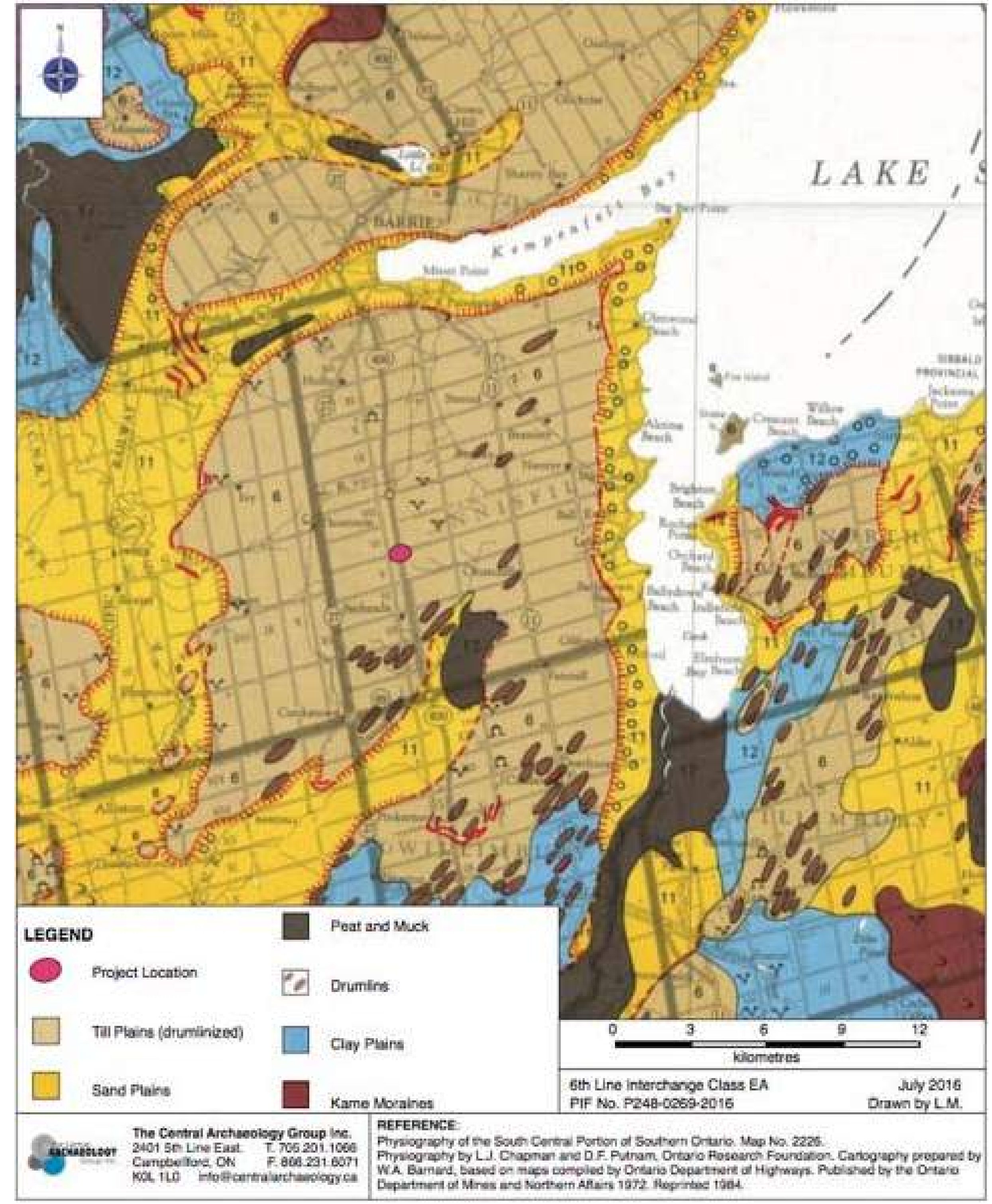
Map 3. Historical atlas maps of Simcoe County, the Geographic Township of Innisfil and a close up of the project area (Belden 1881).



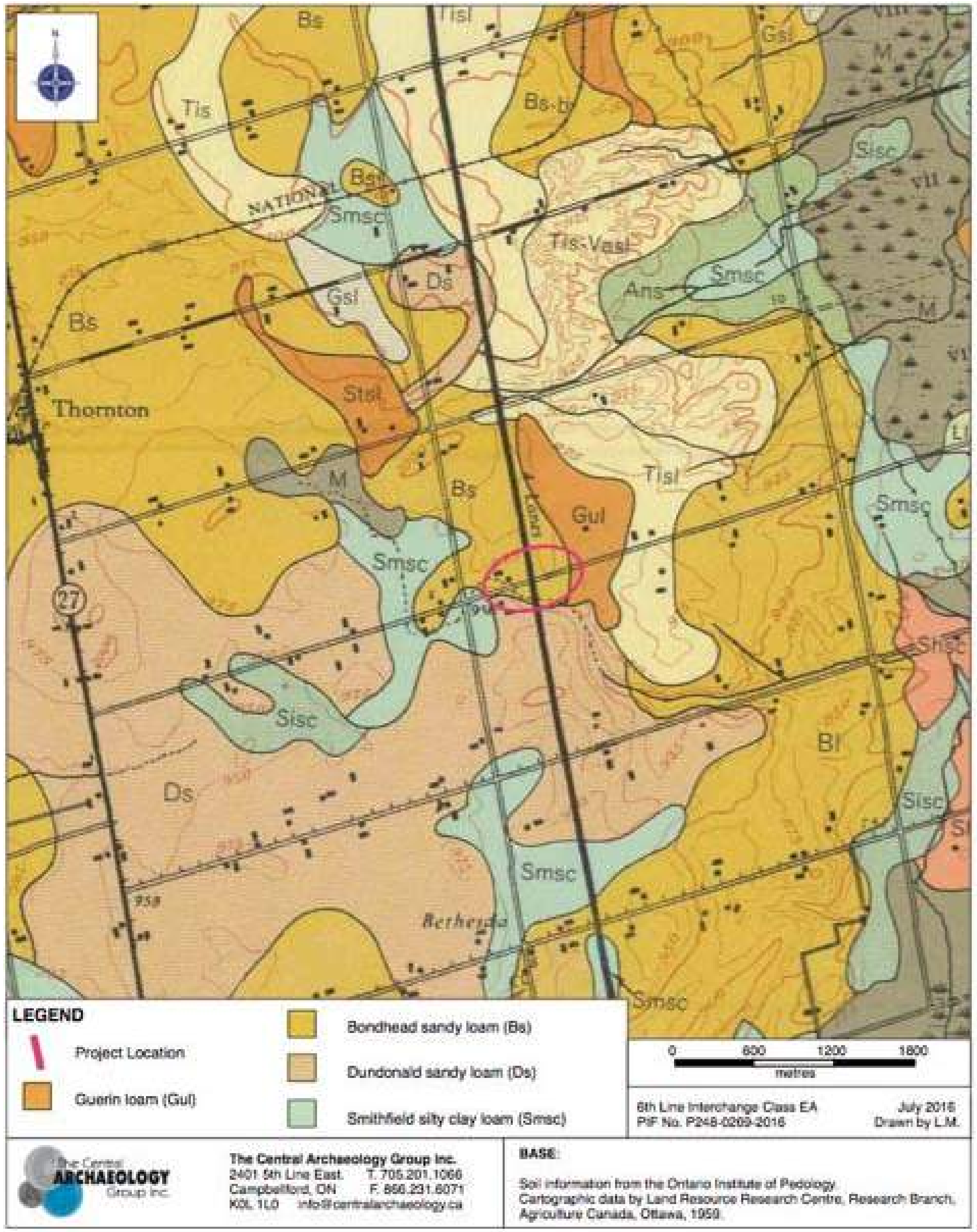
Map 4. Terrestrial ecozones of Canada (Ecological Stratification Working Group 1996).



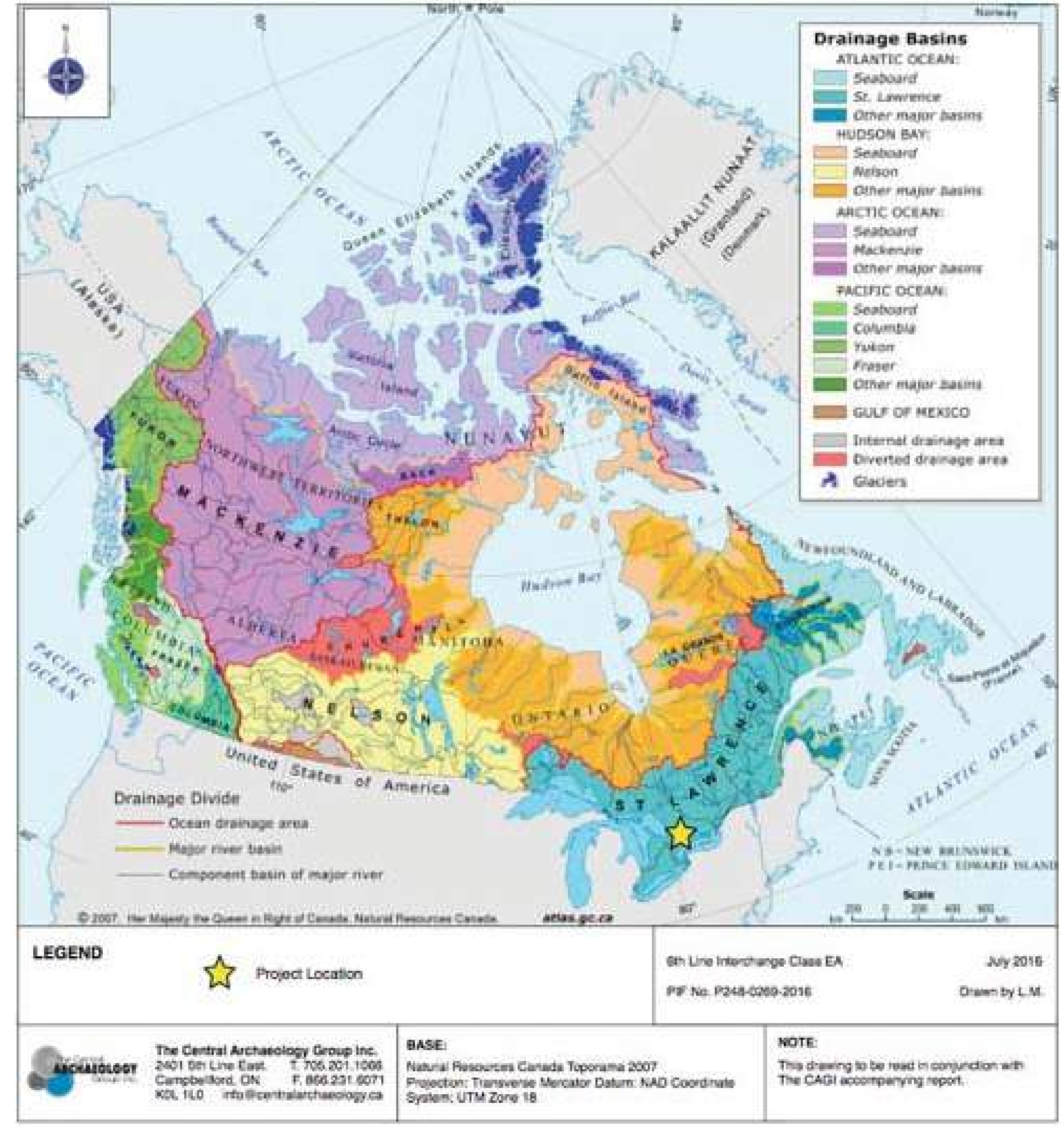
Map 5. Bedrock geology of the project and surrounding area.



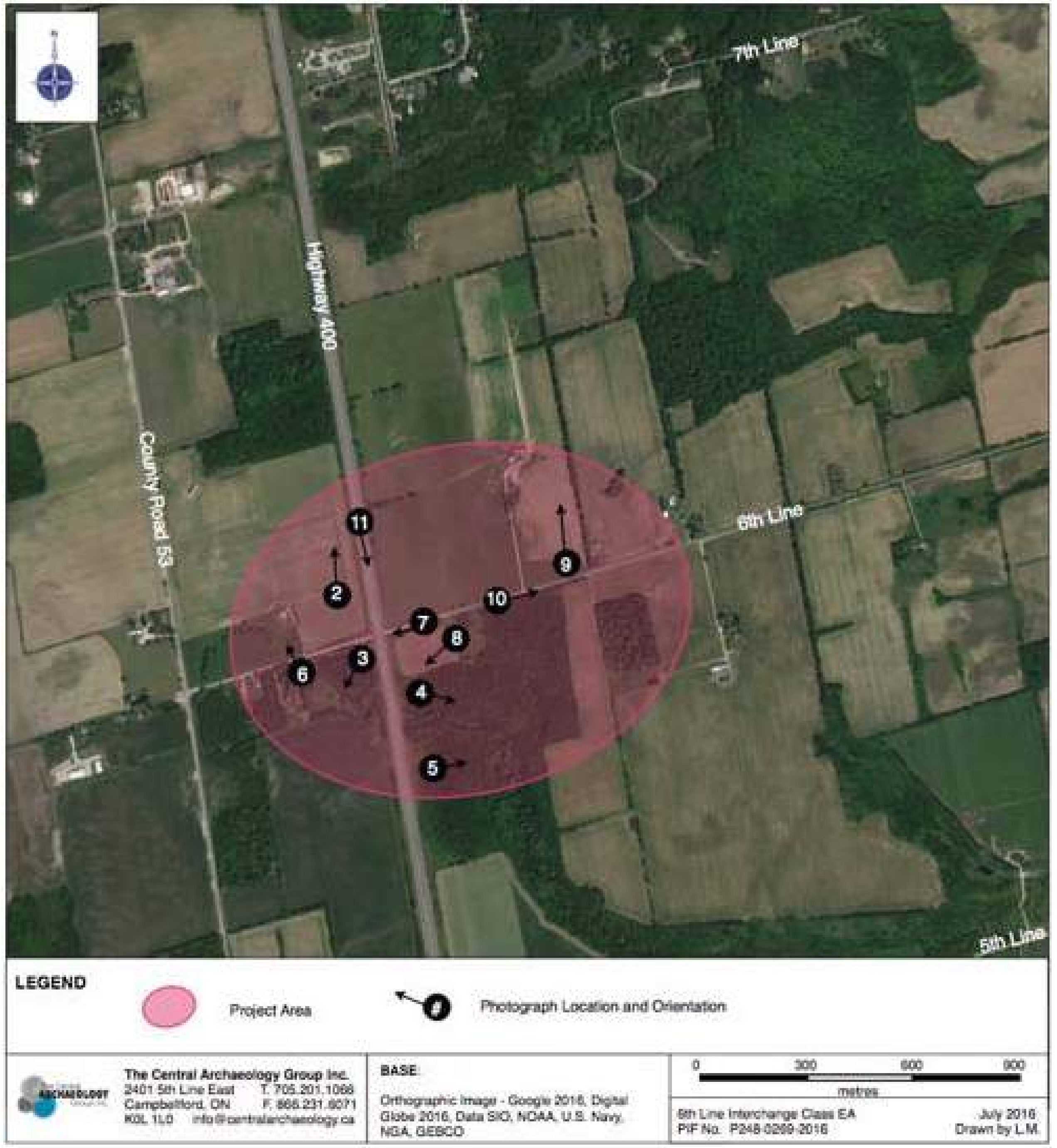
Map 6. Surficial geology of the project and surrounding area.



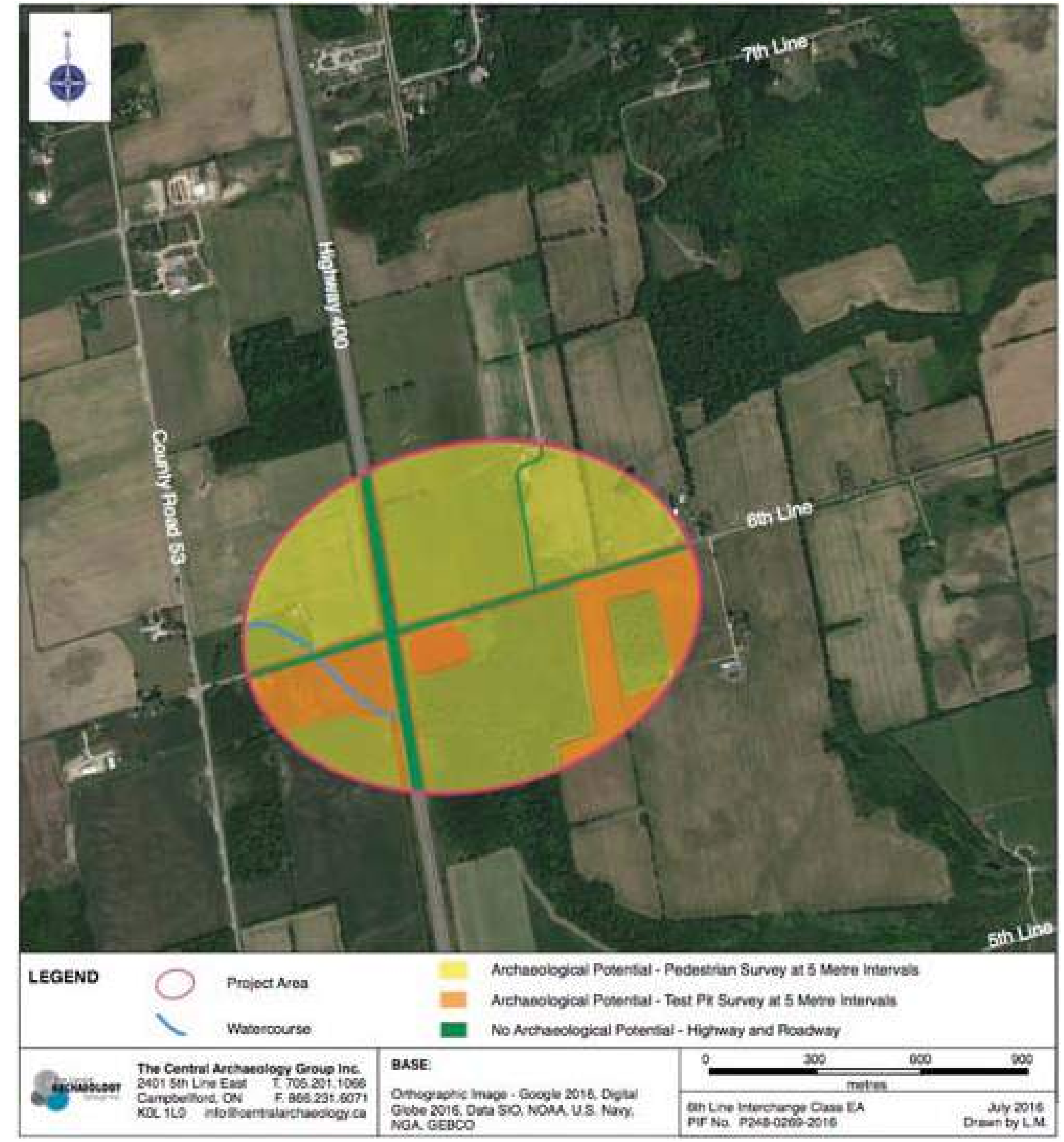
Map 7. Soil of the project and surrounding area.



Map 8. Watersheds of Canada.



Map 9. Site conditions.



Map 10. Archaeological potential.

9.0 IMAGES

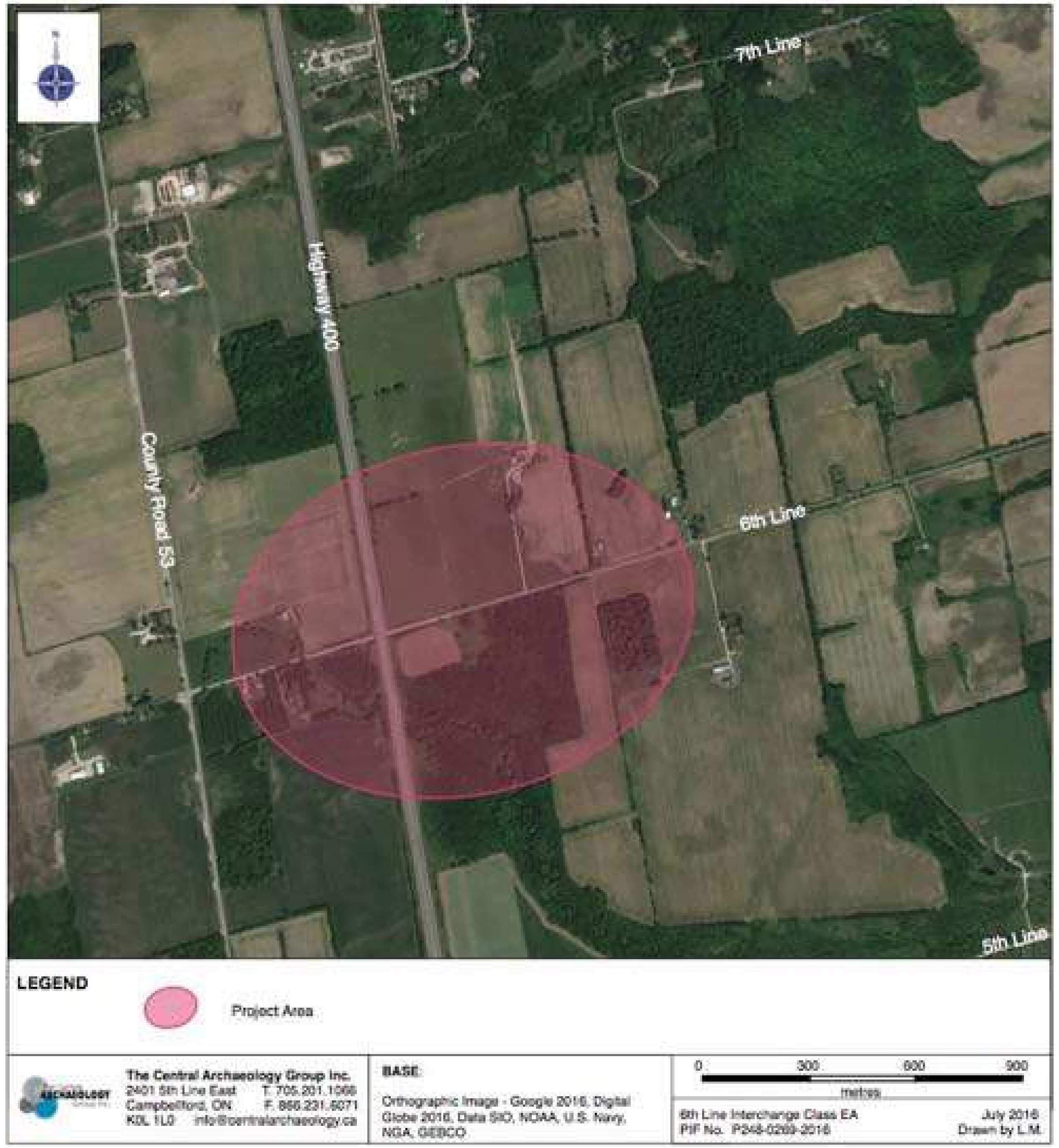


Image 1. Orthographic image of the project and surrounding area (Google Earth 2014).

6TH LINE INTERCHANGE CLASS EA, TOWN OF INNISFIL
STAGE 1 BACKGROUND STUDY
REPORT NO. CAGI-2016-LM4

Image 2

Image 3


Image 4


Image 5


Image 6


Image 7

Image 8

Image 9

Image 10

Image 11

10.0 GLOSSARY OF TERMS

A Horizon - mineral horizon at or near the ground surface (topsoil). May be dark brown due to accumulated humus (Ah) or grey or lighter brown when clay, iron and humus have been leached out (Ae). It is most commonly disturbed by human activities.

Archaeology - is the scientific study of the physical evidence of past human societies recovered through excavation.

Archaeological Site - is a place in which physical evidence of past human activity is preserved and which has been, or may be, investigated using the discipline of archaeology.

Archaic Period - in Ontario is characterized by the appearance of ground stone tools, notched or stemmed projectile points, the predominance of less extensively flaked stone tools, increased reliance on local chert resources, a lack of pottery and smoking pipes, and an increase in the numbers and sizes of sites.

Atlatl - a tool used to throw spears faster and with more accuracy. It consists of a short pole with a handle at one end and a hook for engaging the spear in the other.

B Horizon - below the A Horizon (subsoil). It could be enriched with iron (Bf), with iron and organic matter (Bhf), with organic matter (Bh) or with clay (Bt). If saturated for extended periods, B horizons show signs of gleying or mottling (Bfg, Btg, Bg).

Bioturbation - results in changes to the nature, form, and arrangement of archaeological deposits and sediments as a result of biological activity in the ground. This includes root action, animal activity, and the degeneration of organic matter.

BP - Before Present. Years before present (1950), used in dating sites and/or artifacts from an archaeological site.

Borden Number - a borden number is an identifier given to an archaeological site in Canada. It was created by Charles E. Borden and contains four letters and one to several numbers.

Burial Goods or Burial Paraphernalia - items interred with an individual (or group) burial that may give clues to their social and/or economic and/or political position within their culture.

Chert - is a fine-grained, sedimentary rock, similar to flint. In antiquity, chert was one of the universally preferred materials for making stone tools.

Contact Period - refers to the period when European and First Nations peoples were first exposed to one another. In Ontario from 450 BP to 200 BP.

Cultural Resources - are sites, structures, landscapes, and objects of particular importance to a culture or community.

Diagnostic - a distinguishing characteristic serving to identify or determine the artifact.

Disarticulated - this occurs when bones are found separated at the joints.

Disturbed - refers to a study area that has recently been excavated or altered from its original characteristics.

Ecozone - classification system that defines different parts of the environment with similar geography, vegetation, animals, climate, topography and water sources.

Environmental Assessment Act - sets up a process for reviewing the environmental impact of proposed activities prior to the granting of government funds.

Erratic - large rock or boulder that differs from the surrounding rock and is believed to have been transported a long distance as a result of glacial action.

Excavation - is the systematic digging and recording of an archaeological site.

Flake - is a fragment of stone removed from a core or from another flake.

Feature - is a collection of one or more contexts representing some human activity that has a vertical characteristic to it in relation to site stratigraphy.

Fluted - grooved or channeled. A fluted point is a projectile point which has had one or more long thinning flakes removed from the base along one or both faces.

Glaciofluvial - sediments laid down by glacial meltwater action (i.e., rivers or streams).

Ground Stone - is a stone artifact shaped by sawing, grinding, and/or polishing with abrasive materials.

Historic Period - the period when written records become available.

Holocene - the most recent period. Began approximately 10,000 years ago following the end of the Pleistocene.

Knap - to shape a piece of stone material by striking it at specific angles. Term used by archaeologists to denote the manufacture of a lithic tool.

Lanceolate - lance-shaped, much longer that wide, widened at or above the base and opening to the apex.

Lithic - stone, or made of stone.

Maize - also known as corn, is a cereal grain that was first domesticated in Mesoamerica and then spread throughout the American continents.

Mitigation - measures undertaken to limit the adverse impact of construction methods on archaeological sites or cultural resources.

Ochre - used as a natural pigment, colour is commonly reddish-brown to yellow.

Ontario Heritage Act - allows municipalities and the provincial government to designate individual properties and districts in Ontario as being of cultural heritage value or interest.

Palaeoamerican Period - first evidence of human occupation in Ontario. This period is characterized by groups hunting large game and seasonal occupation along shore environments.

Pleistocene - an epoch within the Quaternary Period which began approximately 2,000,000 millions years ago and ended approximately 10,000 years ago. Immediately preceded the Holocene Period.

Projectile Point - is an artifact used to tip an arrow, atlatl dart, spear, or harpoon. Usually made of chipped or ground stone, however, some are also made of copper.

Stage 1 Background Study - The purpose of a Stage 1 assessment is to investigate the cultural land use, archaeological history, and the present conditions of a property. The majority of the Stage 1 process is conducted in the office and involves the examination of records such as historic settlement maps, land titles, and documents, historical land use and ownership records, primary and secondary documentary sources, and the Ministry of Culture's archaeological site database. The study may also involve interviews with individuals who can provide information about the property and consultation with local First Nations communities. The background study is followed by a property inspection to examine geography, topography and current conditions, and to determine the potential for archaeological resources. Stage 1 background research is usually completed in conjunction with a Stage 2 property survey.

Stage 2 Property Survey - A Stage 2 property survey is undertaken if the Stage 1 background study finds that a property retains archaeological potential. It involves the documentation of archaeological resources by collecting artifacts and mapping cultural features. Depending on the nature of the property environment, two methods are employed in the survey: 1) pedestrian survey on cultivable properties, and; 2) test-pit survey on properties not cultivable due to tree growth, rock content, etc.

Strata - are layers of rock, soil, cultural material, etc. with internally consistent characteristics that distinguish contiguous.

Stratigraphy - the layering of deposits on archaeological sites. Cultural remains and natural sediments become buried over time, forming strata.

Subsistence - obtaining food and shelter necessary to support life.

Survey - is used to accurately determine the terrestrial or three-dimensional space position of points and the distances and angles between them.

Woodland Period - is a period of time following the Archaic Period. It is sub-divided into Early, Middle, and Late.

Appendix K
Bridge and Storm Sewer Review

TECHNICAL MEMORANDUM

TO: Steve Taylor, P.Eng.

FROM: John Stidwill, P.Eng. **DATE:** April 13, 2016

RE: **6th Line and Highway 400, Bridge and Storm Sewer Review**

1. INTRODUCTION

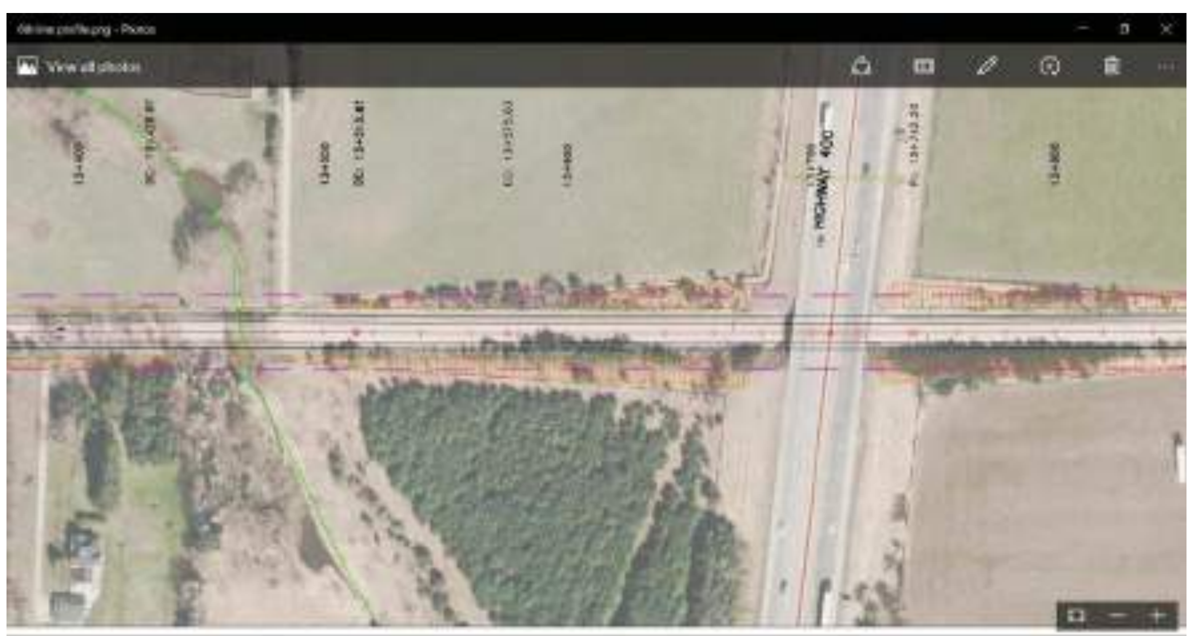
This memorandum presents the results of hydrologic and hydraulic analyses for a proposed storm sewer along 6th Line at Highway 400, Town of Innisfil, and culvert (Cul-01-08) sizing. The objective of this review is to confirm road grades at Highway 400 for a future bridge overpass (vertical clearance).

A previous draft ESR provided a preliminary road profile (year 2015) for the 6th Line.

2. LOCATION

The site location is illustrated in Figure 1.

Figure 1 – Site Location



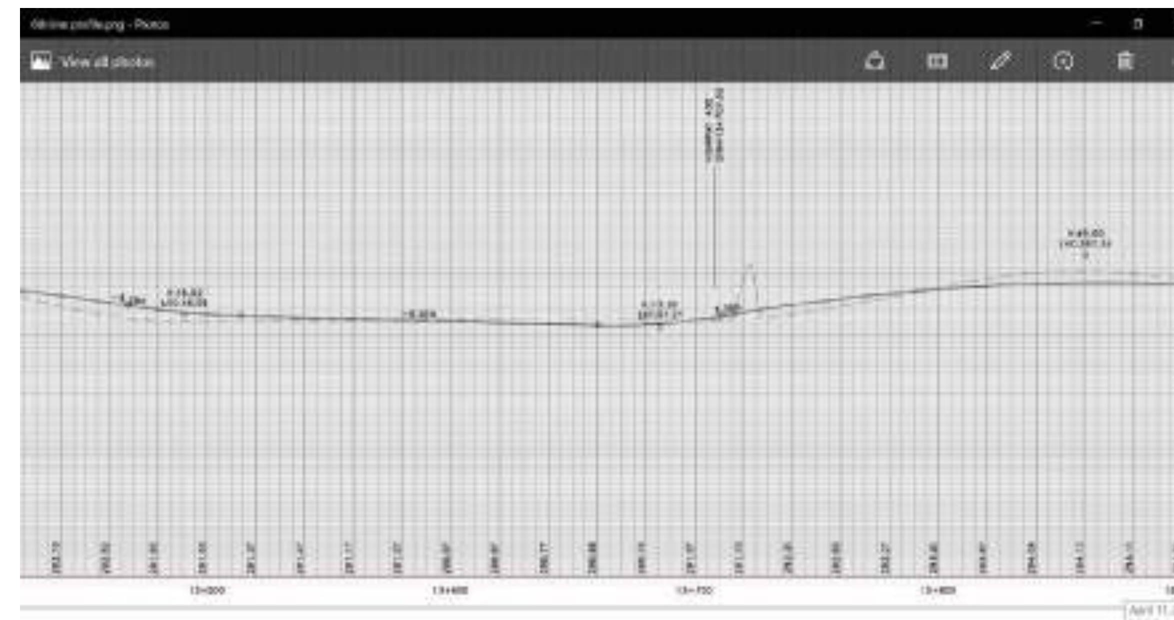
Points of reference from the 2015 draft preliminary 6th Line profile are:

- Cul-01-08, Distance 13+475 (+/-);

- Proposed road center line vertical curve sag point: Distance 13+660, elev. 290.68;
- Highway 400 north drainage ditch: Distance 13+687 (+/-); and
- Intersection of 6th Line and Highway 400: Distance 13+708 (+/-).

The 2015 draft 6th Line profile is illustrated in Figure 2.

Figure 2 – Draft ESR Preliminary 6th Line Profile



3. BACKGROUND INFORMATION

Background information, for existing hydrological parameters and culvert data, was obtained from:

- Highway 400 Interim Alignment Drainage Memorandum, AECOM, July 24, 2015; and
- Town of Innisfil 6th Line Municipal Class Environmental Assessment, Draft Stormwater Management Report, HDR, February 19, 2016.

Hydrological and culvert data are presented in Appendix A.

4. REVIEW CRITERIA

Table 1 outlines the criteria considered in this review.

Table 1 – Criteria

Parameter	Value	Comment
Storm Sewer System	10 year return period	MTO reference - Urban Arterial
Cul-01-08	50 year return period	1.0m freeboard to road edge
Rainfall Intensity		City of Barrie - rainfall curve, climate change modified
Sewer pipe velocity	0.8 m/s	Minimum value
Pipe slope	0.30%	Minimum pipe slope (Town standard)
Min. sewer pipe cover	1.5 m to spring line or	Higher of the two (Town standard)
	1.2m minimum pipe cover	
Road culvert sizing		Do not increase upstream flood levels.

It is anticipated that the storm sewer will provide road drainage only and that there will be no lateral connections to buildings.

5. ANALYSES

Analysis for the storm sewer sizing was performed using the Rational method. Spread sheet information and results are included in Appendix B. The proposed storm sewer will discharge on the downstream side of Cul-01-08 (tailwater location).

Analysis for culvert Cul-01-08 was performed using Visual Otthymo and HY-8 (Culvert Hydraulic Analysis program). Output is provided in Appendices C and D.

Assumptions used in this review are as follows:

- The drainage area at CUL-01-08 is 369.9 ha (reference: HDR - SWM report);
- The drainage area at Highway 400 Bridge C-55 is 459.3 ha (reference: AECOM);
- The CUL-01-08 tailwater surface slope equals the average slope between CUL-01-08 (downstream invert) and Highway 400 Bridge C-55 (upstream invert) elevations; and
- The 6th Line storm sewer drainage area represents Area F (HDR SWM report) plus the Highway 400 storm sewer and Bridge C-56 drainage areas (AECOM report).

Concerning the proposed 6th Line storm sewer, additional drainage areas associated with a new interchange and/or peak flow attenuation measures, are unknown at this time and will need to be taken into consideration during detailed design.

6. FINDINGS AND RESULTS

6.1 CUL-01-08

Table 2 shows the peak flow results for a lumped area hydrological analysis at CUL-01-08. Simulations were performed using the 4-hour Chicago rainfall distribution and a 24-hour SCS design storm. The 50-year peak flow is 14.17 m^3/s.

Table 2 – CUL-01-08 Peak Flow Results (m^3/s)

Storm Distribution	Return Period		
	10-Year	50-Year	100-Year
4 hour Chicago	5.74	9.26	10.86
24-hour SCS	8.93	14.17	16.02

Comparisons were made to peak flows at downstream Bridge C-55. Using the same watershed soil curve number and a 15 minute time step as for CUL-1-08, with a time to peak adjustment for travel time, the 100-year peak flow estimate for Bridge C-55 is 19.44 m^3/s. AECOM reported a peak flow of 19.98 m^3/s, using a 5 minute time step. These two estimates are considered to be reasonably close.

Readers are cautioned that peak flows shown in Table 2 are <u>not</u> based on a detailed watershed model that can take into account attenuating affects related to channel routing and channel reaches that may have significant overbank storage.

The tailwater rating curve calculated for CUL-01-08 is shown in Appendix D.

CUL-01-08 is a 1,800 mm diameter CSP. Culvert hydraulic analysis indicates the existing 6th Line culvert would be overtopped at a flow of 8.05 m^3/s. A preliminary analysis of the culvert indicates that replacement with a 3.0 metre (span) x 2.0 m (rise) precast concrete box, or equivalent opening size, would convey the 50-year flow in this location with a 1.97 metre freeboard to the proposed 6th Line future grade (ESR draft profile – see Figure 2). Hydraulic analyses results are summarized in Table 3.

Table 3 – CUL-01-08 - Hydraulic Analyses Results

Condition	HW Elev.	Road Edge Elev.	Freeboard (m)	Comments
Existing 6th Line and culvert condition				
10-year flow	Road overtopped	290.71	NA	Overtopped at less than 10-year flow.
Proposed 6th Line (draft ESR profile) and 3.0m x 2.0m concrete box culvert				
50-year flow	290.23	292.20	1.97	Other culvert options are available

6.2 6th Line Future Storm Sewer

Preliminary findings from a review of the future 6th Line storm sewer, corresponding to Area F in the HDR ESR, are as follows:

- Storm sewer discharge point to be located on the downstream side of CUL-01-08;
- 600 mm diameter pipe from Distance 13+450 to Distance 13+687 is required at a minimum slope of 0.22%;
- Minimum 300 mm diameter pipe at Distance 13+687+ is required with minimum 1.0% slope, or alternatively a 375 mm diameter pipe at 0.30%;
- Additional external area contributions (interchanges) have not been considered in this pipe analysis. This should be taken into account during detailed design; and
- If an oil/grit separator BMP device is required for water quality purposes, then it should be sized to capture the mean annual flow (2.33 year return period) with a by-pass at higher flows to minimize head loss.

The impact of the storm sewer on proposed road grades (HDR preliminary road profile) is that the road grade would need to be raised 0.40 metres to elevation **291.08** at the vertical sag point (Distance 13+660) in order to meet minimum pipe cover requirements. By extension, the minimum road elevation required at Distance 13+708 (Highway 400 intersection) is **291.51** (minimum).

The road grade required at Distance 13+660 to provide minimum pipe cover is calculated as follows:

TW elev. @ 10-year + pipe velocity head (exit loss) + pipe slope change + MH losses + minimum pipe cover.

289.07 + 0.05 + 255 x 0.0022 + 0.20 + 1.2 **= *291.08*** versus 290.68 as currently proposed in the year 2015 draft ESR profile. A difference of **+0.40** m.

By extension, a road grade elevation at the intersection of Highway 400 and 6th Line (Distance 13+708) would be:

291.08 + 48 x 0.003 (pipe slope) + 0.10 (MH loss) + 0.187 (cover allowance for 375 mm dia. pipe) = ***291.51*** versus 291.40 as currently proposed in the year 2015 draft ESR profile. A difference of **+0.11** m. A +0.20 m additional allowance is recommended in order to accommodate interchange external drainage areas, based on potential pipe slope changes required for capacity purposes.

Results are summarized in Table 4.

Table 4 – Road Grade Results

Distance	Grade Revision	2015 draft ESR Proposed	Difference
13+660	291.08	290.68	+ 0.40
13+708 - (375mm @ 0.30%)	291.51 291.71 (with allowance)	291.40 +/-	+ 0.11 + 0.31 with allowance to accommodate additional external areas

As a final note, it is recommended that the Highway 400 north drainage ditch, Distance 13+687, be surveyed to confirm that this area can connect into the proposed storm sewer.

Attachments:

Appendix A – Drainage Area Plans
Appendix B – Hydrotechnical Parameters
Appendix C – Storm Sewer Spread Sheet
Appendix D – Visual Otthmo Output
Appendix E – HY8 Output

Appendix A

Hydrotechnical Parameters

1 INNISFIL CREEK WATERSHED - TIME TO PEAK CALCULATIONS

Culvert: CUL_01-08 Distance: 13+455 6th Line Road

Parameters	*Value*		*Comment*
Drainage area (1)	365.9	Ha	Reference: 6th Line Road ESR - HDR SWM Report
Drainage area (2)	375	Ha	ACAD measured from Dillon drainage report plan (2013)
Rational Method 'C' value	0.25		Reference: 6th Line Road ESR - HDR SWM Report
Watershed Length	3425	m	Reference: South Innisfil Creek Municipal Drain Report - Dillion (plan measurement)
Watershed Slope	0.5	%	Average slope (rounded)
Time of concentration	Tc=3.26 (1.1-C) L^0.5 / Sw^0.33		Airport Method
	203.8	Minutes	Tc
	3.40	Hours	Tc
Time to Peak	2.04	Hours	Tp = 0.6 x Tc
CN	77		Reference: AECOM - Hwy 400 Culvert Assessment Summary Memorandum
Culvert size x Length	1800 mm CSP x 17.8 m		
Q 50	1.56	cms	Reference: HDR - MNR Flow Analysis Classification Method
Q 50			This review - Visual Otthymo (SCS - 24 hour storm)

Culvert: C-55 Distance: 16+724 Hwy. 400

Parameters	*Value*		*Comment*
Drainage area (1)	459.3	Ha	Reference: AECOM - ESR SWM Technical Report
Drainage area (2)	400	Ha	ACAD measured from Dillon drainage report plan (2013)
Rational Method 'C' value	0.25		Reference: 6th Line Road ESR - HDR SWM Report
Watershed Length	3750	m	Reference: South Innisfil Creek Municipal Drain Report - Dillion (plan measurement)
Watershed Slope	0.5	%	Average slope rounded (delta h=18m +/-, from 2m contour GIS topographic map)
Time of concentration	Tc=3.26 (1.1-C) L^0.5 / Sw^0.33		Airport Method
	213.3	Minutes	Tc
	3.56	Hours	Tc
Time to Peak	2.13	Hours	Tp=0.6 Tc AECOM: Reported Tp is 1.48 hours
CN	77		Reference: AECOM - Hwy 400 Culvert Assessment Summary Memorandum
Culvert size x Length	6830mm x 4650mm x 80m		Concrete Arch
Q 100	19.98	cms	AECOM - Visual Otthymo result for a 100 year - 24 hour SCS Type 2 distribution
Q 100			This review - Visual Otthymo (SCS - 24 hour storm)

2 STORM SEWER DRAINAGE AREAS and Parameters

Parameters	*Value*		*Comment*			
Area F	0.45 Ha	C=0.6	upstream of Hwy 400 - HDR			
(total = 1.65 Ha)	1.25 Ha	C=0.6	downstream of Hwy 400 (C=.95 - 50% + C=.25 - 50%)			
Bridge C-56 area	7.47 Ha	C=0.25	AECOM			
Hwy 400 storm sewer area	0.59 Ha	C=0.95	Point 454 - AECOM	0.50	0.95	0.475
Hwy 400 storm sewer area	unknown		Point 461 AECOM	0.50	0.25	0.125
Parclo A4	unknown			1		0.600
C total	0.35		9.31 Ha			
Minimum inlet time	15 minutes		Town design standard	1.25	0.6	0.75
Design return period	10 year		Urban arterial - MTO	7.47	0.25	1.8675
				0.59	0.95	0.5605
				9.31	0.341353	3.178

3 HEADWATER ORIGINAL CALCULATIONS - SUMMARY (by others)

Parameters	*Value*	*Comment*
Culvert: CUL_01-08 Distance: 13+455 6th Line Road		
Culvert upstream Invert Elevation	288.00	Reference: 6th Line Road ESR - HDR SWM Report
Culvert downstream Invert Elev.	287.69	Reference: 6th Line Road ESR - HDR SWM Report
Edge of Pavement Elev. (existing)	290.71	Reference: 6th Line Road ESR - HDR SWM Report
Tailwater Elevation - 50-year	287.69	Reference: 6th Line Road ESR - HDR SWM Report
Headwater Elevation - 50-year	289.06	Reference: 6th Line Road ESR - HDR SWM Report

Based on Q 50 flow estimate (1.56 cms)

Culvert: C-55 Distance: 16+724 Hwy. 400

Culvert upstream Invert Elevation	286.10	Reference: AECOM - Hwy 400 Culvert Assessment Summary Memorandum
Culvert downstream Invert Elev.	285.54	Reference: AECOM - Hwy 400 Culvert Assessment Summary Memorandum
Freeboard	7.81	Reference: AECOM - Hwy 400 Culvert Assessment Summary Memorandum
Tailwater Elevation	287.92	Reference: AECOM - Hwy 400 Culvert Assessment Summary Memorandum
Headwater Elevation	288.19	Reference: AECOM - Hwy 400 Culvert Assessment Summary Memorandum

Based on Q 100 flow estimate (19.98 cms)

4 Rainfall Parameters

	100 Yr
Rainfall Parameters	1426.408

Appendix A - Hydrotechnical Parameters

						5.273
					50 Yr	0.759
Formula	I = A / (Tc + B) ^{c}		I = Average rainfall int		1236.52	
		5 Yr	*10 Yr*	*25 Yr*	4.699	
	A	853.608	975.865	1146.275	0.751	
	B	4.699	4.699	4.922		
	C	0.766	0.76	0.757		
	City of Barrie (2009) - adjusted for climate change					

5 Cul_01-08 Tailwater data

Input:

Distance	*Elevation*	*Manning n*
0	290	0.1
20	289	0.1 / 0.035
22	287.69	0.035
23.5	287.69	0.035
25.5	289	0.1 / 0.035
50	290	0.035

Average water surface Slope: 0.63%

Appendix B

Storm Sewer Spread Sheet

STORM SEWER - RATIONAL METHOD DESIGN SHEET

PROJECT: Area F - 6th Line and Hwy 400

DESCRIPTION: 6th Line Future | Rainfall Curve: 10 year (City of Barrie modified for climate change)

Urban Arterial | Curve informatic: i=975.865 / (Inlet time + 4.699)^0.760

DATE: April, 2016

Rev. 1 - May, 2016 | Pipe n = 0.013 | C=0.2 (1-I) +0.9 I | I (% impervious) | I: 0.22 | C: 0.35

STREET	LOCATION FROM CB	LOCATION TO CB	INDIVIDUAL Area (Ha)	TOTAL Area (Ha)	Runoff Coeff. C	Ti or Tc (min.)	Travel Time (min)	Total Time (min)	Rainfall Intensity (mm/hr)	DESIGN Flow (l/s)	LENGTH (mm)	PROPOSED STORM SEWER SIZE (mm)	Type of Pipe	Grade (%)	CAPACITY (l/s)	FULL FLOW VEL.(m/s)	ACTUAL VEL.(m/s)
6th Line Storm Sewer to Cul-01-08																	
6th Line	13+850	13+720	0.45	0.45	0.60	15.00	0.00	15.00	101.30	76.04	130	375	Pvc	0.26	88.70	0.80	0.90
6 th Line	13+720	Cul-08	8.86	9.31	0.35	92.00	0.00	92.00	30.23	273.86	245	600	Pvc	0.22	286.18	1.01	1.15

Notes: Tc baced on minimum 15 minutes or Hwy. 400 Bridge C-56, Tp to Tc conversion, where applicable.

Sewer sizing is preliminary only, additional areas associated withexternal interchange areas (Parclo A4)may apply.

All catch basin laterals are assumed to connect at matching pipe spring lines - to provide minimum pipe cover.

Minimum pipe grades to meet pipe flow capacity or minimum 0.8 m/s pipe velocity is shown

Town of Innisfil design standard is a minimum pipe grade of 0.30%

C Values	13+850	13+720
	13+720	Cul-08

No increase in C values for 10-year return period, as per MTO Drainage Manual.

Appendix C

Visual Otthymo Output

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```
     V   V  I   SSSSS  U  U   A   L
     V   V  I   SS     U  U  A A  L
      V V   I    SS    U  U AAAAA L
      V V   I     SS   U  U A   A L
       VV   I   SSSSS  UUUUU A   A LLLLL

      OOO  TTTTT  TTTTT  H  H  Y  Y  M  M  OOO    TM, Version 2.0
     O   O   T      T    H  H   YY   MM MM O   O
     O   O   T      T    H  H   Y    M  M  O   O  Licensed To: SAI Engineering
      OOO    T      T    H  H   Y    M  M   OOO               V02-0162
```

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***** D E T A I L E D   O U T P U T *****

Input   filename: C:\Program Files\Visual OTTHYMO v2.0\voin.dat
Output filename: C:\SAI projects 2\Almonte Industrial Park\channel\Chicago 4 Hr - 10 Year.out
Summary filename: C:\SAI projects 2\Almonte Industrial Park\channel\Chicago 4 Hr - 10 Year.sum

DATE: 12/04/2016   TIME: 12:11:59 AM

USER:

COMMENTS: ____

****
** SIMULATION NUMBER: 4 **
****

| READ STORM | Filename: C:\SAI projects 2\Almonte Industrial Park\
| | channel\MSCS100.mst.STM
| Ptotal=136.79 mm | Comments: * 100 - 24 hr SCS storm

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.00	6.50	2.74	12.75	19.70	19.00	2.19
.50	1.37	6.75	2.74	13.00	11.22	19.25	2.19
.75	1.37	7.00	2.74	13.25	11.22	19.50	2.19
1.00	1.64	7.25	2.74	13.50	7.66	19.75	2.19
1.25	1.64	7.50	2.74	13.75	7.66	20.00	1.91
1.50	1.64	7.75	2.74	14.00	5.74	20.25	1.91
1.75	1.64	8.00	2.74	14.25	5.74	20.50	1.64
2.00	1.64	8.25	2.74	14.50	4.65	20.75	1.64
2.25	1.64	8.50	3.56	14.75	4.65	21.00	1.64
2.50	1.64	8.75	3.56	15.00	3.83	21.25	1.64
2.75	1.64	9.00	3.83	15.25	3.83	21.50	1.64
3.00	1.64	9.25	3.83	15.50	3.56	21.75	1.64
3.25	1.64	9.50	4.38	15.75	3.56	22.00	1.64
3.50	1.64	9.75	4.38	16.00	3.28	22.25	1.64
3.75	1.64	10.00	4.92	16.25	3.28	22.50	1.64
4.00	1.91	10.25	4.92	16.50	3.28	22.75	1.64
4.25	1.91	10.50	6.02	16.75	3.28	23.00	1.64
4.50	2.19	10.75	6.02	17.00	2.74	23.25	1.64
4.75	2.19	11.00	9.03	17.25	2.74	23.50	1.64
5.00	2.19	11.25	9.03	17.50	2.74	23.75	1.64
5.25	2.19	11.50	12.86	17.75	2.74	24.00	1.37
5.50	2.19	11.75	12.86	18.00	2.46	24.25	1.37
5.75	2.19	12.00	103.96	18.25	2.46		
6.00	2.19	12.25	103.96	18.50	2.19		
6.25	2.19	12.50	19.70	18.75	2.19		

| MODIFY STORM | MODIFYING PARAMETERS
| CASE= 1 | Multiplication Factor=   .68
--------------------   Time shift (min)   =   .00

10 year storm

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.250	.00	6.500	1.86	12.750	13.37	19.00	1.49
.500	.93	6.750	1.86	13.000	7.62	19.25	1.49
.750	.93	7.000	1.86	13.250	7.62	19.50	1.49
1.000	1.11	7.250	1.86	13.500	5.20	19.75	1.49
1.250	1.11	7.500	1.86	13.750	5.20	20.00	1.30
1.500	1.11	7.750	1.86	14.000	3.90	20.25	1.30
1.750	1.11	8.000	1.86	14.250	3.90	20.50	1.11
2.000	1.11	8.250	1.86	14.500	3.16	20.75	1.11
2.250	1.11	8.500	2.42	14.750	3.16	21.00	1.11
2.500	1.11	8.750	2.42	15.000	2.60	21.25	1.11
2.750	1.11	9.000	2.60	15.250	2.60	21.50	1.11
3.000	1.11	9.250	2.60	15.500	2.42	21.75	1.11
3.250	1.11	9.500	2.97	15.750	2.42	22.00	1.11
3.500	1.11	9.750	2.97	16.000	2.23	22.25	1.11
3.750	1.11	10.000	3.34	16.250	2.23	22.50	1.11
4.000	1.30	10.250	3.34	16.500	2.23	22.75	1.11
4.250	1.30	10.500	4.09	16.750	2.23	23.00	1.11
4.500	1.49	10.750	4.09	17.000	1.86	23.25	1.11
4.750	1.49	11.000	6.13	17.250	1.86	23.50	1.11
5.000	1.49	11.250	6.13	17.500	1.86	23.75	1.11
5.250	1.49	11.500	8.73	17.750	1.86	24.00	.93
5.500	1.49	11.750	8.73	18.000	1.67	24.25	.93
5.750	1.49	12.000	70.59	18.250	1.67		
6.000	1.49	12.250	70.59	18.500	1.49		
6.250	1.49	12.500	13.37	18.750	1.49		

| CALIB |
| NASHYD   (0001) | Area   (ha)= 365.90   Curve Number   (CN)= 77.0
|ID= 1 DT=15.0 min | Ia   (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.80

Unit Hyd Qpeak (cms)=   7.764

PEAK FLOW   (cms)=   8.933 (i)
TIME TO PEAK   (hrs)= 14.000
RUNOFF VOLUME   (mm)= 47.161
TOTAL RAINFALL   (mm)= 92.879
RUNOFF COEFFICIENT   =   .508

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 5 **
****

| READ STORM | Filename: C:\SAI projects 2\Almonte Industrial Park\
| | channel\MSCS100.mst.STM
| Ptotal=136.79 mm | Comments: * 100 - 24 hr SCS storm

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```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.00	6.50	2.74	12.75	19.70	19.00	2.19
.50	1.37	6.75	2.74	13.00	11.22	19.25	2.19
.75	1.37	7.00	2.74	13.25	11.22	19.50	2.19
1.00	1.64	7.25	2.74	13.50	7.66	19.75	2.19
1.25	1.64	7.50	2.74	13.75	7.66	20.00	1.91
1.50	1.64	7.75	2.74	14.00	5.74	20.25	1.91
1.75	1.64	8.00	2.74	14.25	5.74	20.50	1.64
2.00	1.64	8.25	2.74	14.50	4.65	20.75	1.64
2.25	1.64	8.50	3.56	14.75	4.65	21.00	1.64
2.50	1.64	8.75	3.56	15.00	3.83	21.25	1.64
2.75	1.64	9.00	3.83	15.25	3.83	21.50	1.64
3.00	1.64	9.25	3.83	15.50	3.56	21.75	1.64
3.25	1.64	9.50	4.38	15.75	3.56	22.00	1.64
3.50	1.64	9.75	4.38	16.00	3.28	22.25	1.64
3.75	1.64	10.00	4.92	16.25	3.28	22.50	1.64
4.00	1.91	10.25	4.92	16.50	3.28	22.75	1.64
4.25	1.91	10.50	6.02	16.75	3.28	23.00	1.64
4.50	2.19	10.75	6.02	17.00	2.74	23.25	1.64
4.75	2.19	11.00	9.03	17.25	2.74	23.50	1.64
5.00	2.19	11.25	9.03	17.50	2.74	23.75	1.64
5.25	2.19	11.50	12.86	17.75	2.74	24.00	1.37
5.50	2.19	11.75	12.86	18.00	2.46	24.25	1.37
5.75	2.19	12.00	103.96	18.25	2.46		
6.00	2.19	12.25	103.96	18.50	2.19		
6.25	2.19	12.50	19.70	18.75	2.19		

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--------------------
| MODIFY STORM    |    MODIFYING PARAMETERS
| CASE= 1         |    Multiplication Factor=   .92
--------------------   Time shift  (min)    =   .00
```

50 year storm

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.250	.00	6.500	2.51	12.750	18.10	19.00	2.01
.500	1.26	6.750	2.51	13.000	10.31	19.25	2.01
.750	1.26	7.000	2.51	13.250	10.31	19.50	2.01
1.000	1.51	7.250	2.51	13.500	7.04	19.75	2.01
1.250	1.51	7.500	2.51	13.750	7.04	20.00	1.76
1.500	1.51	7.750	2.51	14.000	5.28	20.25	1.76
1.750	1.51	8.000	2.51	14.250	5.28	20.50	1.51
2.000	1.51	8.250	2.51	14.500	4.27	20.75	1.51
2.250	1.51	8.500	3.27	14.750	4.27	21.00	1.51
2.500	1.51	8.750	3.27	15.000	3.52	21.25	1.51
2.750	1.51	9.000	3.52	15.250	3.52	21.50	1.51
3.000	1.51	9.250	3.52	15.500	3.27	21.75	1.51
3.250	1.51	9.500	4.02	15.750	3.27	22.00	1.51
3.500	1.51	9.750	4.02	16.000	3.02	22.25	1.51
3.750	1.51	10.000	4.53	16.250	3.02	22.50	1.51
4.000	1.76	10.250	4.53	16.500	3.02	22.75	1.51
4.250	1.76	10.500	5.53	16.750	3.02	23.00	1.51
4.500	2.01	10.750	5.53	17.000	2.51	23.25	1.51
4.750	2.01	11.000	8.30	17.250	2.51	23.50	1.51
5.000	2.01	11.250	8.30	17.500	2.51	23.75	1.51
5.250	2.01	11.500	11.82	17.750	2.51	24.00	1.26
5.500	2.01	11.750	11.82	18.000	2.26	24.25	1.26
5.750	2.01	12.000	95.54	18.250	2.26		
6.000	2.01	12.250	95.54	18.500	2.01		
6.250	2.01	12.500	18.10	18.750	2.01		

```
--------------------------------------------------------------------------------
--------------------
| CALIB           |
| NASHYD    (0001) |   Area    (ha)= 365.90   Curve Number   (CN)= 77.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.80

    Unit Hyd Qpeak  (cms)=   7.764

    PEAK FLOW       (cms)=  14.171 (i)
    TIME TO PEAK    (hrs)=  14.000
    RUNOFF VOLUME    (mm)=  74.119
    TOTAL RAINFALL   (mm)= 125.709
    RUNOFF COEFFICIENT    =    .590

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
 ****************************
 ** SIMULATION NUMBER:   6 **
 ****************************


--------------------
|   READ STORM    |    Filename: C:\SAI projects 2\Almonte Industrial Park\
|                 |              channel\MSCS100.mst.STM
| Ptotal=136.79 mm |    Comments: * 100 - 24 hr SCS storm
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.25	.00	6.50	2.74	12.75	19.70	19.00	2.19
.50	1.37	6.75	2.74	13.00	11.22	19.25	2.19
.75	1.37	7.00	2.74	13.25	11.22	19.50	2.19
1.00	1.64	7.25	2.74	13.50	7.66	19.75	2.19
1.25	1.64	7.50	2.74	13.75	7.66	20.00	1.91
1.50	1.64	7.75	2.74	14.00	5.74	20.25	1.91
1.75	1.64	8.00	2.74	14.25	5.74	20.50	1.64
2.00	1.64	8.25	2.74	14.50	4.65	20.75	1.64
2.25	1.64	8.50	3.56	14.75	4.65	21.00	1.64
2.50	1.64	8.75	3.56	15.00	3.83	21.25	1.64
2.75	1.64	9.00	3.83	15.25	3.83	21.50	1.64
3.00	1.64	9.25	3.83	15.50	3.56	21.75	1.64
3.25	1.64	9.50	4.38	15.75	3.56	22.00	1.64
3.50	1.64	9.75	4.38	16.00	3.28	22.25	1.64
3.75	1.64	10.00	4.92	16.25	3.28	22.50	1.64
4.00	1.91	10.25	4.92	16.50	3.28	22.75	1.64
4.25	1.91	10.50	6.02	16.75	3.28	23.00	1.64
4.50	2.19	10.75	6.02	17.00	2.74	23.25	1.64
4.75	2.19	11.00	9.03	17.25	2.74	23.50	1.64
5.00	2.19	11.25	9.03	17.50	2.74	23.75	1.64
5.25	2.19	11.50	12.86	17.75	2.74	24.00	1.37
5.50	2.19	11.75	12.86	18.00	2.46	24.25	1.37
5.75	2.19	12.00	103.96	18.25	2.46		
6.00	2.19	12.25	103.96	18.50	2.19		
6.25	2.19	12.50	19.70	18.75	2.19		

```
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--------------------
| CALIB           |
| NASHYD    (0001) |   Area    (ha)= 365.90   Curve Number   (CN)= 77.0
|ID= 1 DT=15.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.80

    Unit Hyd Qpeak  (cms)=   7.764

    PEAK FLOW       (cms)=  16.021 (i)
    TIME TO PEAK    (hrs)=  14.000
    RUNOFF VOLUME    (mm)=  83.636
    TOTAL RAINFALL   (mm)= 136.788
    RUNOFF COEFFICIENT    =    .611

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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```

FINISH
===
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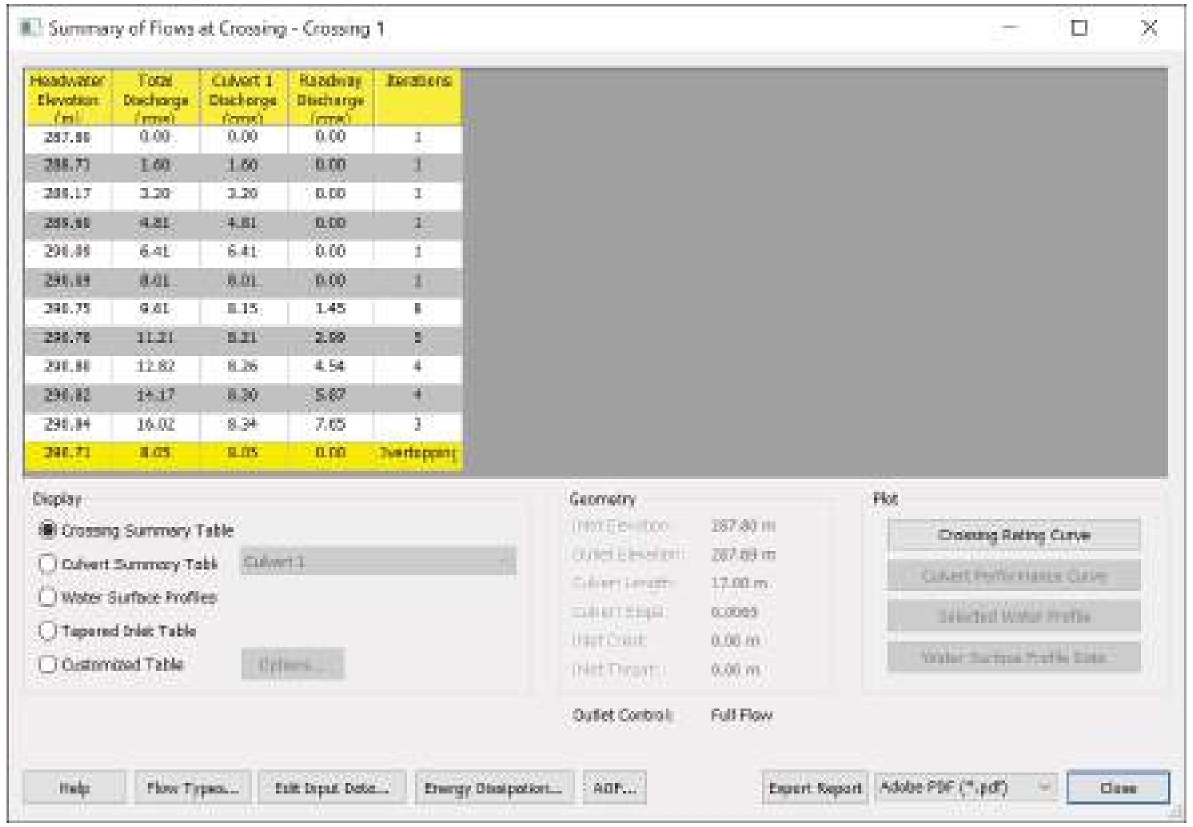
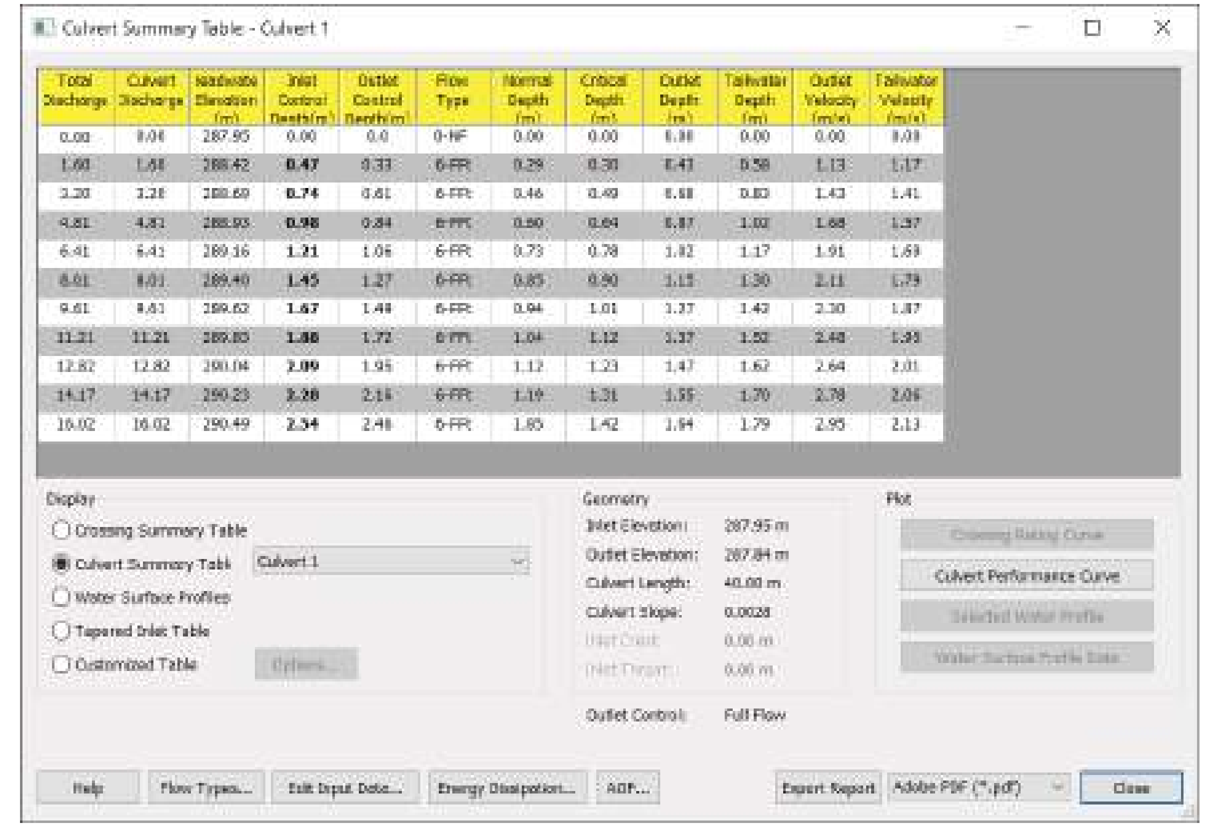
Appendix D

HY8 Output



Headwater Elevation (m)	Total Discharge (cms)	Culvert 1 Discharge (cms)	Roadway Discharge (cms)	Iterations
287.80	0.00	0.00	0.00	1
288.71	1.60	1.60	0.00	1
288.17	3.20	3.20	0.00	1
289.60	4.81	4.81	0.00	1
290.08	6.41	6.41	0.00	1
290.69	8.01	8.01	0.00	1
290.75	9.61	8.15	1.45	8
290.78	11.21	8.21	2.99	5
290.80	12.82	8.26	4.54	4
290.82	14.17	8.30	5.87	4
290.84	16.02	8.34	7.65	3
290.71	8.05	8.05	0.00	Overtopping

Cul_01-08 Existing Condition



Total Discharge	Culvert Discharge	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	287.95	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
1.60	1.60	288.42	0.47	0.33	6-FFt	0.29	0.30	0.43	0.58	1.13	1.17
3.20	3.20	288.69	0.74	0.61	6-FFt	0.46	0.49	0.68	0.83	1.43	1.41
4.81	4.81	288.93	0.98	0.84	6-FFt	0.60	0.64	0.87	1.02	1.68	1.57
6.41	6.41	289.16	1.21	1.06	6-FFt	0.73	0.78	1.02	1.17	1.91	1.69
8.01	8.01	289.40	1.45	1.27	6-FFt	0.85	0.90	1.15	1.30	2.11	1.79
9.61	9.61	289.62	1.67	1.48	6-FFt	0.94	1.01	1.27	1.42	2.30	1.87
11.21	11.21	289.83	1.88	1.72	6-FFt	1.04	1.12	1.37	1.52	2.48	1.95
12.82	12.82	290.04	2.09	1.95	6-FFt	1.12	1.23	1.47	1.62	2.64	2.01
14.17	14.17	290.23	2.28	2.16	6-FFt	1.19	1.31	1.55	1.70	2.78	2.06
16.02	16.02	290.49	2.54	2.48	6-FFt	1.05	1.42	1.64	1.79	2.95	2.13

Cul_01-08 3.0m x 2.0m Concrete Box Culvert

Appendix L
Phase I ESA

6th Line Interchange ESA Study, Town of Innisfil
Phase 1 ESA Report

November 2016

BT Eng Project 16-006

Table of Contents

List of Figures

List of Appendices

Executive Summary

BT Engineering Inc. (BTE) was retained by the Town of Innisfil to conduct a Phase I Environmental Site Assessment (ESA) in the vicinity of the proposed 6th Line and Highway 400 interchange as part of the 6th Line Interchange Class Environmental Assessment (EA) Study. The Phase I ESA has been completed in accordance with Canadian Standards Association Standard Z768-01 and in general accordance with the requirements of Ontario Regulation 153/04 (as amended). BTE understands that this Phase I ESA will not be used to support the preparation of a Record of Site Condition (RSC) in accordance with Ontario Regulation (O.Reg.) 153/04 (as amended), and that the purpose of the Phase I ESA was to identify areas of potential environmental concern at the site related to the proposed 6th Line and Highway 400 interchange.

The historical land use of the Site has been community, consisting of roads, including present 6th Line and Highway 400. The Phase I Study Area has historically consisted of agricultural properties with rural residences and undeveloped land.

No areas of potential environmental concern were identified for the Phase I Site or Phase I Study Area. Based on available information, it is our opinion that a Phase II ESA is not required for the Phase I Site or the properties adjacent to the site which may require land acquisition based on the currently proposed interchange configuration.

1.0 Introduction

BT Engineering Inc. (BTE) was retained by the Town of Innisfil to conduct a Phase I Environmental Site Assessment (ESA) in the vicinity of the proposed 6th Line and Highway 400 interchange as part of the 6th Line Interchange Class Environmental Assessment (EA) Study. The property (hereafter referred to as the "Site") encompasses the Highway 400 and 6th Line overpass located east of the Town of Innisfil. The site is location is shown on **Figure 1**. For the purpose of this review, 6th Line is aligned east/west and Highway 400 is aligned north/south.

1.1 Phase I Property Information

The site is currently a rectangular parcel of land consisting of Highway 400, in the vicinity of the existing 6th Line overpass.

Municipal Address	n/a
Site Legal Description (including Property Identification Number, if any)	P.I.N. 58062-0021 (Highway 400)
Site Owner / Client Contact	Jessica Jenkins, P.Eng. Captial Project Manager Town of Innisfil 2101 Innisfil Beach Road Innisfil ON L9S 1A1 Phone: 705-436-3740 Email: j.jenkins@innisfil.ca

Preparation of a legal survey plan for the site was not included in the scope of work for the Phase I ESA.

2.0 Scope of Investigation

The Phase I ESA has been completed in accordance with Canadian Standards Association Standard Z768-01 and in general accordance with the requirements of Ontario Regulation 153/04 (as amended). BTE understands that this Phase I ESA will not be used to support the preparation of a Record of Site Condition (RSC) in accordance with Ontario Regulation (O.Reg.) 153/04 (as amended), and that the purpose of the Phase I ESA was to identify areas of potential environmental concern at the site related to the proposed 6th Line and Highway 400 interchange.

The Phase I ESA included the following scope of work:

- Records review (if applicable);
- Site reconnaissance;
- Interviews (if possible);
- Evaluation of reporting; and,
- Reporting.

This Phase I ESA is not an environmental compliance audit or review. Findings and conclusions are based solely on the extent of observations and available information gathered during the Phase I ESA. Hazardous materials, mould, and/or vapour intrusion surveys were not conducted. Sampling and analysis of soil, groundwater, air, or other materials were not conducted as part of this investigation.

3.0 Records Review

3.1 General

3.1.1 Phase I Study Area Determination

The Phase I study area was determined to be the area extending an approximate 500 m radius from the property boundaries. The Phase I study area was expanded from the generally accepted standard of 250 m due to the land area requirements of the proposed interchange configuration alternatives of the proposed 6th Line and Highway 400 interchange. Based on information compiled during records review, interviews and site reconnaissance, it was concluded that the study area was sufficient for the purpose of this Phase I ESA.

3.1.2 First Developed Use Determination

Based on information compiled during records review, site reconnaissance and interviews, it was concluded that the study area has been used as agricultural land and roads in their current configuration to the earliest record reviewed as part of the Phase I ESA (1954).

3.1.3 Fire Insurance Plans

A search was conducted at the National Archives in Ottawa, Ontario. No fire insurance plans were available for the site.

Historical mapping of the area (Simcoe County Council, 1956) indicates Highway 400 and 6th Line were both present. Highway 400 is shown aligned north-south between 6th and 7th Sideroads. A school is shown west of the site, northwest of the intersection of 5th Sideroad and 6th Line.

3.1.1 City Directories

A search was conducted at the National Archives in Ottawa, Ontario. Based on a review of directories from 1998/99 and 1993/94 for Barrie, Ontario, no listings were available for the site.

3.1.2 Chain of Title

A title search for the site was not included in the scope of work for the Phase I ESA.

3.1.3 Environmental Reports

The following reports were reviewed as part of the Phase I ESA:

- HDR, 2016. Environmental Study Report, 6th Line Municipal Class Environmental Assessment, County Road 27 to St John's Road, Town of Innisfil, Ontario, September 6, 2016.

The following information was obtained from the above report:

- The contamination overview study of the ESR included conducting historical record reviews which are also included in the Phase I ESA. No properties with issues of potential environmental concern were identified within the Phase I Study Area. One (1) property, 3368 6th Line, was identified adjacent to the Phase I Study Area as a residential property with vehicle maintenance. Potential contaminants of concern were identified as: volatile organic compunds (VOCs), petroleum hydrocarbon fraction (PHC) F1 to F4, metals, inorganics and polycyclic aromatic hydrocarbons (PAHs).

- The geotechnical and pavement design report for the ESR included boreholes BH304 and BH305 drilled along 6th Line, within the west and east limits of the Phase I Study Area, respectively. Borehole log information indicated that the native soil underlying the granular road base consisted of silt and sand with trace gravel and clay. Both boreholes were identified as wet at 0.9 m below grade.
- The preliminary hydrogeology assessment indicated that the land in the vicinity of the Phase I Study Area is situated within the Nottawasaga River watershed and the Innisfil Creek sub-watershed. Groundwater and surface water is anticipated to flow via local tributaries and Innisfil Creek, toward the Nottawasaga River located west of the Phase I Study Area. The wetland area in the vicinity of Highway 400 was identified as a potential area of significant groundwater discharge.

As the site did not comprise commercial and/or industrial properties, company records were not included in the scope of work for the Phase I ESA.

3.2 Environmental Source Information

National Pollutant Release Inventory – Environment Canada

A search of the National Pollutant Release Inventory (NPRI, 2016) was conducted. Based on available information, no listings were identified for the Phase I Study Area.

PCB – Ontario

A search of the Ontario Inventory of PCB Storage Sites (MOE, 1995) was conducted. Based on available information, no listings were identified for the Phase I Study Area.

A request was submitted to the local (Barrie) District Office of the MOECC to search their current electronic database for the Phase I Study Area. A response from the MOECC has not been received at the time of reporting. If a response is received indicating environmental records containing pertinent information of environmental concern, the client will be contacted.

Certificates of Approval – Ontario

A search of the Ministry of the Environment and Climate Change (MOECC) Access Environment was conducted. This tool provides detailed information regarding environmental approvals and registrations including: Environmental Compliance Approvals (ECA), Renewable Energy Approvals (REA), Environmental Activity and Sector Registry (EASR) registrations and Certificates of Approval (replaced by Environmental Compliance Approvals in 2011). Based on available information, no listings were identified for the Phase I Study Area.

Inventories of Coal Gasification Plants and Coal Tar Sites – Ontario

A search of the Inventory of Coal Gasification Plant Waste Sites (MOE, 1987) and the Inventory of Industrial Sites Producing or Using Coal Tar and Related Tars (MOEE, 1988) in Ontario was conducted. Based on available information, no listings were identified for the Phase I Study Area.

A request was submitted to the local (Barrie) District Office of the MOECC to search their current electronic database for the Phase I Study Area. A response from the MOECC has not been received at the time of reporting. If a response is received indicating environmental records containing pertinent information of environmental concern, the client will be contacted.

Ontario Ministry of Environment (MOE) Freedom of Information (FOI) Request

A request was submitted to the Ministry of the Environment and Climate Change (MOECC) Freedom of Information (FOI) office to inquire if there were any files of environmental concerns, orders, spills, investigations/prosecutions, waste generation or Certificates of Approval pertaining to the properties adjacent to the site which may require land acquisition. MOECC FOI requests were submitted for the following properties:

Northeast	3424 6th Line / Lot 7, Concession 6
Southeast	No municipal address / Lot 7, Concession 5 & 3325 6th Line / Lot 8, Concession 5
Southwest	3573 & 3581 6th Line / Lot 6, Concession 5
Northwest	No municipal address / Lot 6, Concession 6

A response from the MOECC has not been received at the time of reporting. If a response is received indicating environmental records containing pertinent information of environmental concern, the client will be contacted.

Waste Management Records

A search of the MOECC Hazardous Waste Information System database was conducted. This network includes registered hazardous waste generators, carriers, and receivers. Based on available information, no listings were identified for the Phase I Study Area.

Technical Standards and Safety Authority (TSSA)

A request was submitted to the Technical Standards and Safety Authority (TSSA) to search their electronic database for selected properties in the Phase I Study Area (no municipal address was available for the site). The TSSA database includes records pertaining to current and historical sites with registered underground storage tanks dating from 1987 to present. The following municipal addresses were provided:

- 6784 5 Sideroad
- 3424 6th Line
- 3573 6th Line
- 3581 6th Line

The TSSA reported that no records were found for the addresses provided. A copy of their response is provided in Appendix A.

MOE Brownfields Environmental Site Registry

A search of the Ministry of the Environment and Climate Change (MOECC) Brownfields Environmental Site Registry was conducted. This registry contains records of site condition and transition notices filed in the Environmental Site Registry since October 1, 2004. Based on available information, no listings were identified for the Phase I Study Area.

Ontario Ministry of Natural Resources

A search of the Ontario Ministry of Natural Resources and Forestry (MNRF) natural heritage web application was conducted. The search did not identify any provincially significant wetlands or areas of natural or scientific significance for the Phase I Study Area.

MOE Waste Disposal Site Inventory

A review of the Waste Disposal Site Inventory in Ontario (MOE, 1991) was conducted. This document contains all known active and closed waste disposal sites in the province of Ontario as of October 31, 1990. Based on available information, no listings were identified for the Phase I Study Area or within 1 km of the site.

MOE Small and Large Landfills

A search of the MOE Small Landfills Site List was conducted on September 23, 2016. This list contains records of small landfills in Ontario that includes open/closed status, site owner, site location, and Certificate of Approval number. Based on available information no listings were identified for the Phase I Study Area. Three (3) listings were identified for the Town of Innisfil, the nearest being the Innisfil landfill, ECA A252202, located approximately 1.5 km northeast of the site.

A search of the MOE Large Landfills Map was conducted on November 7, 2016. This map contains records of large landfills in Ontario that includes site location, name and Certificate of Approval number. Based on available information, no listings were identified for the Phase I Study Area or within 1 km of the site.

3.3 Physical Setting Sources

3.3.1 Aerial Photographs

Aerial photographs from the Country of Simcoe Interactive Mapping System were reviewed for the years 1954, 2002, 2008, 2012 and 2016. Based on the review, the following observations were made:

Year	Site	Surrounding Area
1954	The site contains Highway 400 and 6th Line. No additional details are visible due to the scale of the aerial photograph.	The Phase I Study Area is comprised of agricultural land. Rural residences appear to be present at properties east, southwest and west of the site; however no additional details are visible due to the scale of the aerial photograph. The property southwest of the intersection of Highway 400 and 6th Line is forest covered north of the creek. The creek is present in the same configuration as present. There appear to be forest-covered and wetland areas further southeast of the intersection of Highway 400 and 6th Line in the same configuration as present.
2002	The site is in similar configuration to the 1954 aerial photograph.	The surrounding area is in similar configuration to the 1954 aerial photograph. Rural residences and/or properties which appear to be agricultural are present at the properties adjacent to the east (3424), southwest (3573 and 3581) and west (address unknown).
2008	The site is in similar configuration to the 2002 aerial photograph.	The surrounding area is in similar configuration to the 2002 aerial photograph. There appears to be a stockpile of unknown material located east of the building at the properties adjacent to the east (3424) and west (address unknown).
2012	The site is in similar configuration to the 2008 aerial photograph.	The surrounding area is in similar configuration to the 2008 aerial photograph. One of the buildings located on the property adjacent to the southwest (3573) has been demolished and debris remains.
2016	The site is in similar configuration to the 2012 aerial photograph.	The surrounding area is in similar configuration to the 2012 aerial photograph.

Additional aerial photographs from the National Air Photo Library (NAPL) were available for select years from 1946 to 1995. However, additional aerial photographs were not reviewed as:

- The Contamination Overview Study of the ESR (HDR, 2016) provided by the Town of Innisfil had previously reviewed aerial photographs from the National Air Photo Library (NAPL) for the years 1946, 1962, 1976, 1981 and 1995 and did not discern any noteworthy information for the study area; and,
- Based on information compiled during the remaining records review, site reconnaissance and interviews, no information indicated that additional research of aerial photographs was required.

3.3.2 Topography, Hydrology, Geology

Based on the Ministry of Natural Resources and Forestry (MNRF) topographic mapping web map application and County of Simcoe Interactive Mapping System, the site is located at an elevation of approximately 290 metres above sea level (masl). The Phase I site is generally flat with an incline to Highway 400. The Phase I Study Area has a gradual slope to the south, as well as a descent to the tributary of Innisfil creek which crosses underneath Highway 400 approximately 200 m south of 6th Line.

Surface water flows southeast through tributaries toward Innisfil Creek. Local groundwater flow in the Phase I Study Area is inferred to be in the southeasterly direction, toward the tributary of Innisfil Creek. Regionally surface water is expected to flow via Innisfil Creek to the south, then towards the west. Regionally groundwater flow is expected to divide, west towards the Nottsawasaga River and southeast toward Lake Simcoe.

Surficial geology in the Phase I Study Area is reportedly glaciofluvial ice-contact deposits from the Pleistocene series of the Quaternary system consisting of gravel and sand as well as minor till, including esker, kame, moraine, ice-marginal delta and subaqueous fan deposits (Barnett, Cowan and Henry, 1991). Bedrock geology in the Phase I Study Area is reportedly limestone, dolostone, shale, arkose and sandstone of the Simcoe group from the middle Ordovician period (OGS, 1991).

3.3.3 Fill Materials

No observations of recent placement of fill were noted during site reconnaissance. Historical placement of fill of unknown origin likely occurred during construction of Highway 400 and 6th Line.

3.3.4 Water Bodies and Areas of Natural Significance

Based on the Ministry of Natural Resources and Forestry (MNRF) topographic mapping web map application and County of Simcoe Interactive Mapping System, the site is located approximately 10 km east of Lake Simcoe.

3.3.5 Well Records

A search of the MOECC water well record website for all well records within the Phase I Study Area was conducted on September 23, 2016. The search returned no records for the site and four (4) records for properties within the Phase I Study Area.

Based on available information, the following water well records were identified for the Phase I Study Area:

Well ID	Date Drilled	Use
5701049	01/06/1968	Farm
5711926	20/08/1974	Domestic
5730867	11/07/1994	Domestic
5734464	24/08/1999	Domestic

3.3.1 Town of Innisfil Official Plan

The Town of Innisfil Official Plan (2006) Schedule A Municipal Structure indicates that a Natural Heritage System is present southeast of the intersection of 6th Line and Highway 400, south of the creek crossing Highway 400. This “Natural Heritage System” is further identified as significant woodlands and other wetlands in Appendices 1 and 2 of the Town of Innisfil Official Plan.

The Town of Innisfil Official Plan (2006) Schedule B Land Use indicates that the Phase I Site and Study Area are designated as agricultural land. The creek is shown crossing 6th Line to the west and Highway 400 to the south, at the intersection of 6th Line and Highway 400. To the west of Highway 400, a natural environment area is shown as the boundary of the creek; however, to the southeast of the intersection of 6th Line and Highway 400 the natural environment area expands to encompass a larger area. A Hazard Land Area Overlay is also shown generally surrounding the creek and natural environmental area.

The Town of Innisfil Official Plan (2006) Appendix 5: Areas of Groundwater Recharge indicates that there are groundwater recharge zones present approximately north and south of the Phase I Study Area.

3.4 Site Operating Records

At the time of the ESA, the Phase I site was vacant. No site operating records were provided for review.

4.0 Interviews

Attempts to reach a local resident, Mr. John Hilverda, of the area were made on numerous occasions in November 2016 without success.

5.0 Site Reconnaissance

5.1 General Requirements

Site reconnaissance was conducted of the site, adjacent properties and Phase I Study Area. Specific observations are provided below. Photographs and descriptions are provided in Appendix B.

Date/Time/Length	April 20, 2016 July 28, 2016 August 20, 2016
Weather Conditions	Fair, clear
Facility Operation	n/a
Name and Qualifications of Investigator	Rudi Warmé, P.Eng.

5.2 Specific Observations at Phase I Property

Above-ground Structures and Improvements

Highway 400 has been constructed above the general grade of the Phase I Study Area, with sloped sides and a concrete overpass over 6th Line (**Photo 1**).

Below-ground Structures and Utilities

Corrugated steel pipe culverts exist below Highway 400 and 6th Line for storm water drainage and tributary passage. One (1) large concrete culvert is located south of 6th Line to allow passage of the creek tributary (Photos 2 and 3).

No underground utilities were observed; however there is potential for underground utilities to be present in the Phase I Study Area.

Storage Tanks/Containers

No storage tanks or containers were observed.

Hazardous Materials and Designated Substances

The potential presence of hazardous materials and/or designated substances was assessed including, but not limited to: asbestos-containing materials, benzene, lead, mercury, mould, ozone-depleting materials, polychlorinated biphenyls (PCBs), radon, silica and urea foam formaldehyde insulation.

Silica is likely present in the concrete structures (overpass and culvert) observed in the Phase I Study Area. No other materials potentially containing designated substances were observed.

Railway Lines/Spurs

No current or former railway lines or spurs were observed.

Fill Material

No observations of recent placement of fill were noted during site reconnaissance. Historical placement of fill of unknown origin likely occurred during construction of Highway 400 and 6th Line.

Ground Cover

Ground cover consisted of pavement on Highway 400 and 6th Line, cultivated land on the adjacent agricultural properties and scrub/woodland in unused land areas.

Odours/Staining/Stressed Vegetation

An area of stained soil was observed on disturbed soil at the corrugated steel pipe culvert located west of Highway 400 which appeared to have recently been re-lined (**Photo 4**).

Water Sources

One (1) wellhead was observed at 3424 6th Line, approximately 300 m east of the intersection of Highway 400 and 6th Line (**Photo 5**).

5.2.1 Enhanced Investigation Property

No information was obtained during records reviews, interviews or site reconnaissance that would classify the site as an enhanced investigation property.

5.3 Specific Observations of Adjacent Properties

Adjacent Land Use

The observations of the adjacent properties are provided below:

Northeast	Agricultural
Southeast	Agricultural followed by forest
Southwest	Forest followed by agricultural
Northwest	Agricultural

Potentially Contaminating Activities

Inspection of the culvert located approximately 200 m west of Highway 400 revealed a large buildup of material. This was likely accumulation of an unknown material due to runoff from the adjacent agricultural properties.

No other potentially contaminating activities (PCAs) were observed in the Phase I Study Area.

Areas of Natural Significance

No areas of natural significance (ANSIs) were observed in the Phase I Study Area.

Water Bodies

A tributary of Innisfil Creek arches across the property northwest of the Phase I site, crossing under 6th Line approximately 250 m west of Highway 400, travelling southwest of a woodland area, crossing under Highway 400 approximately 200 m south of 6th Line. Another tributary of the creek extends south from 6th Line, approximately 300 m east of Highway 400. The two tributaries flow through the property located southeast of the Phase I Site and join as they flow to the south (**Photos 6 to 8**).

5.4 Written Description of Investigation

Site reconnaissance was conducted on April 20, July 28 and August 20 by Rudi Warmé, P.Eng. of BT Engineering. Site reconnaissance included inspection of the site, adjacent properties and the Phase I Study Area in order to identify current conditions relevant to the existence of any areas of potential environmental concern. Observations of the adjacent properties and Phase I Study Area were made from the site and/or publicly accessible property (i.e. roadways).

6.0 Review and Evaluation of Information

6.1 Current and Past Uses

A description of the current and past uses of the Phase I site is provided below:

Property	Year(s)	Owner	Property Use	Observations of Environmental Concern
No municipal address	1946 to Present	Government	Community (Road; the part of a common or public highway, street, avenue, parkway, square, place, bridge, viaduct or trestle that is improved, designed or ordinarily used for regular traffic and includes the shoulder)	None

A description of the current and past uses of the adjacent properties and any noted properties within the Phase I Study Area are provided below:

Property	Year(s)	Property Use	Observations of Environmental Concern
3424 6th Line / Lot 7, Concession 6 (adjacent to the northeast)	1946 to Present	Agricultural with rural residence	Stockpiles of unknown material were observed in aerial photographs from 2008, 2012 and 2016.
No municipal address / Lot 7, Concession 5 (adjacent to the southeast)	1946 to Present	Mixed agricultural and undeveloped land	None
3573 6th Line / Lot 6, Concession 5 (adjacent to the southwest)	1946 to Present	Mixed agricultural with rural residence and undeveloped land	None
No municipal address / Lot 6, Concession 6 (adjacent to the northwest)	1946 to Present	Agricultural	Stockpiles of unknown material were observed in aerial photographs from 2008, 2012 and 2016.

6.2 Potentially Contaminating Activity

No potentially contaminating activities were identified for the Phase I Site or Phase I Study Area that may be contributing to an area of potential environmental concern.

6.3 Areas of Potential Environmental Concern

No areas of potential environmental concern were identified for the Phase I Site or Phase I Study Area.

6.4 Conceptual Site Model

The Conceptual Site Model is discussed below and illustrated in **Figure 2**.

Detail	Discussion
Existing buildings and structures	Figure 2
Water bodies	Figure 2
Areas of natural significance	None
Drinking water wells	Figure 2
Roads, including names	Figure 2
Uses of adjacent properties	Figure 2
Areas where any potentially contaminating activity has occurred (including tanks)	None
Areas of potential environmental concern	None
Contaminants of potential concern	None
Potential for underground utilities, if any present, to affect contaminant distribution and transport,	No APECs were identified at the Phase I Site or in the Phase I Study Area. No underground utilities were identified; however culverts were identified under roads for surface water drainage. There is potential for underground utilities to affect contaminant distribution and transport, if present.
Available regional or site specific geological and hydrogeological information	Geological mapping indicated geology in the Phase I Study Area is generally gravel and sand as well as minor till underlain by limestone, dolostone, shale, arkose and sandstone. Borehole log information indicated that the native soil underlying the granular road base consisted of silt and sand with trace gravel and clay. Boreholes were identified as wet at 0.9 m below grade.
Uncertainty or absence of information	No uncertainties were identified in the Phase I ESA however conclusions are drawn from available information at the time of reporting. Information not reviewed/available could affect the validity of the model.

7.0 Conclusions

BT Engineering Inc. (BTE) was retained by the Town of Innisfil to conduct a Phase I Environmental Site Assessment (ESA) in the vicinity of the proposed 6th Line and Highway 400 interchange as part of the 6th Line Interchange Class Environmental Assessment (EA) Study. BTE understands that this Phase I ESA will not be used to support the preparation of a Record of Site Condition (RSC) in accordance with Ontario Regulation (O.Reg.) 153/04 (as amended), and that the purpose of the Phase I ESA was to identify areas of potential environmental concern at the site related to the proposed 6th Line and Highway 400 interchange. The Phase I study area was expanded from the generally accepted standard of 250 m due to the land area requirements of the proposed interchange configuration alternatives of the proposed 6th Line and Highway 400 interchange.

No areas of potential environmental concern were identified for the Phase I Site or Phase I Study Area. Based on available information, it is our opinion that a Phase II ESA is not required for the Phase I Site or the properties adjacent to the site which may require land acquisition based on the currently proposed interchange configuration.

Tina Stone, P. Eng.

Project Engineer

8.0 References

Barnett, P.J., Cowan, W.R. and Henry, A.P. 1991. Quaternary geology of Ontario, southern sheet; Ontario Geological Survey, Map 2556, scale 1:1 000 000.

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FIGURE 1
SITE LOCATION

6th Line and Highway 400 Town of Innisfil Date Drafted: November 28, 2016	BT ENGINEERING BTE	SCALE NOT TO SCALE

Innisfil

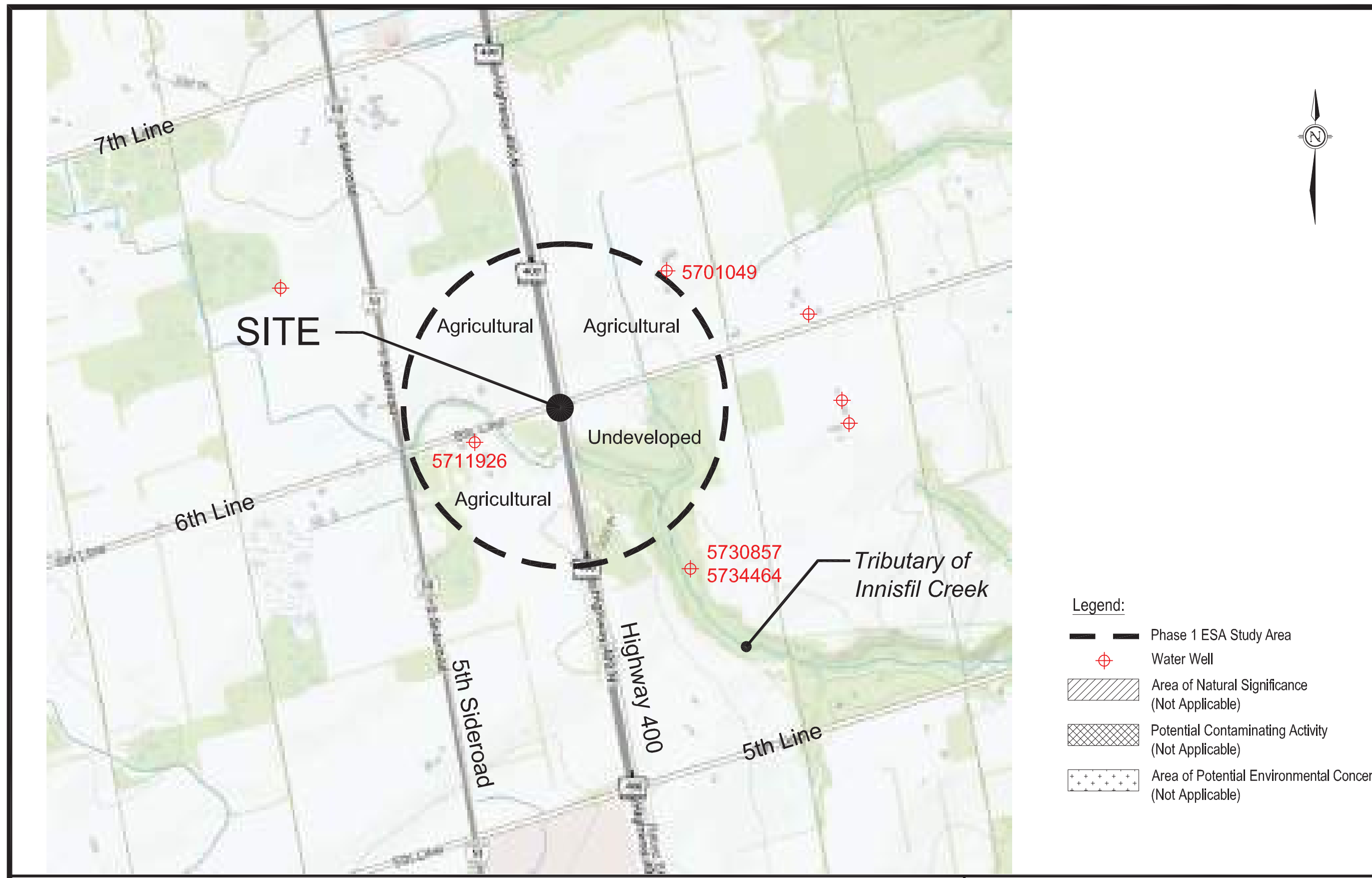


FIGURE 2
CONCEPTUAL SITE MODEL

6th Line and Highway 400 Town of Innisfil Date Drafted: November 28, 2016	BT ENGINEERING BTE	SCALE NOT TO SCALE

Innisfil

APPENDICES

Appendix A

Regulatory Responses

Tina Stone

From: Public Information Services <publicinformationservices@tssa.org>
Sent: Tuesday, November 8, 2016 9:27 AM
To: Tina Stone
Subject: RE: Information Request - Innisfil (Project 16-006)

Hi Tina,

Thank you for your inquiry.

We have no record in our database of any fuel storage tanks at the subject address (addresses).

For a further search in our archives please submit your request in writing to Public Information Services via e-mail (publicinformationservices@tssa.org) or through mail along with a fee of $56.50 (including HST) per location. The fee is payable with credit card (Visa or MasterCard) or with a Cheque made payable to TSSA.

Although TSSA believes the information provided pursuant to your request is accurate, please note that TSSA does not warrant this information in any way whatsoever.

Thanks!

Suman Guram | Coordinator
Records
345 Carlingview Drive
Toronto, Ontario M9W 6N9
Tel: +1-416-734-6203 | Fax: +1-416-231-6183 | E-Mail: sguram@tssa.org
www.tssa.org

From: Tina Stone [mailto:tina.stone@bteng.ca]
Sent: Monday, November 07, 2016 2:50 PM
To: Public Information Services <publicinformationservices@tssa.org>
Subject: Information Request - Innisfil (Project 16-006)

Hello,

Could you please perform a TSSA database search to see if there are any records available for the following addresses:

6784 5 Sideroad
3424 6th Line
3573 6th Line
3581 6th Line

All properties are located in Innisfil, Ontario.

Tina Stone
Project Engineer
100 Craig Henry Drive, Suite 201
Ottawa, Ont. K2G 5W3
E-Mail: tina.stone@bteng.ca
Phone: 613-228-4813
FAX: 1-613-280-1305
Toll Free: 1-855-228-4813
www.bteng.ca

Appendix B

Site Photographs

Photo 1: Highway 400 overpass, view eastward

Photo 2: Corrugated steel pipe culvert

Photo 3: Concrete culvert, view eastward

Photo 4: Area of stained soil located west of Highway 400, view eastward

Photo 5: Wellhead observed at 3424 6th Line, view northward

Photo 6: Creek extending south of 6th Line, east of Highway 400, view northward

Photo 7: Creek north of 6th Line, west of Highway 400, view eastward

Photo 8: Creek south of 6th Line, west of Highway 400, view eastward

Photo 9: Creek south of 6th Line, east of Highway 400, view eastward

Photo 10: Deposit, south of 6th Line, west of Highway 400

Photo 9: Creek south of 6th Line, east of Highway 400, view eastward

Photo 10: Deposit, south of 6th Line, west of Highway 400

Appendix M
Cultural Heritage Report

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE

TECHNICAL MEMO

KITCHENER
WOODBRIDGE
LONDON
KINGSTON
BARRIE
BURLINGTON

To:	**Steve Taylor, BT Engineering**
From:	**Dan Currie / Nick Bogaert, MHBC Planning**
Date:	**May 31st, 2016 (revised August 2016)**
File:	**6th Line Interchange – Environmental Assessment, MHBC File "12217 AG"**
Subject:	**PRELIMINARY CULTURAL HERITAGE SCREENING**

MHBC has been retained by BT Engineering to undertake a preliminary cultural heritage screening exercise as part of the Municipal Class Environmental Assessment (EA) and Preliminary Design for a new interchange at Highway 400 and 6th Line, in the Town of Innisfil.

The purpose of this assessment is to review historical research, mapping, previous studies and information provided by the Town of Innisfil in order to determine if there are any built heritage or cultural heritage landscape features within or adjacent to the study area that are of cultural heritage significance. Depending on the outcome of this preliminary assessment and the final design options for the interchange, a Cultural Heritage Evaluation Report (CHER) and/or a Heritage Impact Assessment (HIA) may be required in order to fully assess cultural heritage resources.

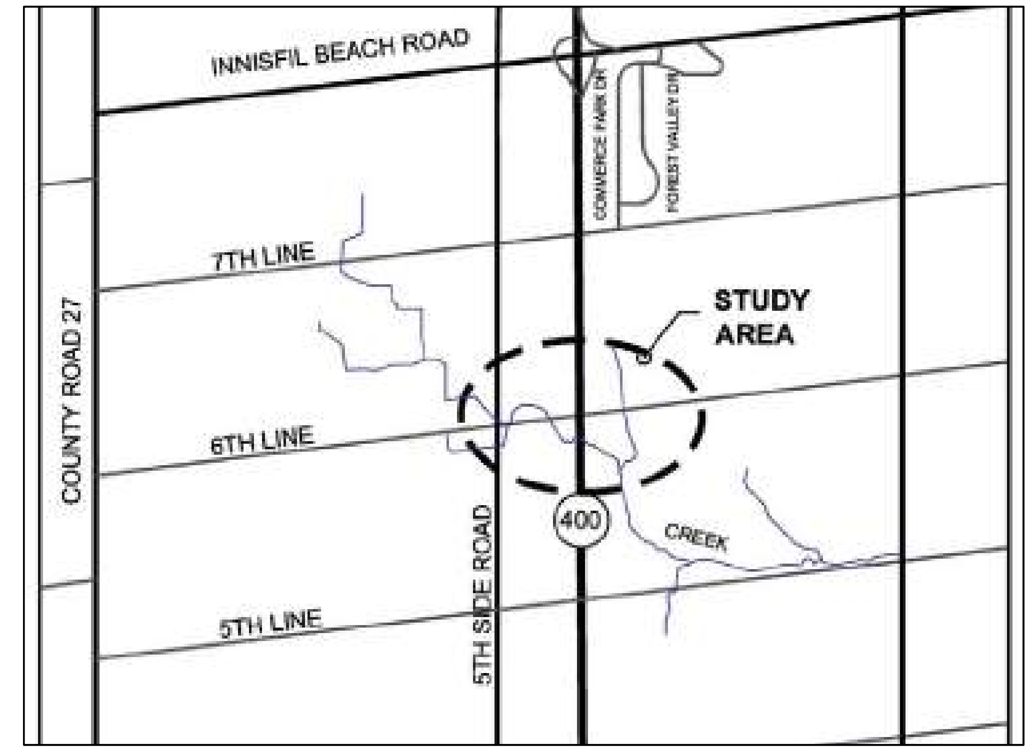
The Municipal Class EA applies to municipal infrastructure projects in Ontario, including roads, water, wastewater and transit projects. The purpose of the *Ontario Environmental Assessment Act* (R.S.O. 1990) is to provide for:

> *"...the betterment of the people of the whole or any part of Ontario by providing for the protection, conservation and wise management in Ontario of the environment."*

Environment is defined in a broad manner in the *Environmental Assessment Act* to mean the "natural, social, cultural, built and economic environments". This screening exercise focuses on the cultural environment, as it relates to built heritage and cultural heritage landscape resources. Archaeological resources are not assessed as part of this cultural heritage screening.

LOCATION AND DESCRIPTION OF STUDY AREA

The study area for the project is located in the Town of Innisfil, where 6th Line (a municipal road) intersects with Highway 400. For the purposes of this assessment, the study area is comprised of the area containing the bridge and the immediately surrounding lands. The entirety of 6th Line was previously assessed under a separate Class EA process carried out by the Town of Innisfil in order to determine required road upgrades along 6th Line from Highway 27 to St. John's Road. This earlier work has assisted the study team by providing background information regarding the lands within and surrounding the study area for this EA project. Since the surrounding area has been previously assessed for impacts of road improvements, the present Class EA therefore focuses on the bridge replacement and related on-ramps and off-ramps. The study area is depicted below:



HISTORICAL BACKGROUND OF STUDY AREA

The Town of Innisfil stems from the original Township of Innisfil, which was originally surveyed in 1820. Settlers began arriving soon after surveying, but growth was slow until the first sawmill and grist mill were erected in the 1830's. Early settlement was focused on the area around Kempenfelt Bay, and by 1843 the first school was constructed. By 1850 the Township had a population of 1,807, and following the connection of the Northern Railway the Township became an important shipping hub for the lumber industry (Archaeological Services Inc., 2015). Since the mid-1800's, the Township has continued to be a strong agricultural community, as well as host to the section of a main thoroughfare connecting Toronto and Barrie.

The construction of Highway 400 dates from the late 1940's, with the stretch of highway between Toronto and Barrie opening in late 1951. Various extensions have being undertaken in the decades following the initial development of the highway, and work continues on the extension of the highway north of Parry Sound (The Kings Highway, 2016). The 6th Line bridge was constructed in 1951, when the section of Highway 400 through Innisfil was built (MTO, 2015). The 1954 airphoto of the area surrounding the study area shows Highway 400 and the bridge structure.

200-540 BINGEMANS CENTRE DRIVE / KITCHENER / ONTARIO / N2B 3X9 / T 519 576 3650 / F 519 576 0121 / **WWW.MHBCPLAN.COM**

1954 airphoto of study area, with bridge location noted.

IDENTIFIED CULTURAL HERITAGE RESOURCES

As part of the background research conducted for this project, a search was undertaken of the municipal, provincial and federal heritage properties database in order to understand if any nearby properties are identified. The search consisted of Heritage Conservation Districts, *Ontario Heritage Act* property designations (Part IV and V), provincially-owned heritage properties and National Historic Sites. In addition, the Town of Innisfil was contacted in order to determine if there are any properties either designated under the *Ontario Heritage Act* located within the study area, or if there are any properties listed by the Municipal Heritage Committee under the *Ontario Heritage Act*.

Project team members were advised that there are no such properties within the study area, although there are two properties of interest located to the west of 5th Side Road: an early 20th century dwelling and outbuildings, as well as a former schoolhouse associated with the settlement of Killyleagh. The study team was advised that the former schoolhouse located at 3654 6th Line is on the municipal register and identified as a non-designated property of cultural heritage interest.

CURRENT CONDITIONS OF THE STUDY AREA

The study area is located within a rural area that contains a mix of agricultural and rural residential uses. There are several agricultural fields located within or adjacent to the study area, as well as farm buildings and related structures. The road is a typically rural hard-surface road, with gravel shoulder and ditches on each side of the road. An older home, garage and farm outbuildings are located at 3573 6th Line, approximately 300 metres west of the 6th Line Bridge, and a remnant farm complex consisting of a barn and silo are located on the north side of 6th Line, approximately 200 metres west of the 6th Line Bridge. Neither property has been identified by the Town as containing cultural heritage resources, but were both identified through the Environmental Assessment previously completed for 6th Line upgrades (Archaeological Services Inc., 2015). The EA documentation recommended that a site-specific heritage impact assessment of 3573 6th Line be undertaken as part of the road improvements to 6th Line.

6th Line looking west from the bridge structure

6th Line looking east from the bridge structure

Early 20th century home located at 3573 6th Line

Remnant farm complex located northeast of 3573 6th Line

Example of agricultural field north of 6th Line, adjacent to Highway 400.

Killyleagh settlement sign, located west of 5th Side Road

The 6th Line Bridge carries Highway 400 over 6th Line, and is an example of a simple rigid frame concrete slab bridge. The bridge features reinforced cast in-place concrete. The bridge has undergone various repairs since construction, most notably a major rehabilitation in 1992 and a minor rehabilitation in 2011 (MTO, 2015). The bridge does not feature any adornments, such as the Ontario crest that is found on some other bridges along Highway 400.


6th Line Bridge as viewed from the west


Underside of 6th Line Bridge


6th Line Bridge as viewed from side of Highway 400


Detail of 6th Line Bridge abutment

CONCLUSIONS RELATED TO CULTURAL HERITAGE VALUE
The *Municipal Class Environmental Assessment* (amended 2007 and 2011) provides the following definitions under "Cultural Environment" (part B – Municipal Road Projects, Page B-3):

> **Built heritage resources** means one or more significant buildings, structures, monuments, installations or remains associated with architectural, cultural, social, political, economic or military history and identified as being important to a community. These resources may be identified through designation or heritage conservation easement under the *Ontario Heritage Act*, or listed by local, provincial or federal jurisdictions.
>
> **Cultural heritage landscape** means a defined geographical area of heritage significance which has been modified by human activities and is valued by a community. It involves grouping(s) of individual heritage features such as structures, spaces, archaeological sites, and natural elements, which together form a significant type of heritage form, distinctive from that of its constituent elements or parts. Examples may include, but are not limited to, heritage conservation districts designated under the *Ontario Heritage Act*; and villages, parks, gardens, battlefields, mainstreets and neighbourhoods, cemeteries, trailways and industrial complexes of cultural heritage value.
>
> **Cultural heritage resources** include built heritage, cultural heritage landscapes, marine and other archaeological sites. The Minister of Culture (MCL) is responsible for the administration of the Ontario Heritage Act and is responsible for determining policies, priorities and programs for the conservation, protection and preservation of Ontario's heritage, which includes cultural heritage landscapes, built heritage and archaeological resources. MCL has released a series of guides on the *Ontario Heritage Act*, entitled the Ontario Heritage Tool Kit.

As noted above, Town of Innisfil staff have confirmed that there are no listed or designated properties within the study area. The schoolhouse located west of 5th Side Road is included in the Town of Innisfil heritage register as a non-designated property, but is located outside the study area. Based on our analysis, review of previous work, and the site visit undertaken on May 2nd, 2016, there are two cultural heritage resources located west of the 6th Line Bridge. These are the late 19th century dwelling, garage and outbuildings located at 3573 6th Line (approximately 300 metres from the existing bridge), and the remnant farm complex consisting of a barn and silo located on the north side of 6th Line (approximately 200 metres from the existing bridge). Preliminary interchange options appear to avoid these built heritage resources. Depending on the design carried forward, these properties may need to be evaluated and assessed further. As such, final design options for the interchange will need to be reviewed in order to determine if there is the potential for direct impacts to these properties.

Based on research conducted, the bridge structure at Highway 400 is more than 40 years old, and a CHER would normally be required to evaluate the bridge if no other evaluation had been completed. A review was undertaken of the Heritage Bridges Identification and Assessment Guide (prepared for the Ministry of Transportation), in order to determine if the 6th Line bridge was included in this earlier work. This document lists all bridges owned by the Province and constructed from 1945-1965, and identifies ones that have cultural heritage value. Since the 6th Line bridge falls within the period assessed and is located along a Provincial highway (Highway 400), the bridge was included and assessed. The bridge at 6th Line was not identified as a Class A, Class B, or Class C bridge in the Heritage Bridges Identification and Assessment Guide, and is therefore determined not to have cultural heritage value. As such, no further work is recommended or required related to the bridge structure.

NEXT STEPS AND STUDY REQUIREMENTS
Following the determination of the final design options for the interchange / bridge configuration, further assessment may need to be undertaken in order to ensure that no impacts on potential built heritage resources are anticipated.

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Appendix N
Analysis and Evaluation Report

ANALYSIS AND EVALUATION REPORT

6th Line Interchange Municipal Class Environmental Assessment

Presented to:

Town of Innisfil
2101 Innisfil Beach Road
Innisfil, ON
L9S 4B4

November 2016

BT ENGINEERING
BTE

EXECUTIVE SUMMARY

A Municipal Class Schedule 'C' Environmental Assessment is being undertaken by the Town of Innisfil, under the Municipal Class Environmental Assessment (amended 2015), to move forward with a new interchange on Highway 400 at the 6th Line. The Municipal Class EA is a planning process developed to ensure that all potential natural, social, cultural and economic environments as well as property and land use effects are considered in undertaking EA projects. The project is being described as the 6th Line Interchange EA. Based on the study recommendations and public and agency interest, the study documentation will be an Environmental Study Report (ESR). The planning process will provide a 30-day public review period of the ESR for agency and public comment.

This report summarizes the process used to systematically analyze, evaluate, rank and select the Technically Preferred Alternative (TPA) for a new interchange on Highway 400 at 6th Line. This sequential methodology includes community and stakeholder input at all key stages of the study. The effects and mitigation associated with the TPA for the Study Area may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Municipal EA which will address the interchange alternatives.

This report reflects the technical evaluation process up to the preliminary identification of the Technically Preferred Alternative (TPA). The preliminary TPA will be presented to the public at Public Open House (POH) No. 2 and may by modified following POH No. 2.

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GLOSSARY OF TERMS

AADT	Annual Average Daily Traffic – the average 24-hour, two-way traffic for the period from January 1st to December 31st.
Alignment	The vertical and horizontal position of a road.
Alternative	Well-defined and distinct course of action that fulfills a given set of requirements. The EA Act distinguishes between Alternatives to the Undertaking and Alternative Methods of Carrying out the Undertaking.
Alternative Planning Solutions	Alternative ways of solving problems or meeting demand (Alternatives to the Undertaking).
Alternative Design Concepts	Alternative ways of solving a documented transportation deficiency or taking advantage of an opportunity. (Alternative methods of carrying out the undertaking).
Alternative Project	Alternative Planning Solution, see above.
ANSI	Area of Natural or Scientific Interest
Berm	Earth landform used to screen areas.
BMP	Best Management Practice
BRT	Bus Rapid Transit
Bump-up	The act of requesting that an environmental assessment initiated as a class EA be required to follow the individual EA process. The change is a result of a decision by the proponent or by the Minister of Environment to require that an individual environmental assessment be conducted. This is described as a Part II Order. Also see Part II order.
Bypass	A form of realignment in which the route is intended to go around a particular feature or collection of features.
Canadian Environmental Assessment Act (CEAA)	The CEAA applies to projects for which the federal government holds decision-making authority. It is legislation that identifies the responsibilities and procedures for the environmental assessment.
Class Environmental Assessment Document	An individual environmental report documenting a planning process which is formally submitted under the EA Act. Once the Class EA document is approved, projects covered by the class can be implemented without having to seek further approvals under the EA Act provided the Class EA process is followed.
Class Environmental Assessment Process	A planning process established for a group of projects in order to ensure compliance with the Environmental Assessment (EA) Act. The EA Act, in Section 13, makes provision for the establishment of Class Environmental Assessments.
Coarse Screening	Initial screening of a group of alternatives. Also see Screening.
Compensation	The replacement of natural habitat lost through implementation of a project, where implementation techniques and other measures could not alleviate the effects.
Corridor	A band variable width between two locations. In transportation studies a corridor is a defined area where a new or improved transportation facility might be located.
Criterion(a)	Explicit feature or consideration used for comparison of alternatives.
Cumulative Effects Assessment	Cumulative Effects Assessment assesses the interaction and combination of the residual environmental effects of the project during its construction and operational phases on measures to prevent or lessen the predicted impacts with the same environmental effects from other past, present, and reasonably foreseeable future projects and activities.
Decibel (dB)	A logarithmic unit of measure used for expressing level of sound.
dBA	'A' weighted sound level; the human ear cannot hear the very high and the very low sound frequencies as well as the mid-frequencies of sounds, and hence the predicted sound levels, measured in dBA, are a reasonable accurate approximation of sound levels heard by the human ear.

Detail Design	The final stage in the design process in which the engineering and environmental components of preliminary design are refined and details concerning, for example, property, drainage, utility relocations and quantity estimate requirements are prepared, and contract documents and drawings are produced.
DFO	Department of Fisheries and Oceans.
Dichotomous Utility Function	A utility function that represents a desirable or undesirable response from a criterion (yes/no, present/absent, true/false).
Dimensionless Number	A number that does not have a unit of measurement, such as length (m), time (s), mass (kg) associated with it. Examples include Utility Score and Overall Score.
Do Nothing Alternative	This alternative is a mandatory requirement of the Class EA. This option is the null or no action alternative and it becomes the baseline to which all alternatives are compared.
Double Counting	Unintentional accounting for a particular factor or attribute more than once in the evaluation.
EA	Environmental Assessment
EA Act	Ontario Environmental Assessment Act (as amended by S.O. 1996 C.27), RSO 1980.
Environment	• Air, land or water, • Plant and animal life, including humans, • The social, economic and cultural conditions that influence the life of man or a community, • Any building structure, machine or other device or thing made by man, • Any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from the activities or man, or • Any part or combination of the foregoing and the interrelationships between any two or more of them, in or of Ontario.
Environmental Effect	A change in the existing conditions of the environment which may have either beneficial (positive) or detrimental (negative) effects.
Environmentally Sensitive Areas (ESA's)	Those areas identified by any agency or level of government which contain natural features, ecological functions or cultural, historical or visual amenities which are susceptible to disturbance from human activities and which warrant protection.
Equivalent Sound Level (Leq)	The level of continuous sound having the same energy as a fluctuating sound in a given time period. In this report Leq refers to 24-hour, 16 or 18-hour averages.
ESR	Environmental Study Report.
Evaluation	The outcome of a process that appraises the advantages and disadvantages of alternatives.
Evaluation Process	The process involving the identification of criteria, rating of predicted impacts, assignment of weights to criteria, aggregation of weights, and rating to produce an ordering of preference of alternatives.
External Agencies	Include Federal departments and agencies, Provincial ministries and agencies, conservation authorities, municipalities, Crown corporations or other agencies other than the City of Cambridge.
Factor	See Global Factors.
Flyover	A grade separation with the side road over the freeway. Also described as an underpass.
Freeway	Freeway is defined as an existing completed, partially developed (staged) or proposed divided highway with full control of access and grade separated intersections. This definition may include some highways that are not officially designated as freeways.
Function Form	See Utility Function
Grade Separation	The separation of a cross road with a vertical grade difference from the freeway. Also see overpass, underpass or flyover.
Global Factors	The main categories of factors, (i.e. Transportation, Economic Environment, Natural Environment, Social and Cultural, Land Use and Property and Cost). All sub-factors are components or a

	subset of global factors.
HADD	Harmful Alteration, Disturbance or Destruction of fish habitat.
Harmonized EA Process	Harmonized planning process for this project that will meet both the Provincial and Federal EA requirements.
Individual Environmental Assessment	An Environmental Assessment for an undertaking to which the EA Act applies and which requires formal review and approval under the Act.
Interchange	The intersection between two roadways at different levels with connecting ramps for traffic turning between them.
Linear Utility Function	A function that can be defined using a linear equation of the form: y = a + bx, where y is the dependent variable (raw score) x is the independent variable (measurement) b is the slope of the function, and a is the y intercept, normalized in this study to be equal to one or zero
Matrix	A rectangular array of criteria and values.
Mitigating Measure	A measure that is incorporated into a project to reduce, eliminate or ameliorate detrimental environmental effects.
Mitigation	Taking actions that either remove or alleviate to some degree the negative impacts associated with the implementation of alternatives.
MNRF	Ministry of Natural Resources and Forestry
MOECC	Ministry of the Environment and Climate Change
MTO	Ministry of Transportation Ontario
Noise Attenuation	A mitigation measure used to lessen the intensity of the noise level (dBA) where the noise level is increased in a noise sensitive area greater than 5 dBA 10 years after completion.
NSA	Noise Sensitive Area is a noise sensitive land use, which has an outdoor living area associated with the residential unit.
OLA	Outdoor Living Area is the part of an outdoor amenity area provided for the quiet enjoyment of the outdoor environment.
Overall Score	The final value of an alternative's score derived by summing all of the weighted scores.
Part II Order	The Environmental Assessment Act (EAA) has provisions that allow an interested person, Aboriginal community, or government agency to ask for a higher level of assessment for a class environmental assessment (Class EA) project if they feel that there are outstanding issues that have not been adequately addressed. This is known as a Part II Order.
Planning Alternatives	Planning alternatives are "alternative methods" under the EA Act. Identification of significant transportation engineering opportunities while protecting significant environmental features as much as possible.
Planning Solutions	That part of the planning and design process where alternatives to the undertaking and alternative routes are identified and assessed. Also described as "Alternative Project" under the federal EA Act.
POH	Public Open House
Prime Agricultural Areas	Prime agricultural areas as defined in municipal official plans and other government policy sources.
Project	A specific undertaking planned and implemented in accordance with this Class EA including all those activities necessary to solve a specific transportation problem.
Proponent	A person or agency that carries or proposes to carry out an undertaking, or is the owner or person having change, management, or control of an undertaking.
Public	Includes the general public, interest groups, associates, community groups, and individuals, including property owners.
RA	Responsible Authority from the Federal government who will act as the lead agency in administering the processing of the federal CEAA screening for this project.

Ranking	The ordering of alternatives from first to last for comparison purposes.
Raw Data	The measurement of the impact, or measured data, under each criterion.
Realignment	Replacement or upgrading of an existing roadway on a new or revised alignment.
Recommended Plan	That part of the planning and design process, during which various alternative solutions are examined and evaluated including consideration of environmental effects and mitigation measures; the recommended design solution is then developed in sufficient detail to ensure that the horizontal and vertical controls are physically compatible with the proposed site, that the requirements of lands and rights-of-way are satisfactorily identified, and that the basic design criteria or features to be contained in the design have been fully recognized and documented in sufficient graphic detail to ensure their feasibility.
Risk	Probability that a given outcome will or will not materialize. Distinct from uncertainty in that the alternative outcomes are known or defined and that the probability of each is measureable.
Route Alternatives	Location alternatives within a corridor.
SADT	Summer Average Daily Traffic – the average 24-hour, two way traffic for the period from July 1st to August 31st including weekends.
Screening	Process of eliminating alternatives from further consideration, which do not meet minimum conditions or categorical requirements.
Step Function	A utility function can be defined by several linear functions within separate ranges that have a slope equal to zero. For this study, two step functions are used: Case A: y = 1, for x = desirable and y = 0, for x = undesirable Case B: y = 1 for x = desirable, y = 0.5 for x = medium performance and y = o for x = undesirable
Study Team	The Study Team will include the City of Cambridge and Consultant Technical management team who will lead all technical elements of the study.
Sub-factor	A single criterion used for the evaluation. Each sub-factor is grouped under one of the factors.
TAC	Technical Advisory Committee
TPA	Technically Preferred Alternative
TPP	Technically Preferred Plan
Traceability	Characteristic of an evaluation process which enables its development and implementation to be followed with ease.
Undertaking	In keeping with the definition of the Environmental Assessment act, a project or activity subject to an Environmental Assessment.
Utility Function	A function (linear, step, dichotomous) that represents the Utility Score versus the criterion measurement or desirableness.
Utility Score	The “y” value derived from the Utility Function of the measurement of the impact induced by a particular alternative’s criterion. A measurement of the usefulness or attractiveness of an alternative with respect to an individual evaluation criterion based on its measured effect (a number between 0 and 1). The utility score is dimensionless.
Weight	The importance attributed to a criterion relative to other criterion. The value of the weight is expressed in a percentage and the sum of all criterion weights is equal to 100%.
Weighted Additive Method	The method used in the quantitative evaluation of alternatives, which reduces the project’s numerous criteria into a dimensionless number for each alternative suitable for comparison.
Weighted Score	A raw score that has been multiplied by the criterion weights. The weighted scores reflect the social value or importance of the specific group providing weights.

1 INTRODUCTION

The purpose of this report is to summarize the analysis and evaluation of the interchange alternatives for the 6th Line Interchange. This report is a component of the Municipal Class Schedule 'C' Environmental Assessment (EA). Based on the study recommendations and public and agency interest, the study documentation will produce an Environmental Study Report (ESR) which will be available for a 30-day public review period.

The EA process requires that all candidate alternatives be evaluated in a manner that is systematic, traceable and transparent. This includes a commitment to open and meaningful public consultation. The analysis and evaluation process must recognize public and agency input as well as Municipal and MTO standards and requirements. This report documents the decision-making process used to select the Technically Preferred Alternative (TPA), including the following activities:

- Assessment of Alternative Planning Solutions;
- Development of a long-list of interchange alternatives;
- Identification of the candidate long-list of assessment factors and sub-factors and screening out those where there were no meaningful and measurable differences among the alternatives as well as those that do not apply to the study area, based on the site inventories carried out;
- Screening out of alternatives which do not achieve the basic project requirements and/or do not comply with MTO standards/requirements;
- Identification of the benefits and potential impacts for the short-listed alternatives;
- Evaluation of select groups of alternatives using a qualitative assessment where the number of alternatives was low or there were a small number of evaluation criteria to distinguish between alternatives;
- Evaluation of short-listed alternatives using a recognized evaluation technique including weighting the relative importance of criteria;
- Ranking alternatives;
- Sensitivity testing to assess the robustness of the evaluation and alternative scores; and
- Selection of the TPA based on the evaluation results.

At the conclusion of the evaluation exercise, the combination of the TPA and minor refinements will be presented as the Recommended Plan of improvements.

2 STUDY PURPOSE

2.1 Scope

This project will evaluate interchange alternatives for the 6th Line Interchange at Highway 400.

This study is following the Class EA process for a Schedule 'C' project under the Municipal Class Environmental Assessment (EA). At the completion of this study, an ESR will be prepared and published for public review.

Several alternatives have been reviewed for a new interchange. Engineering, environmental, and property requirements will be established, along with the identification of mitigation measures to reduce or negate short term (construction related) and long term residual effects.

3 STUDY AREA

The Environmental Assessment (EA) Study is for a new interchange at 6th Line on Highway 400. This study will determine the appropriate strategy for the new interchange. The Study Area is shown in **Figure 3.1**.

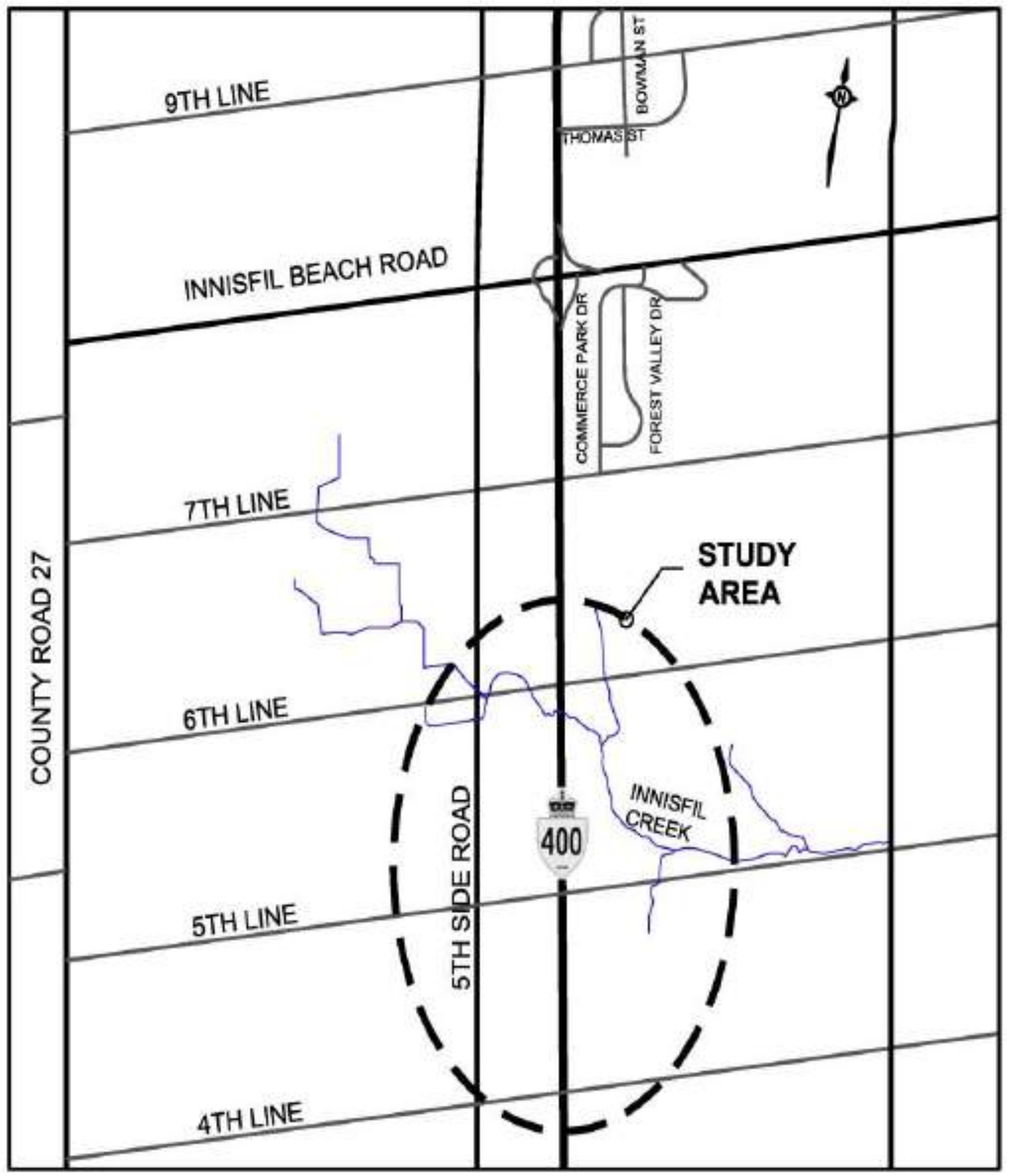

Figure 3.1: Study Area

4 ASSESSMENT OF ALTERNATIVE PLANNING SOLUTIONS

The analysis and evaluation process involves a 2-step decision-making process. Initially the study documents the analysis and evaluation of Alternative Planning Solutions (alternative project types or alternative strategies to address the problem) followed by the subsequent assessment of preliminary design alternatives.

The Town's Transportation Master Plan (TMP) identified the need for a new Highway 400 interchange as one of the Town's long term transportation priorities. The alternative solutions presented for analysis in Section 8.4.3 of the TMP were as follows:

1) Interchange at the 5th Line
2) Interchange at the 6th Line

4.1 Regional TMP Alternative Planning Solutions/Alternatives to the Undertaking

The Alternative Planning Solutions (defined as Alternative Planning Strategies in the Innisfil TMP) represent candidate strategies for meeting the needs of the problem statement of the Town:

1) Alternative 1: The "Do Nothing" Alternative.
2) Alternative 2: Business as Usual.
3) Alternative 3: Balanced Approach
4) Alternative 4: Aggressive Approach

A summary of the evaluation is documented in Section 7.5 of the TMP. The evaluation is shown in **Figure 4.1** (Table 7-2 of the TMP). Alternatives 1 and 2 were screened out based on not meeting future traffic demands. Alternatives 3 and 4 were carried forward for further evaluation.

Criterion	Alternative 1: Do Nothing	Alternative 2: Business As Usual	Alternative 3: Balanced Approach	Alternative 4: Aggressive Approach
Transportation Service	○	◑	◕	●
Natural Environment	●	◕	◕	◕
Policy Environment	○	◔	●	◕
Socio-Economic Environment	○	◑	◕	●
Financial Implications	●	◕	◑	○
Preliminary Findings:	Screened Out	Screened Out	Carried Forward	Carried Forward

Legend: Does Not Meet Criterion ○ ◔ ◑ ◕ ● Meets Criterion

Figure 4.1: Evaluation Summary of Alternative Planning Solutions/Alternatives to the Undertaking (Source: Innisfil 2013 TMP)

While the Town of Innisfil and the Simcoe County OP's currently identifies an interchange at 5th Line on Highway 400, the Town of Innisfil TMP recognizes it may be more beneficial to the Town for the interchange to be located at 6th Line to support future growth and provide better access to Innisfil Heights and the Sleeping Lion development. The documentation of the review and validation of the previous analysis of the preferred location for the interchange is described in **Section 7.3**.

The generalized planning process is presented in **Figure 4.2** illustrating the step where the Assessment of Alternative Planning Solutions is undertaken. The documentation of this assessment is presented in a separate report in **Appendix A (Assessment of Alternative Planning Solutions)**.

This recommendation was presented at POH No. 2 and there were no public or agency comments objecting to this study recommendation.

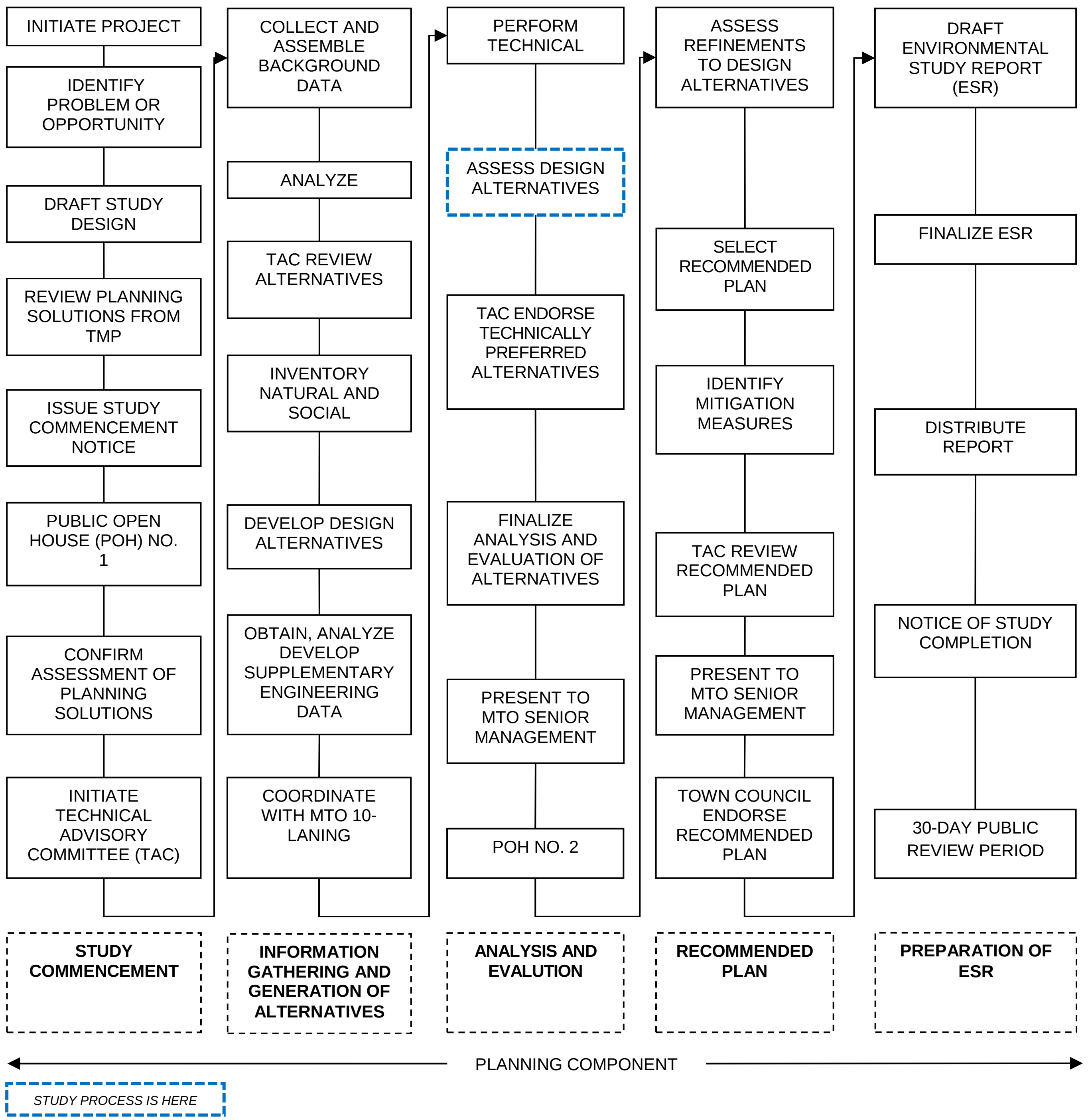

Figure 4.2: Simplified Generalized Preliminary Design Planning Process

4.2 Alternative Planning Solutions for Alcona Growth

In determining the preferred planning alternative for the Town (Alternative 3: Balanced Approach), Alternative Planning Solutions were further analyzed as part of this current EA study for the growth of Alcona. This further review and validation meets the requirements of the Class EA. The planning alternatives include:

1) Alternative 1: “Do Nothing”
2) Alternative 2: Restrict Development
3) Alternative 3: Transportation Demand Management (TDM)
4) Alternative 4: Transportation System Management (TSM)
5) Alternative 5: New Infrastructure (Interchange on Highway 400)

The following recommendations were presented to the Technical Advisory Committee and public at POH No. 1:

1) T**he “Do Nothing” Alternative** – as mandated by the Class EA, must be considered. It represents a baseline from which other approaches can be compared.
2) **Restrict Development** – this strategy would be an approach that would limit any new residential development and therefore eliminate the need for a new interchange.
3) **Transportation Demand Management (TDM)** – This strategy would reduce vehicular demand and would encourage more active modes of transportation (cycling and walking).
4) **Transportation System Management (TSM) –** This strategy would consider operational improvements to existing infrastructure to improve the performance of traffic operations. System improvements may include signal timing improvements, signal coordination or introduction of improvements such as turn lanes.
5) **New Infrastructure** – This strategy would be to provide roadway improvements and a new interchange to accommodate future demand.

4.2.1 *Coarse Screening of Planning Solutions*

Based on planned developments in the area (Sleeping Lion and Innisfil Heights) and projected increase in traffic, the “Do Nothing” alternative and Restricting Development are not recommended to be carried forward.

The TDM and TSM alternatives are not carried forward as standalone solutions, but rather will be incorporated with the New Infrastructure alternative as a Recommended Solution. This recommendation is consistent with the findings of the 2013 TMP and was presented to the public at POH No. 1 and received no objections.

Also presented at the first POH was the comparison of the alternative interchange locations which included the 4th, 5th, and 6th Lines. The comparison table is shown in **Table 4.1** and detailed in the review of Alternative Planning Solutions, described in a technical memorandum, available in **Appendix A**.

Table 4.1: Interchange Location Evaluation Summary

Criteria	4th Line Interchange	5th Line Interchange	6th Line Interchange
Network Wide Benefit (addresses Innisfil Beach Road Capacity Constraint)	×	×	✓
Supports Future Growth Areas	×	-	✓
Environmental Impacts	-	-	-
Property Impacts	-	-	-
Constructability and Cost	-	×	✓
Proximity to Current Development	×	-	✓
Proximity to Projected Development	×	-	✓
Interchange Spacing	✓	✓	-
Highway Geometry - Spatial Separation from Travel Centre	×	×	-
Recommended to be carried forward?	No	No	Yes

5 GENERATION AND ASSESSMENT OF PRELIMINARY DESIGN ALTERNATIVES

The analysis and evaluation process is a central requirement of the EA process and has been the subject of review by the Ministry of the Environment and Climate Change (MOECC). MOECC's review of *Evaluation Methods in Environmental Assessment* provided the framework for the detailed evaluation processes to be followed for this study.

Within the Study Area, several alternatives have been generated for consideration. The long list of alternatives, a description of each alternative, and a coarse screening of the alternatives are found in this section of the report.

The alternatives involve a combination of 6th Line roadway horizontal alignment alternatives, 6th Line roadway vertical alignment alternatives and interchange configuration alternatives. An example of how these will combine to create an overall Technically Preferred Alternative is illustrated in **Figure 5.1**.

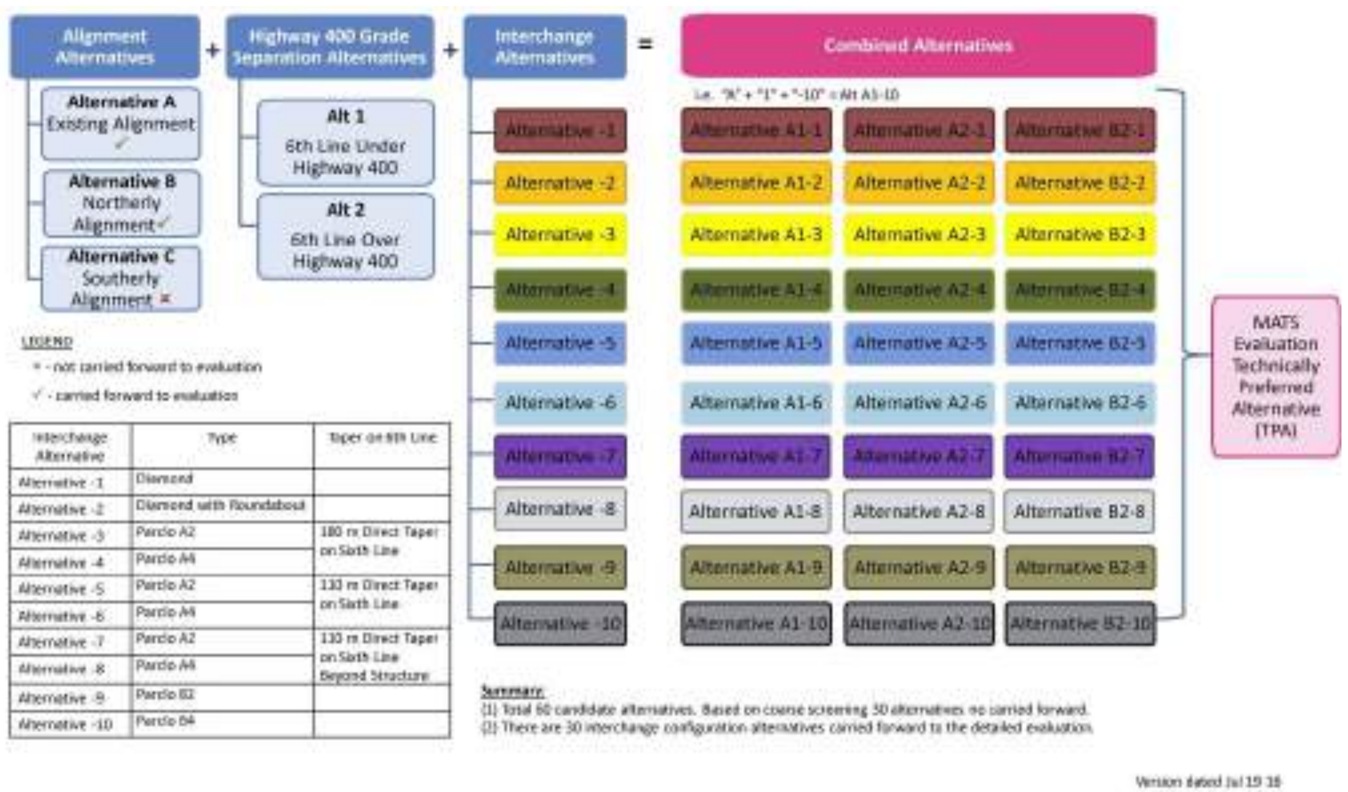

Figure 5.1: Combination of Alternatives to Develop the Technically Preferred Alternative

Table 5.1 illustrates gives details on the alternative numbering for the interchange alternatives.

Table 5.1: Interchange Alternative Numbering

Horizontal / Vertical Alignment	Alternative Number	Interchange Type	Design Speed on Sixth Line	Taper on Sixth Line
Alternative A1: Current / 6th Line under Highway 400	Alt A1-1	Diamond		
	Alt A1-2	Diamond with Roundabout		
	Alt A1-3	Parclo A2	100 km/h Design Speed	180 m Direct Taper on Sixth Line
	Alt A1-4	Parclo A4		
	Alt A1-5	Parclo A2	80 km/h Design Speed	110 m Direct Taper on Sixth Line
	Alt A1-6	Parclo A4		
	Alt A1-7	Parclo A2		110 m Direct Taper on Sixth Line Beyond Structure
	Alt A1-8	Parclo A4		
	Alt A1-9	Parclo B2		
	Alt A1-10	Parclo B4		
Alternative A2: Current / 6th Line over Highway 400	Alt A2-1	Diamond		
	Alt A2-2	Diamond with Roundabout		
	Alt A2-3	Parclo A2	100 km/h Design Speed	180 m Direct Taper on Sixth Line
	Alt A2-4	Parclo A4		
	Alt A2-5	Parclo A2	80 km/h Design Speed	110 m Direct Taper on Sixth Line
	Alt A2-6	Parclo A4		
	Alt A2-7	Parclo A2		110 m Direct Taper on Sixth Line Beyond Structure
	Alt A2-8	Parclo A4		
	Alt A2-9	Parclo B2		
	Alt A2-10	Parclo B4		
Alternative B2: Northerly / 6th Line over Highway 400	Alt B2-1	Diamond		
	Alt B2-2	Diamond with Roundabout		
	Alt B2-3	Parclo A2	100 km/h Design Speed	180 m Direct Taper on Sixth Line
	Alt B2-4	Parclo A4		
	Alt B2-5	Parclo A2	80 km/h Design Speed	110 m Direct Taper on Sixth Line
	Alt B2-6	Parclo A4		
	Alt B2-7	Parclo A2		110 m Direct Taper on Sixth Line Beyond Structure
	Alt B2-8	Parclo A4		
	Alt B2-9	Parclo B2		
	Alt B2-10	Parclo B4		

5.1 Interchange Alternatives

Horizontal Alignment Alternatives

Three horizontal roadway alignment alternatives were identified as follows:

- Alternative A: Existing Alignment, see **Figure 5.2**;
- Alternative B: 50 m Northerly Shift, see **Figure 5.3**; and,
- Alternative C: 50 m Southerly Shift, see **Figure 5.4**.

Alternative C (50 m southerly shift) was coarse screened to not be carried forward due to the impacts to the natural environment.

Vertical Alignment Alternatives

Two vertical roadway alignments (Highway 400 grade separation) were identified and carried forward as follows:

- Alternative 1: 6th Line under Highway 400; and,
- Alternative 2: 6th Line over Highway 400.

Interchange Configuration Alternatives

Ten interchange configuration alternatives were identified and carried forward for the evaluation as follows:

- Alternative 1: Diamond, see **Figure 5.5**;
- Alternative 2: Diamond with Roundabout, see **Figure 5.6**;
- Alternative 3: Parclo A2 with 180 m direct taper on 6th Line, design speed of 100 km/h, see **Figure 5.7**;
- Alternative 4: Parclo A4 with 180 m direct taper on 6th Line, design speed of 100 km/h, see **Figure 5.8**;
- Alternative 5: Parclo A2 with 110 m direct taper on 6th Line, design speed of 80 km/h, see **Figure 5.9**;
- Alternative 6: Parclo A4 with 110 m direct taper on 6th Line, design speed of 80 km/h, see **Figure 5.10**;
- Alternative 7: Parclo A2 with 110 m direct taper on 6th Line beyond structure, design speed of 80 km/h, see **Figure 5.11**;
- Alternative 8: Parclo A4 with 110 m direct taper on 6th Line beyond structure, design speed of 80 km/h, see **Figure 5.12**;
- Alternative 9: Parclo B2, see **Figure 5.13**; and,
- Alternative 10: Parclo B4, see **Figure 5.14**.

Figure 5.2: Horizontal Alignment Alternative A

Figure 5.3: Horizontal Alignment Alternative B

Figure 5.4: Horizontal Alignment Alternative C (not carried forward)

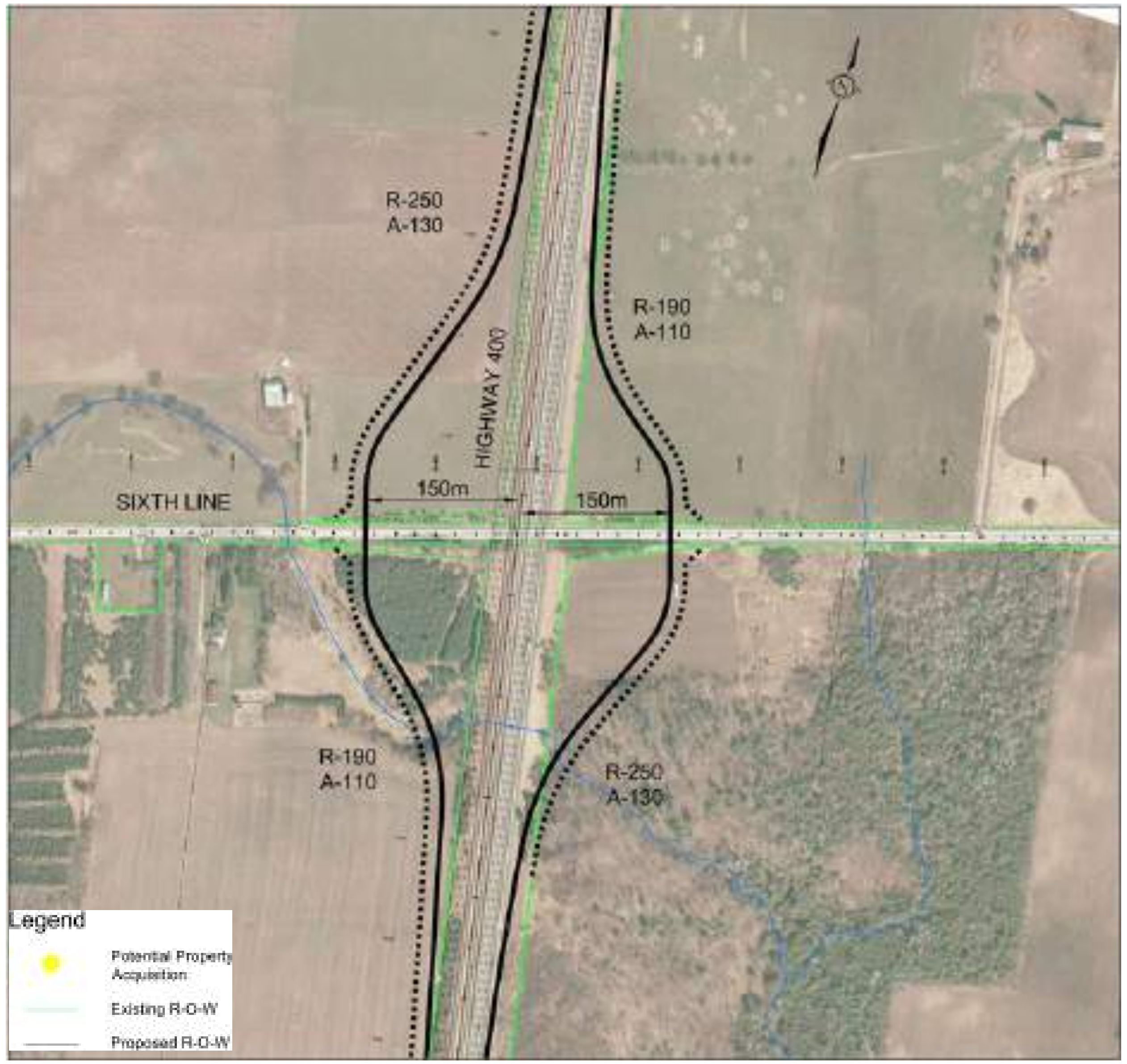

Figure 5.5: Interchange Configuration Alternative 1

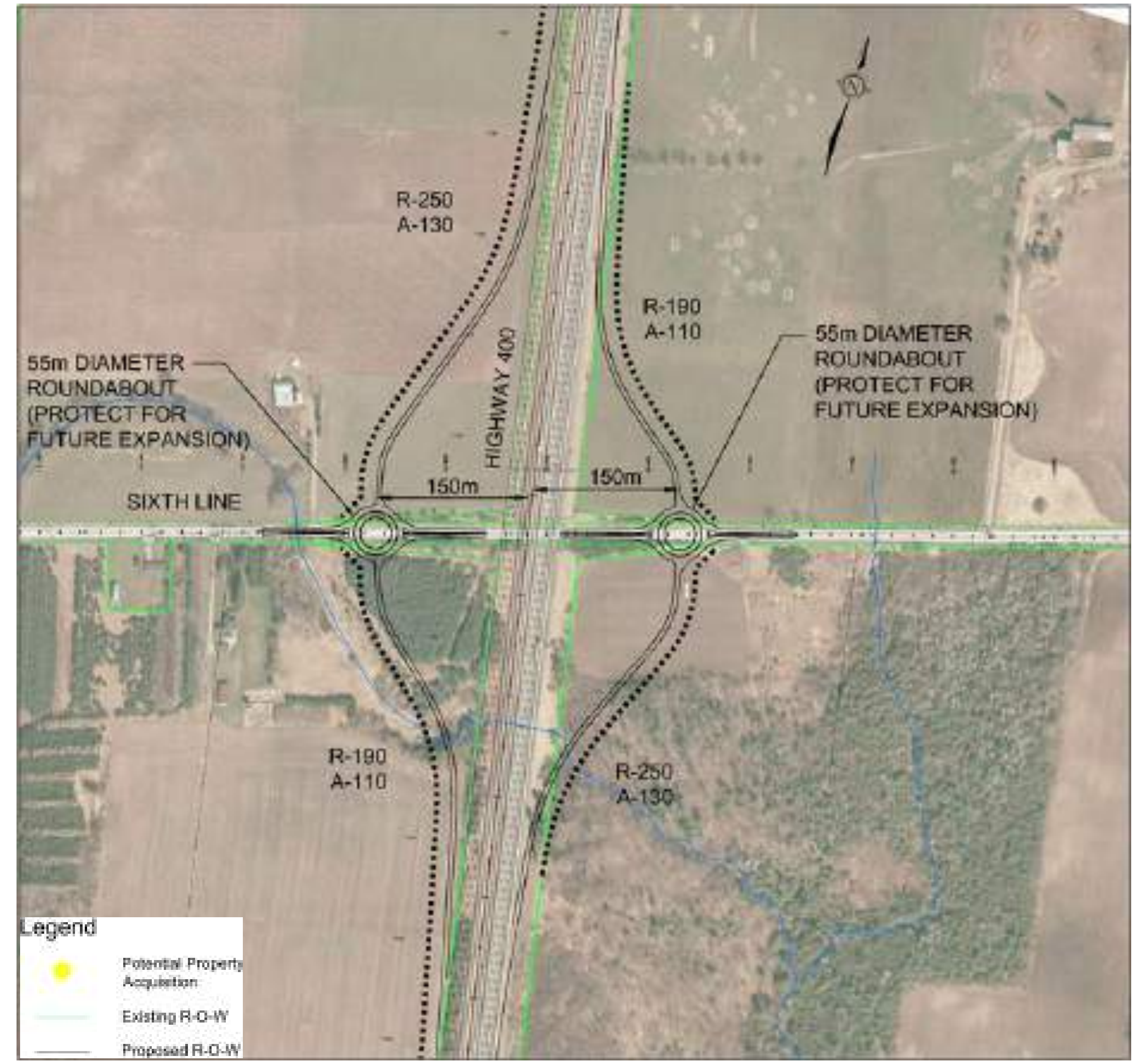

Figure 5.6: Interchange Configuration Alternative 2

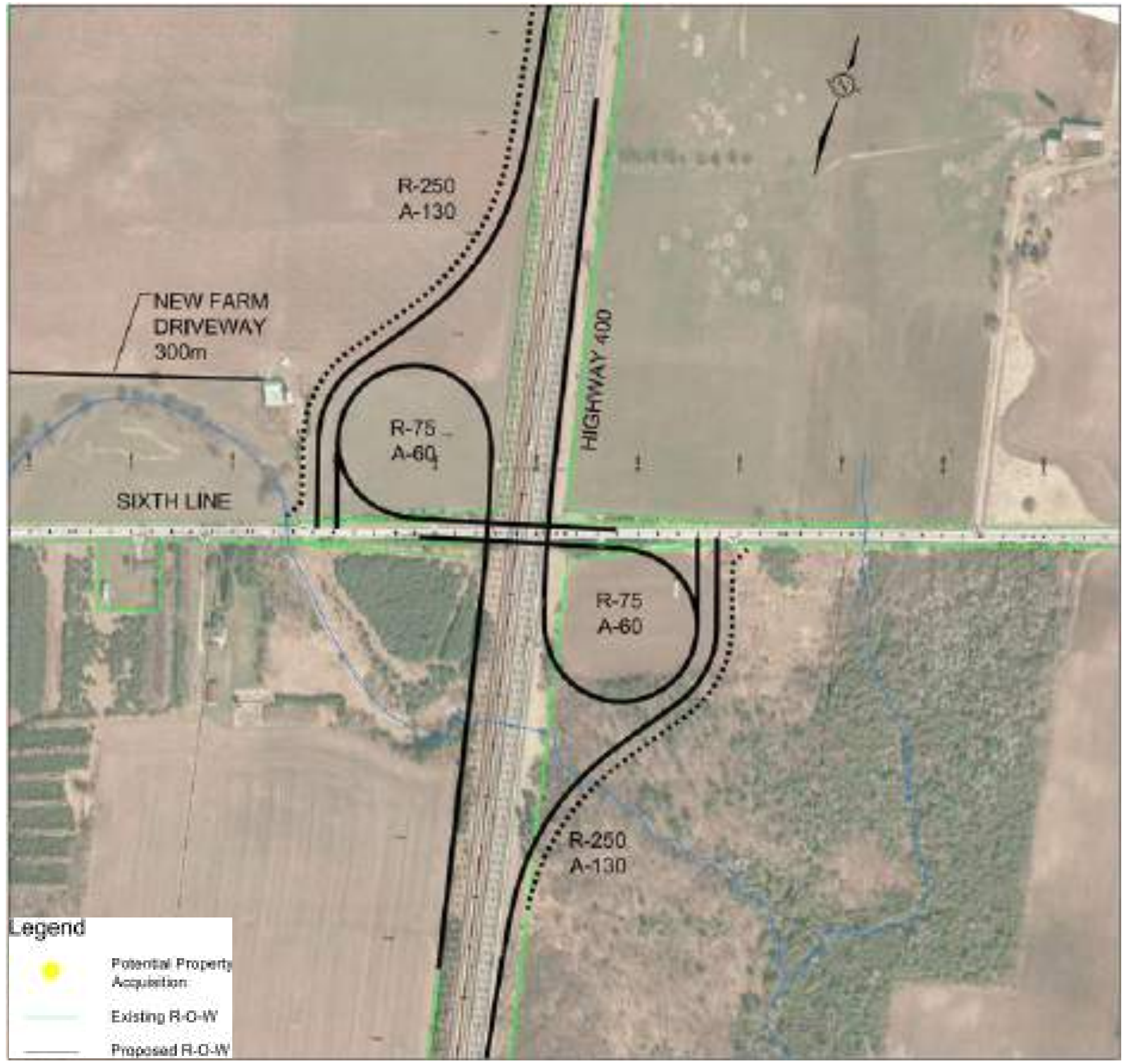

Figure 5.7: Interchange Configuration Alternative 3

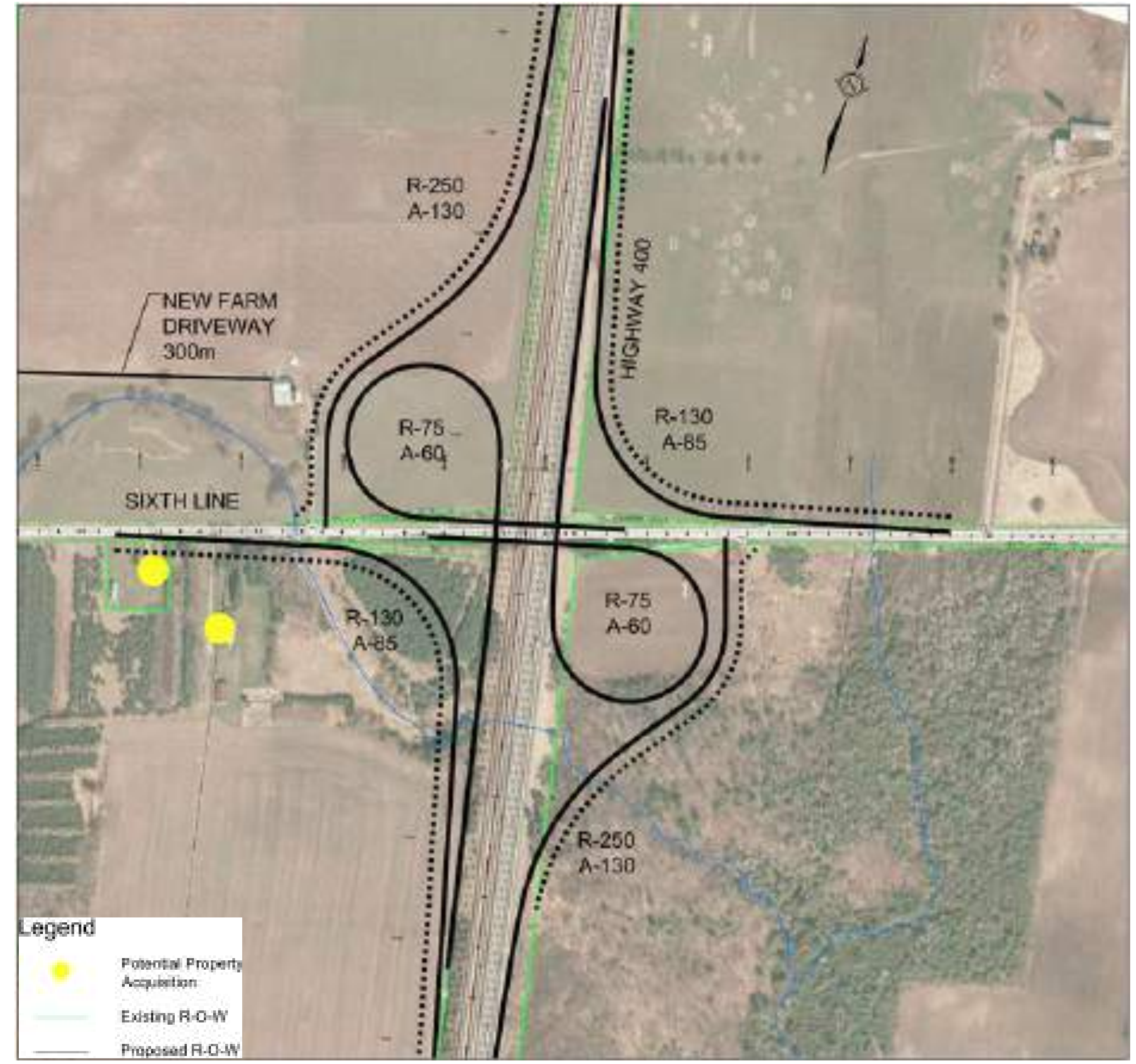

Figure 5.8: Interchange Configuration Alternative 4

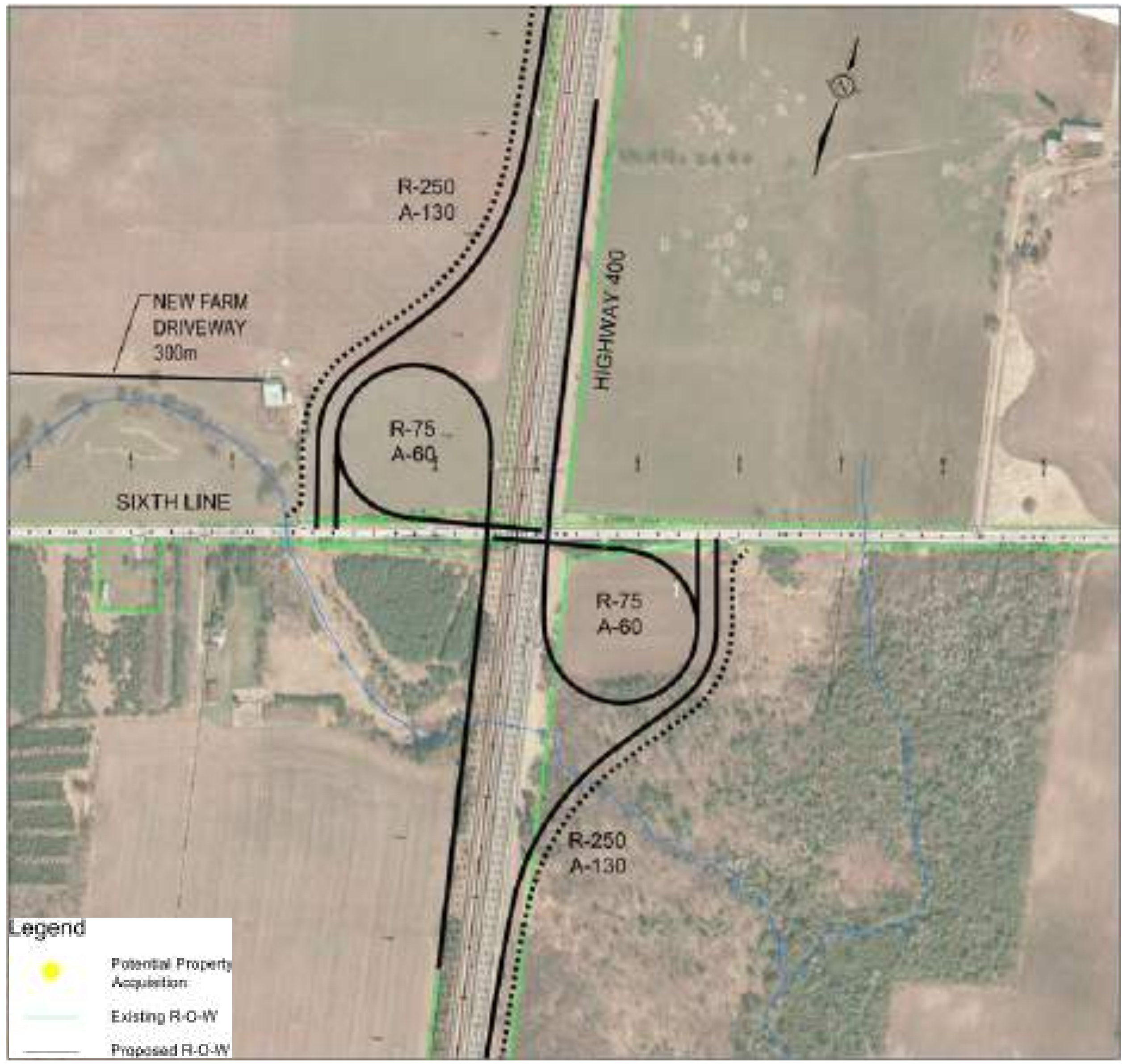

Figure 5.9: Interchange Configuration Alternative 5

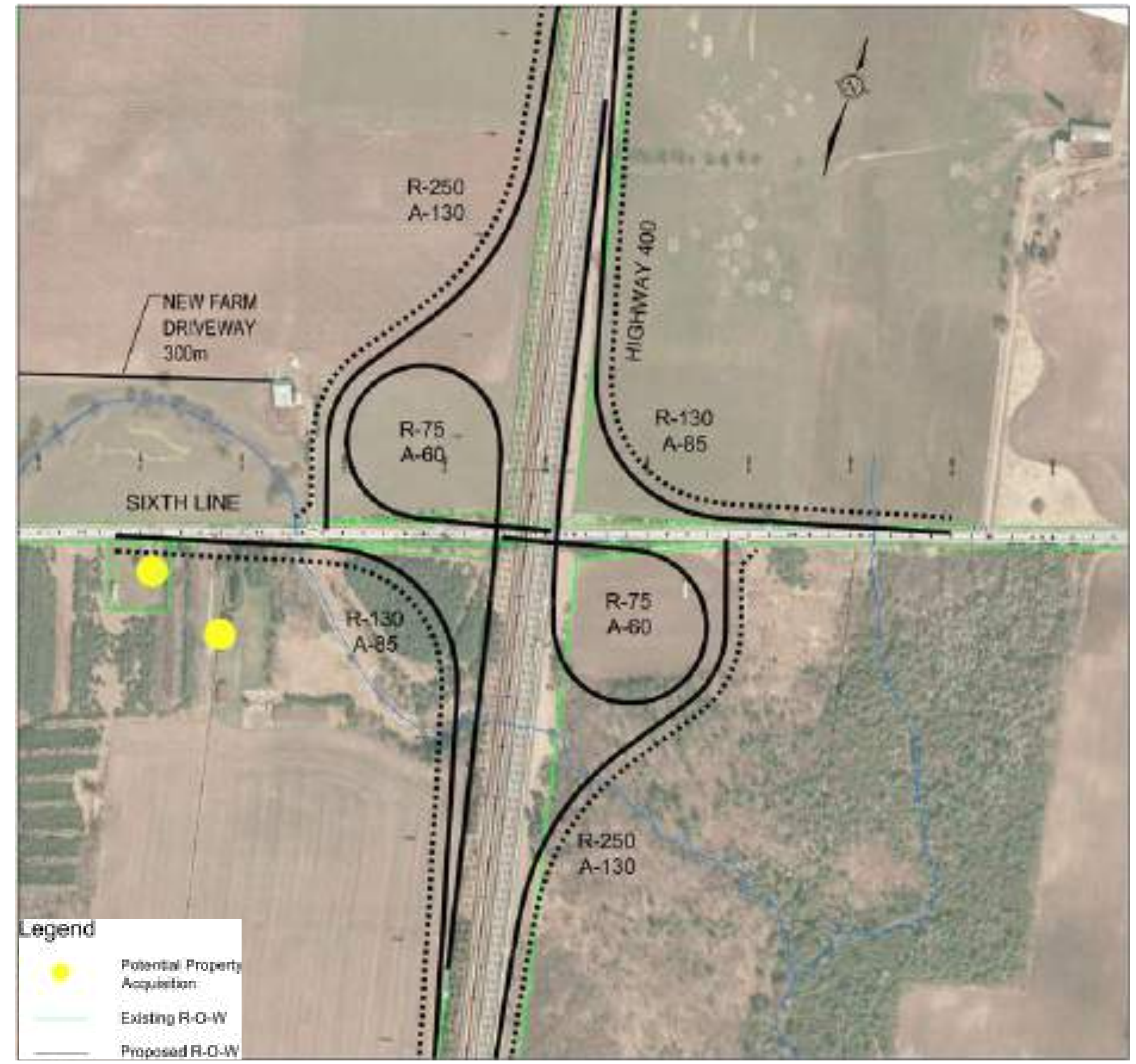

Figure 5.10: Interchange Configuration Alternative 6

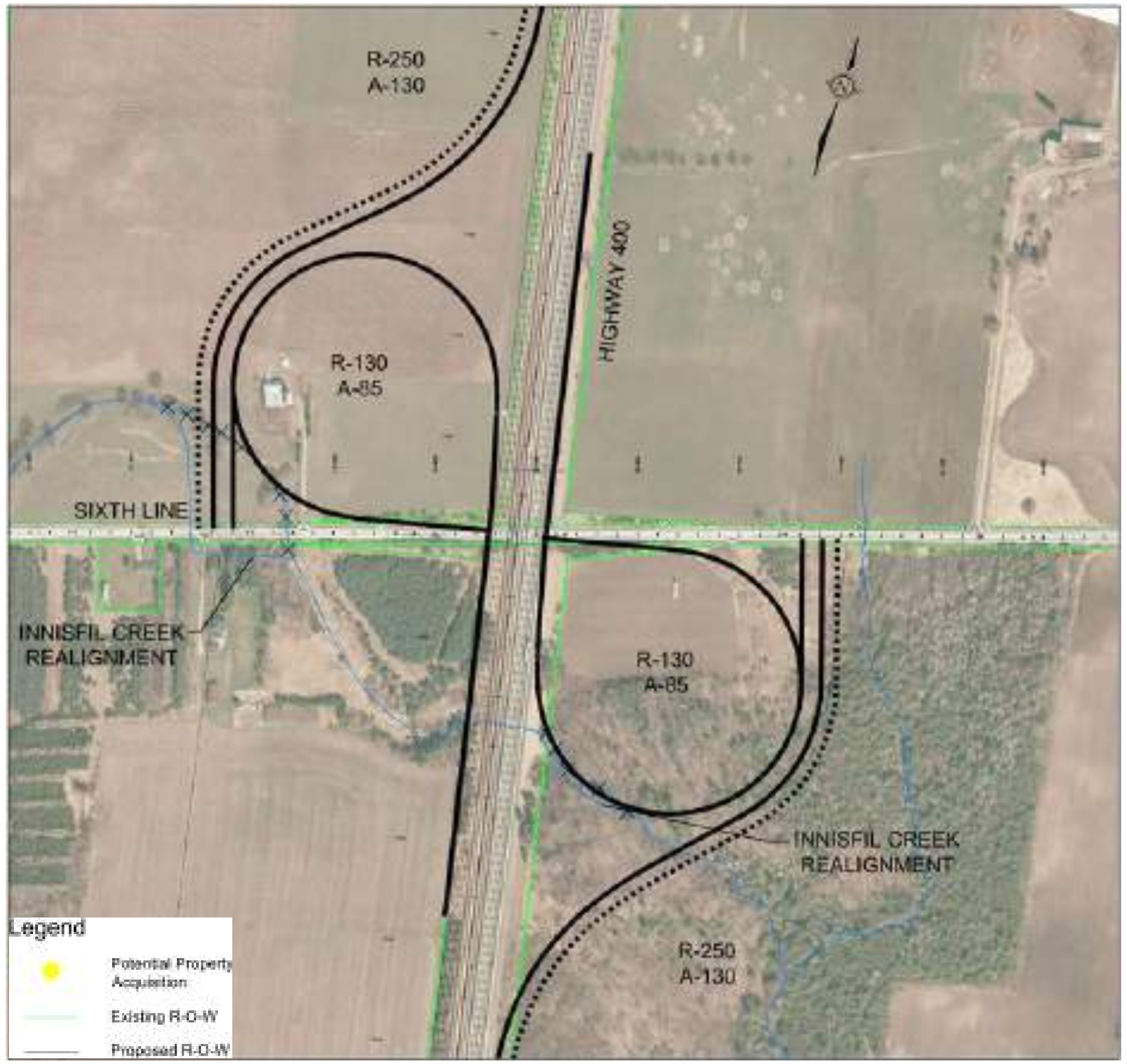

Figure 5.11: Interchange Configuration Alternative 7

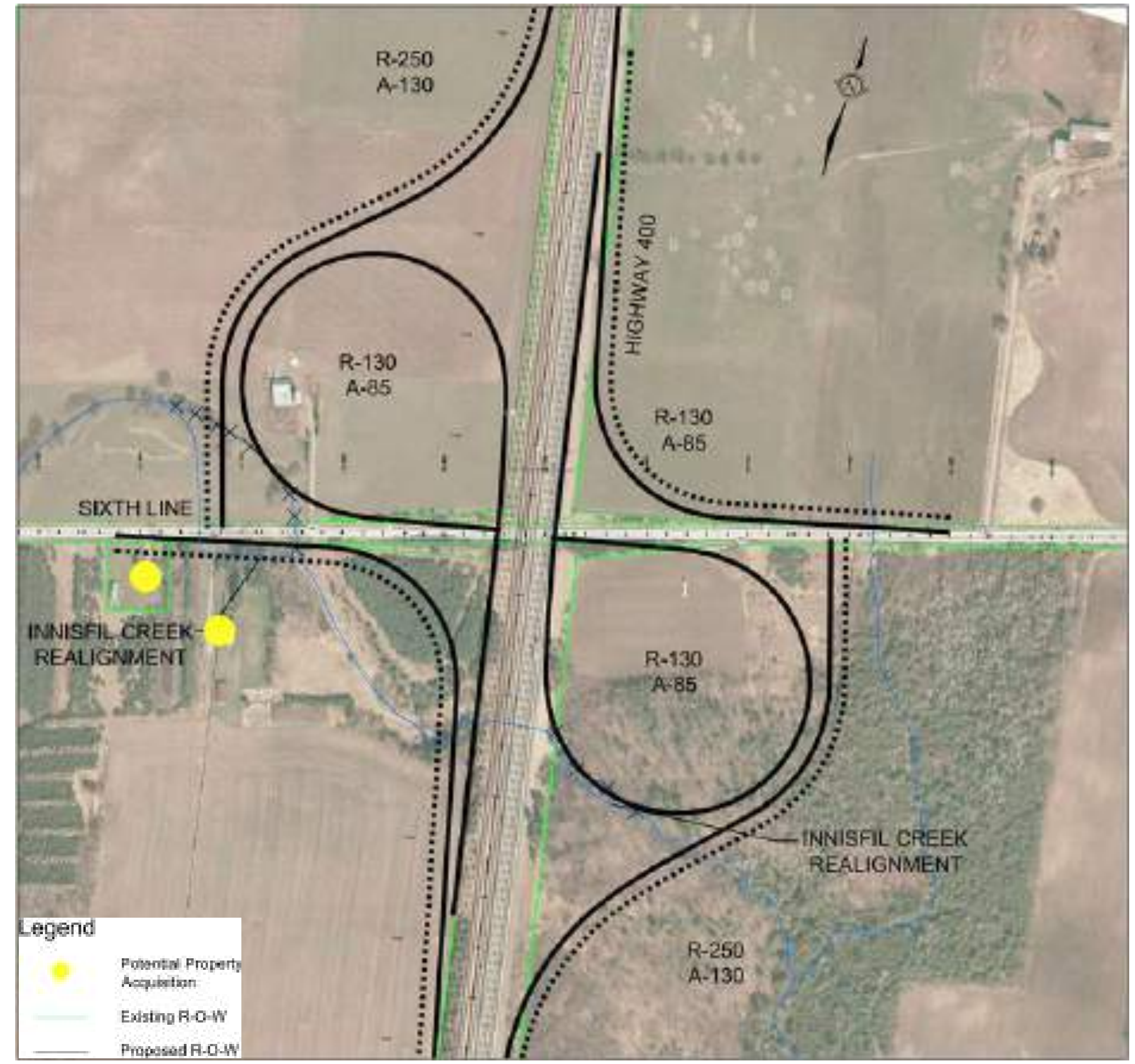

Figure 5.12: Interchange Configuration Alternative 8

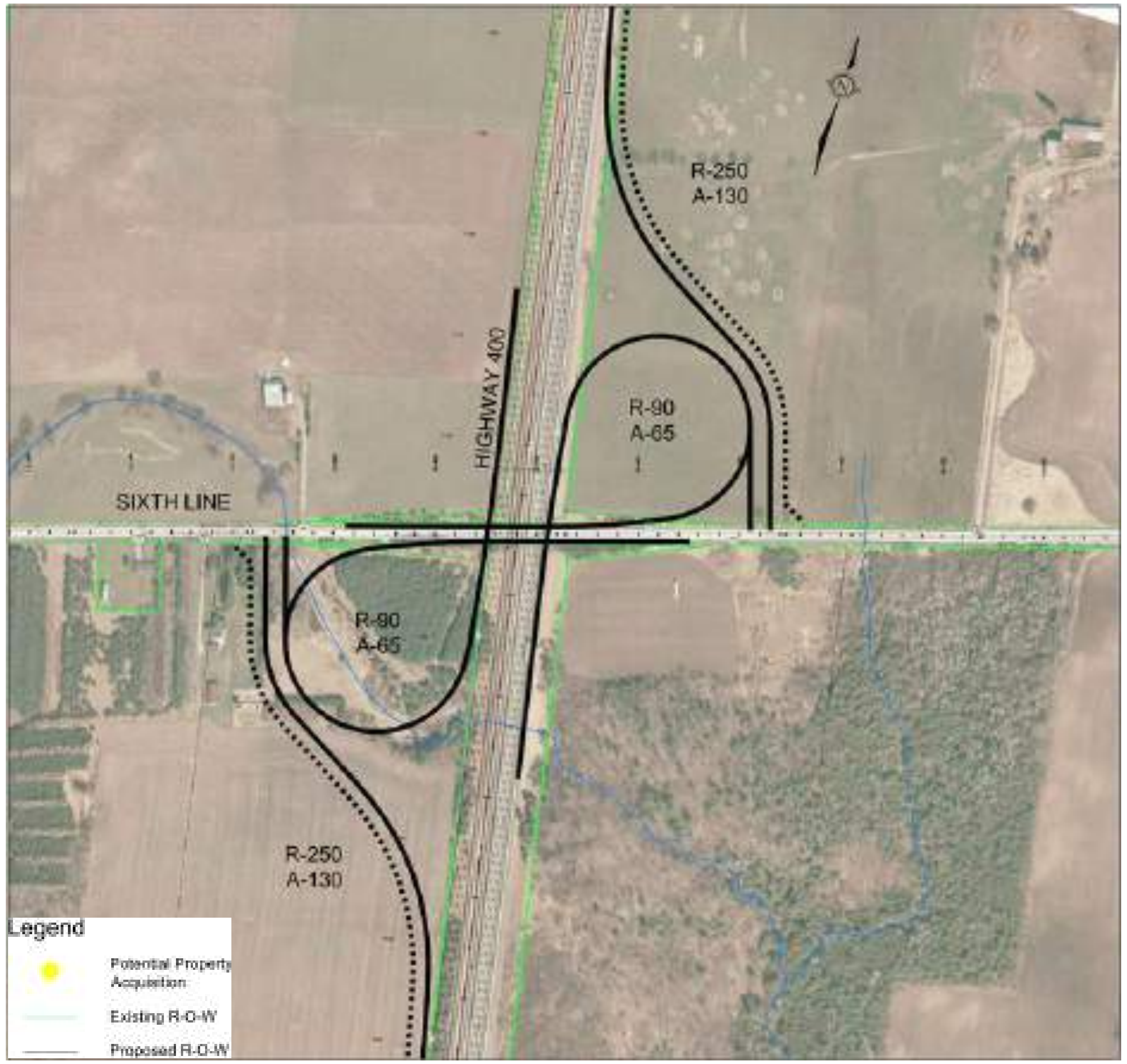

Figure 5.13: Interchange Configuration Alternative 9

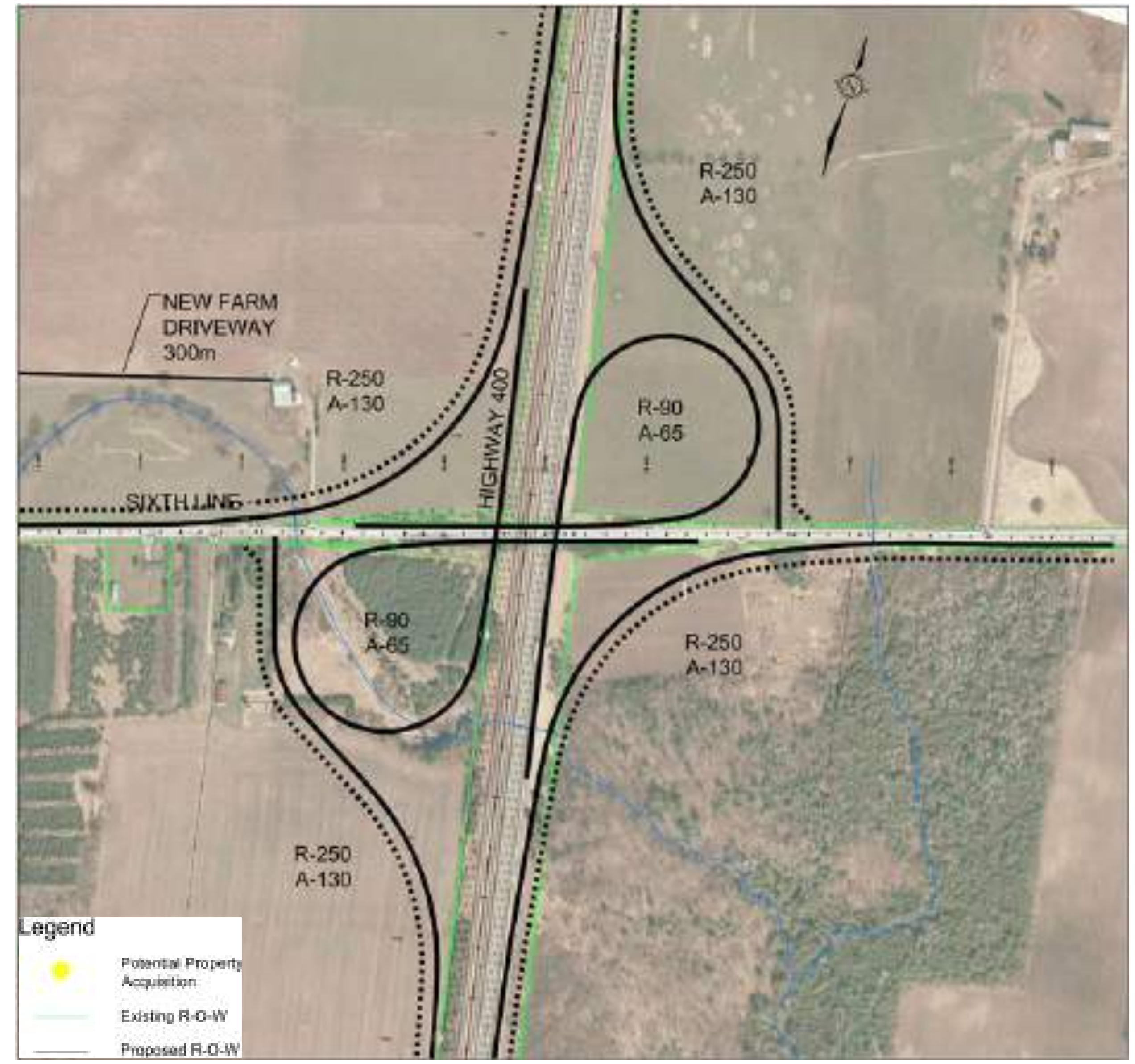

Figure 5.14: Interchange Configuration Alternative 10

6 ANALYSIS AND EVALUATION PROCESS

This section describes the formal quantitative evaluation approach used in this study for evaluating interchange alternatives.

The overall Recommended Plan involves a combination of Technically Preferred Alternatives for horizontal alignment alternatives, vertical alignment alternatives and interchange configuration alternatives, as illustrated in **Figure 6.1**.

This chapter describes the differences between qualitative and quantitative assessments and how the interchange alternatives were evaluated using a quantitative methodology known as the Multi-Attribute Trade-off System (MATS).

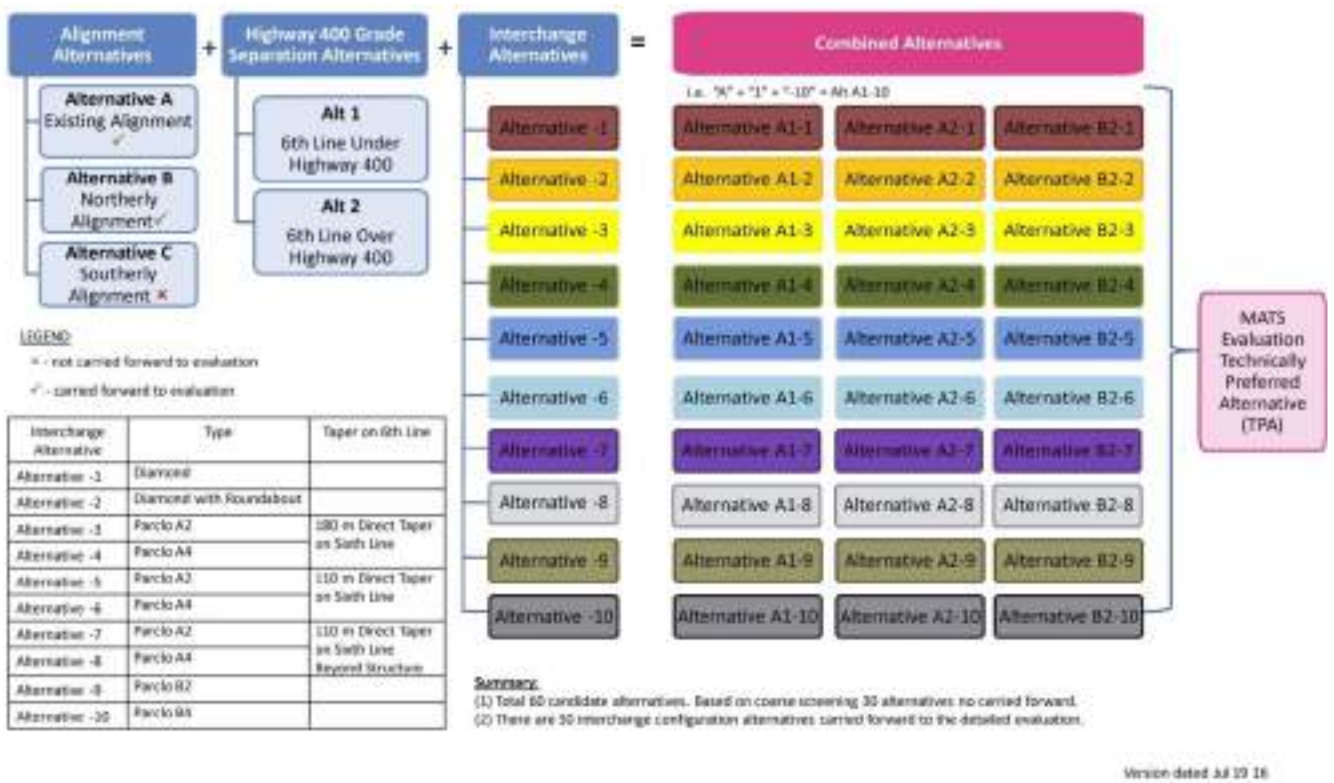

Figure 6.1: Combination of Alternatives to develop Technically Preferred Plan

6.1 Quantitative Evaluation Methodology

The interchange alternatives were evaluated quantitatively. The three sets of alternatives were combined to create 30 alternatives carried forward for the evaluation, as illustrated in **Figure 6.1**. This evaluation approach is based on the "Weighted Additive Method" which focuses on the differences between the alternatives, addresses the complexity of the base data collected, and provides a traceable decision-making process. In addition, the method allows quick sensitivity tests to be performed because of the matrix configuration of the assessment and the use of numerical scores to measure the impact of the alternatives. The sensitivity tests are also documented in this report. This approach is consistent with the MTO and MOECC practices for the evaluation of numerous and complex alternatives. Using the "Weighted Additive Method", overall scores are assigned to each alternative and the option with the highest score is selected as the preferred alternative to complete the evaluation.

The steps shown below, as described in the Evaluation Methodology report included in **Appendix B**, are being followed by the Technical Advisory Committee (TAC) to arrive at an overall score for each alternative.

- Development of Evaluation Criteria (Coarse screening a long list of criteria to develop a short list of criteria to carry forward for evaluation). These factors and sub-factors are used to measure the differences between the alternatives.
- Public review (POH No. 1)
- Development of definitions and utility functions for each sub-factor carried forward. (Data must be collected for each alternative under each sub-factor. Measurements for each alternative, under each sub-factor, are conducted using topographic plans, field surveys, numerical modelling etc.)
- Weighting of Criteria (assigning weights to each Factor and Sub-factor based on their importance to each team member's discipline or area of expertise)
- Rating Alternatives (based on Average TAC Weights)
- Selection of TPA – Highest Ranked Alternative
- Sensitivity testing;
- Refinements to the TPA;
- Public review (POH No. 2), and
- Recommendations and presentation of a Recommended Plan.

This systematic approach is consistent with MOECC practices for the evaluation of numerous and complex alternatives. It avoids many of the pitfalls associated with qualitative assessments by using an analytical approach that measures scores based on a mathematical relationship, i.e. the degree of subjectivity by the TAC is minimized. This traceable process allows the TAC and the public an opportunity to assess trade-offs involved in the evaluation and use of this information in the decision making process. These steps are briefly described in the following sections.

6.2 Evaluation Criteria

The initial task in the evaluation is to develop evaluation criteria from which alternatives will be assessed. This process includes the identification of "global" groups of factors followed by the selection of a number of "local" sub-factors under the global groups.

6.2.1 *Global Evaluation Factors*

As an initial step, the evaluation criteria were grouped into broad categories, or factors, established to describe the study specific engineering and environmental concerns. Eight factors were selected which were used for each evaluation.

The global factors for the combined roadway and interchange alternatives are:

- Transportation;
- Natural Environment;
- Structures;
- Heritage;
- Social and Cultural Environment;
- Land Use and Property;
- Economic Environment; and,
- Cost.

6.2.2 *Evaluation Sub-Factors*

Under each of the eight general global factors listed above there were a number of sub-factors selected under which measurements could be made. These sub-factors, under one of the applicable global factors, were the individual descriptors for the evaluation. The selection of the sub-factors is very important to the decision-making process because they must adequately describe the issue or aspect of the environment to be evaluated and the unique features of each alternative. Any information regarding an alternative, where there are differences among alternatives, is incorporated into the decision making process by including it as a sub-factor. Generally, the process begins by establishing a long list of potential sub-factors through discussions with the TAC, Stakeholders and the Public. Then, for each group of alternatives being evaluated the sub-factors are reviewed and screened by eliminating those that were considered equal or not applicable among the alternatives. This was presented at the initial POH for public review and comment. The long list can be found in **Appendix C**.

Table 6.1 provides the Short List of Factors and Sub-Factors carried forward for interchange alternatives to the analysis for each alternative.

Table 6.1:Short List of Factors and Sub-factors for Combined Interchange Alternatives

Factors and Sub-Factors	Unit of Measurement
Transportation	
Traffic Operations – Offset to ONroute Service Centre	m
Interchange Safety (Freeway Exits)	High/Low
Interchange Design Consistency	High/Medium/Low
Collision Potential –Highway 400 during Construction	High/Low
Arterial Road Safety	High/Medium/Low
Pedestrian Safety	High/Medium/Low
Bicycle Safety	High/Medium/Low
Out-of-way Travel (During Construction)	High/Low
Flexibility to Accommodate Barrie Bypass	Yes/No
Peak Directional Movements - GTA	High/Low
Peak Directional Movements - Barrie	High/Medium/Low
Traffic Capacity Potential on the Arterial	High/Low
Natural Environment	
Cool water fish habitat impacted – Realigned Creek	m
Cool water fish habitat impacted – Length of Culverts	m
Warm water fish habitat affected – Realigned Creek	m
Warm water fish habitat affected – Length of Culverts	m
Water quality – stormwater runoff	m^2
Regionally significant natural areas and habitat (Stream Valley Ravine)	m^2
Significant Wildlife Habitat Impacted	m^2
Specimen Trees Removed	Yes/No
Woodlands and other Vegetated Areas	m^2
Transformed Landscape (active and regenerating agricultural area)	m^2
Special Concern Species at Risk (SAR) Impacted	Yes/No
SAR Loss of Habitat (Barn Swallows in Barn)	Yes/No
Structures	
Constructability of Structure Type	High/Medium/Low
Durability of Structure	High/Low
Complexity of Future Rehabilitation Staging	High/Low
Ease of Future Widening of Highway 400	Yes/No
Heritage	
Cultural Heritage Landscape Impact – Northwest Remnant Farm Complex	High/Medium/Low
Cultural Heritage Landscape Impact – Southwest Remnant Farm Complex	High/Medium/Low

Table 6.1:Short List of Factors and Sub-factors for Combined Interchange Alternatives	
Factors and Sub-Factors	**Unit of Measurement**
Existing Barn Structure Property Impacts	Yes/No
3573 6th Line Impacts	High/Medium/Low
Social and Cultural Environment	
Prehistoric Archaeological Potential Areas Impacted	m^2
Sound Level Increases for Stop and Go Traffic	Yes/No
Land Use and Property	
Number of Property Acquisitions (Residential)	No. Acquisitions
Economic Environment	
Loss of farmland	m^2
Impact to Existing Barn Structure (North)	Yes/No
Out-of-way travel for Farm Equipment during Construction	Yes/No
Cost	
Life Cycle Cost	$M

6.3 Social Utility Function

The evaluation method (Weighted Additive Method) used to evaluate alternatives related the performance or attractiveness of alternatives using a mathematical relationship. This included two variables. The first was the raw, measured or modelled data, and the second was the utility score. The utility score is the measure of the attractiveness of the alternative under the particular sub-factor. For this study, the relationship between these two variables was described by either a linear, stepped or a dichotomous social utility function. These utility functions assigned a dimensionless score between 0 and 1 to an alternative for each sub-factor.

Examples of dichotomous, stepped and linear functions used in this study are explained in the following sections.

6.3.1 *Dichotomous Utility Function*

The dichotomous utility function, shown in **Figure 6.2**, permits the decision-makers to establish criteria that present an “either-or” situation (desirable or undesirable, negative or positive, present or absent, etc.). If a “no” answer is desirable then a utility score of ‘one’ would be assigned to this criterion, otherwise a value of ‘zero’ would be assigned; no other utility score being available.

6.3.2 *Stepped Utility Function*

The stepped utility function, shown in **Figure 6.2**, permits the decision-makers to assess criteria when the sub-factor presents more than one level of impact. An example of this situation is where the sub-factor can be categorized into “high, medium or low” degrees of impact. If a “high” answer is undesirable then a utility score or zero is assigned to this criterion, a “medium” answer would be 0.5 and “low” would have a value of 1.0 assigned to it. The stepped function may have more than three categories, with each category assigned a value between one and zero.

The value for each step is determined by the subject area specialist (expert). The maximum value found within the group is either the highest or lowest step. If the maximum value is undesirable it is given a value of zero and conversely the lowest value is desirable and is assigned a value of one.

6.3.3 *Linear Utility Function*

The linear function, shown in **Figure 6.2**, was used to convert scores for sub-factors that had varying measurements. Given a measurement, a unique score between zero and one could be assigned to a sub-factor.

The slope of the linear utility function is either negative or positive depending on the desirability of the impact. In the example below, the slope of the function is negative.

The short listed criteria, including definitions and their respective social utility functions are included as **Appendix C**.

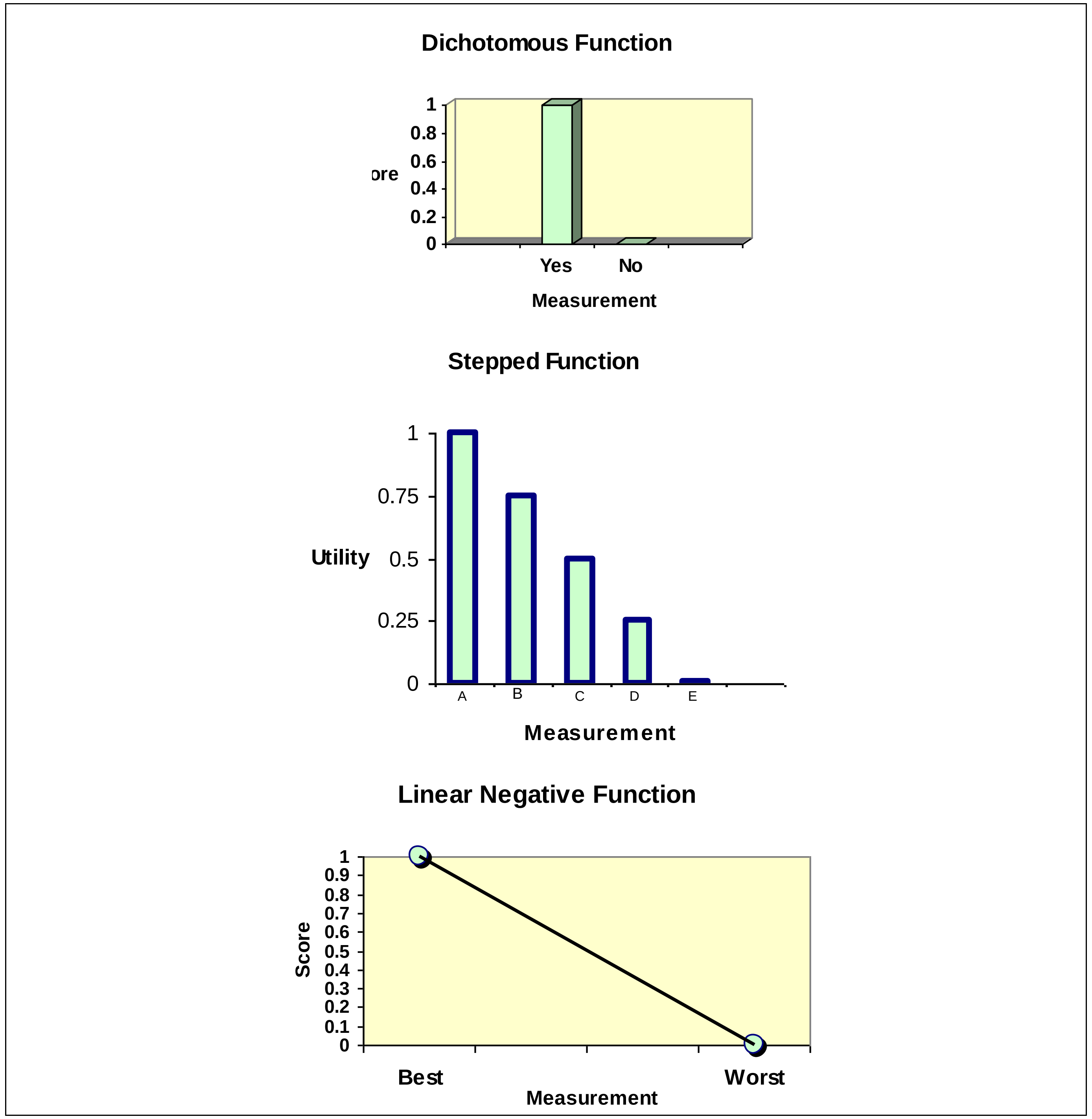

Figure 6.2: Sample Utility Functions

6.4 Weighted Global Factors and Sub-Factors

Factors were eliminated where they were not applicable (because there was no difference between alternatives or they were considered equal). The selection of weights for the factors and sub-factors was based on assessments by the Technical Advisory Committee (TAC). Within a group of factors, inevitably there was an ordering with some sub-factors having more importance than others. This is accounted for by each individual assigning weights to each factor and sub-factor, which is reflected in the "Global Factor Weight" and "Sub-factor Weight" columns in **Table 6.2**.

Table 6.2: Sample Global Factor / Sub-Factor Weights (Sample)

Global Factors/Sub-factors	TAC	
	Global Factor Weight	**Sub-factor Weight**
Transportation	41.7%	
• Accessibility for Pedestrians		75%
• Pedestrian Safety		10.5%
• Bicycle Safety		7.8%
• Disruption of Area Traffic		6.7%
TOTAL		100%

The percentage weight for all global factors totalled, (considered as global weights), is 100%. As well, the percentage weight for the sub-factors under each global factor, described as local weights, must total 100%. There is a degree of subjectivity in deciding which is the most important global factor and which is the least important factor. Every person assigning weights has a personal bias and understanding of the scope of the project and life experience. Hence, there is an advantage to having a diversified team of professionals with varied backgrounds performing the evaluation. The members of the TAC consisted of a diverse group of transportation planners, environmental planners plus structural and transportation engineers and technicians.

Each member assigns percentage weights to each global factor and sub-factor based on their opinion of the relative importance of each after a presentation by each specialist to TAC members. Their individual weights were then averaged to determine the TAC weight for each global factor and sub-factor.

The results of the weighting exercise for each alternative are provided in the following sections.

6.4.1 *Weighting Results*

The weighting exercises were carried out by the TAC. The results of the weighting exercises and the sensitivity tests have been included in the following sections. The sensitivity tests provided the TAC with an indication of possible trade-offs between indicators.

The Multi Attribute Trade-off System (MATS) evaluation method is a numerical quantitative evaluation methodology based on the weighted additive method. For the purpose of this report, they can be treated as identical terms.

Interchange Alternatives

The results of the weights and rankings of the MATS evaluation for the interchange alternatives are illustrated on **Figure 6.3** and **Figure 6.4**, respectively, with the results of the weights for each sub-factor shown in **Table 6.3** and **Table 6.4.** The MATS evaluation ranked Alternative B2-2 as the Technically Preferred Alternative (TPA).

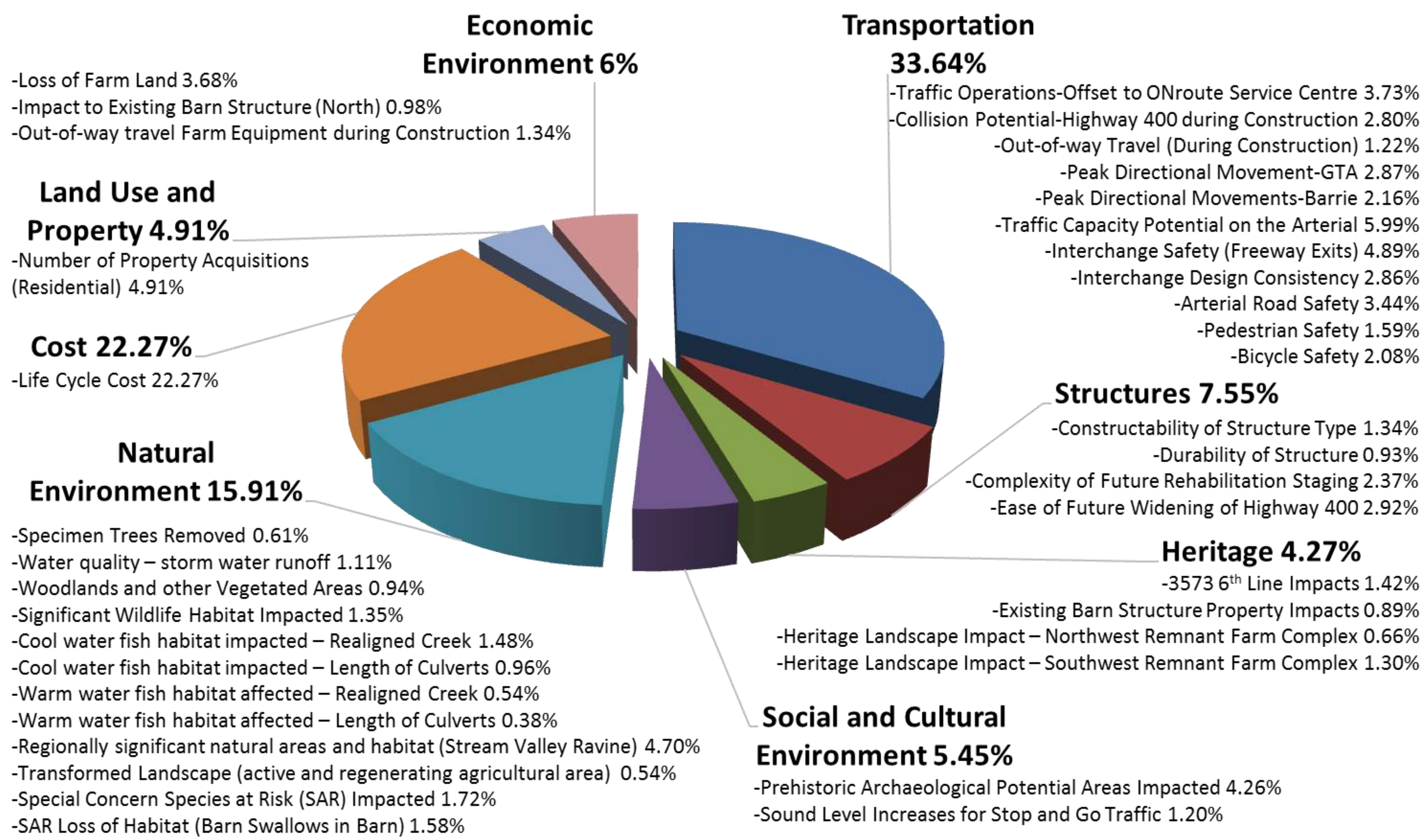

Figure 6.3: MATS Weighting Results for Interchange Alternatives

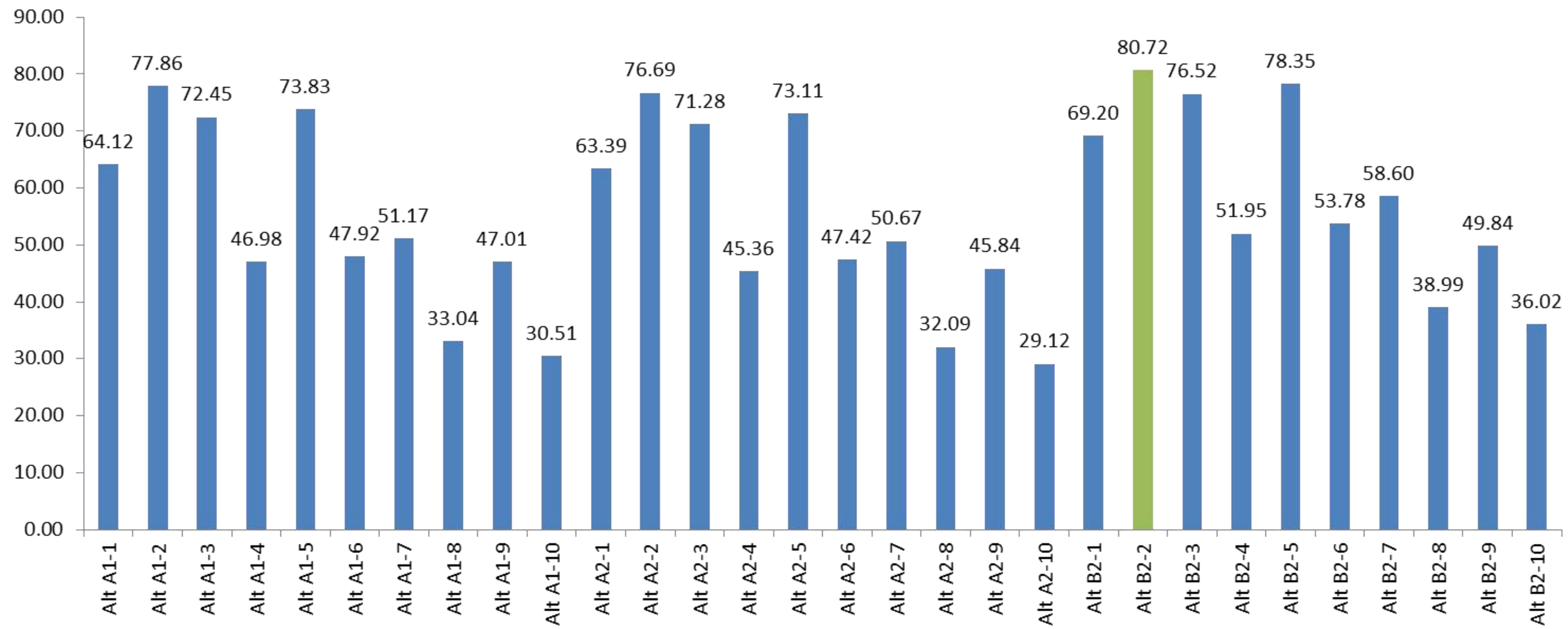

Figure 6.4: Bridge Structure Alternatives MATS Evaluation Ranking Results

Table 6.3: MATS Evaluation Weighted Scores for Bridge Structure Alternatives (Alternatives A1-1 to A2-5)

	Alt A1-1	Alt A1-2	Alt A1-3	Alt A1-4	Alt A1-5	Alt A1-6	Alt A1-7	Alt A1-8	Alt A1-9	Alt A1-10	Alt A2-1	Alt A2-2	Alt A2-3	Alt A2-4	Alt A2-5
Transportation															
Traffic Operations – Offset to ONroute Service Centre	0.37	0.37	3.13	0.22	3.13	0.22	3.47	1.83	0.00	0.00	0.37	0.37	3.13	0.22	3.13
Interchange Safety (Freeway Exits)	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	0.00	0.00	4.89	4.89	4.89	4.89	4.89
Interchange Design Consistency	1.43	1.43	2.86	2.86	2.86	2.86	2.86	2.86	0.00	0.00	1.43	1.43	2.86	2.86	2.86
Collision Potential –Highway 400 during Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.80	2.80	2.80	2.80	2.80
Arterial Road Safety	0.00	3.44	0.00	1.72	0.00	1.72	0.00	1.72	0.00	0.00	0.00	3.44	0.00	1.72	0.00
Pedestrian Safety	1.59	1.59	0.80	0.00	0.80	0.00	0.80	0.00	0.80	0.00	1.59	1.59	0.80	0.00	0.80
Bicycle Safety	2.08	2.08	1.04	0.00	1.04	0.00	1.04	0.00	1.04	0.00	2.08	2.08	1.04	0.00	1.04
Out-of-way Travel (During Construction)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.22	1.22	1.22	1.22	1.22
Peak Directional Movements - GTA	0.00	2.87	2.87	2.87	2.87	2.87	2.87	2.87	0.00	0.00	0.00	2.87	2.87	2.87	2.87
Peak Directional Movements - Barrie	1.08	2.16	0.00	1.08	0.00	1.08	0.00	1.08	2.16	2.16	1.08	2.16	0.00	1.08	0.00
Traffic Capacity Potential on the Arterial	0.00	5.99	0.00	5.99	0.00	5.99	0.00	5.99	0.00	0.00	0.00	5.99	0.00	5.99	0.00
Total	11.44	24.83	15.59	19.64	15.59	19.64	15.93	21.25	3.99	2.16	15.46	28.85	19.62	23.66	19.62

Table 6.3: MATS Evaluation Weighted Scores for Bridge Structure Alternatives (Alternatives A1-1 to A2-5)

	Alt A1-1	Alt A1-2	Alt A1-3	Alt A1-4	Alt A1-5	Alt A1-6	Alt A1-7	Alt A1-8	Alt A1-9	Alt A1-10	Alt A2-1	Alt A2-2	Alt A2-3	Alt A2-4	Alt A2-5
Natural Environment															
Cool water fish habitat impacted – Realigned Creek	1.48	1.48	1.48	1.48	1.48	1.48	0.00	0.00	1.48	1.48	1.48	1.48	1.48	1.48	1.48
Cool water fish habitat impacted – Length of Culverts	0.96	0.96	0.96	0.48	0.96	0.48	0.96	0.96	0.96	0.00	0.96	0.96	0.96	0.48	0.96
Warm water fish habitat affected – Realigned Creek	0.54	0.54	0.54	0.54	0.54	0.54	0.00	0.00	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Warm water fish habitat affected – Length of Culverts	0.38	0.38	0.38	0.27	0.38	0.27	0.38	0.27	0.22	0.27	0.38	0.38	0.38	0.27	0.38
Water quality – stormwater runoff	1.06	1.11	0.88	0.07	0.92	0.12	0.53	0.16	0.71	0.00	1.06	1.11	0.88	0.07	0.92
Regionally significant natural areas and habitat (Stream Valley Ravine)	2.91	2.91	4.28	3.53	4.28	3.53	0.75	0.00	0.75	0.66	2.91	2.91	4.28	3.53	4.28
Significant Wildlife Habitat Impacted	0.83	0.83	1.22	1.01	1.22	1.01	0.22	0.00	0.22	0.19	0.83	0.83	1.22	1.01	1.22
Specimen Trees Removed	0.61	0.61	0.61	0.00	0.61	0.00	0.61	0.00	0.61	0.61	0.61	0.61	0.61	0.00	0.61
Woodlands and other Vegetated Areas	0.69	0.69	0.83	0.61	0.83	0.61	0.23	0.00	0.72	0.72	0.69	0.69	0.83	0.61	0.83
Transformed Landscape (active and regenerating agricultural area)	0.52	0.52	0.54	0.41	0.54	0.41	0.24	0.12	0.52	0.30	0.52	0.52	0.54	0.41	0.54
Special Concern Species at Risk (SAR) Impacted	0.00	0.00	1.72	0.00	1.72	0.00	1.72	0.00	0.00	0.00	0.00	0.00	1.72	0.00	1.72
SAR Loss of Habitat (Barn Swallows in Barn)	1.58	1.58	1.58	1.58	1.58	1.58	0.00	0.00	1.58	1.58	1.58	1.58	1.58	1.58	1.58
Total	11.57	11.63	15.02	9.98	15.06	10.03	5.64	1.51	8.31	6.35	11.57	11.63	15.02	9.98	15.06
Structures															
Constructability of Structure Type	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.00	0.00	0.00	0.00	0.00
Durability of Structure	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.93	0.93	0.93	0.93
Complexity of Future Rehabilitation Staging	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.37	2.37	2.37	2.37	2.37
Ease of Future Widening of Highway 400	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	0.00	0.00	0.00	0.00	0.00
Total	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.29	3.29	3.29	3.29	3.29
Heritage															
Cultural Heritage Landscape Impact – Northwest Remnant Farm Complex	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.33	0.33	0.33	0.00	0.00	0.00
Cultural Heritage Landscape Impact – Southwest Remnant Farm Complex	0.65	0.65	1.30	0.65	1.30	0.65	1.30	0.65	0.00	0.00	0.65	0.65	1.30	0.65	1.30
Existing Barn Structure Property Impacts	0.89	0.89	0.89	0.89	0.89	0.89	0.00	0.00	0.89	0.89	0.89	0.89	0.89	0.89	0.89
3573 6th Line Impacts	1.42	1.42	1.42	0.00	1.42	0.00	1.42	0.00	1.42	1.42	1.42	1.42	1.42	0.00	1.42
Total	3.29	3.29	3.61	1.54	3.61	1.54	2.72	0.65	2.97	2.64	3.29	3.29	3.61	1.54	3.61
Social and Cultural Environment															
Prehistoric Archaeological Potential Areas Impacted	3.79	3.79	4.13	3.07	4.13	3.07	1.36	0.30	3.32	2.26	3.79	3.79	4.13	3.07	4.13
Sound Level Increases for Stop and Go Traffic	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00
Total	3.79	4.99	4.13	3.07	4.13	3.07	1.36	0.30	3.32	2.26	3.79	4.99	4.13	3.07	4.13
Land Use and Property															
Number of Property Acquisitions (Residential)	4.91	4.91	4.91	0.00	4.91	0.00	4.91	0.00	4.91	4.91	4.91	4.91	4.91	0.00	4.91
Total	4.91	4.91	4.91	0.00	4.91	0.00	4.91	0.00	4.91	4.91	4.91	4.91	4.91	0.00	4.91
Economic Environment															

Table 6.3: MATS Evaluation Weighted Scores for Bridge Structure Alternatives (Alternatives A1-1 to A2-5)

	Alt A1-1	Alt A1-2	Alt A1-3	Alt A1-4	Alt A1-5	Alt A1-6	Alt A1-7	Alt A1-8	Alt A1-9	Alt A1-10	Alt A2-1	Alt A2-2	Alt A2-3	Alt A2-4	Alt A2-5
Loss of farmland	3.61	3.61	3.68	2.84	3.68	2.84	1.66	0.85	3.57	2.06	3.61	3.61	3.68	2.84	3.68
Impact to Existing Barn Structure (North)	0.98	0.98	0.98	0.98	0.98	0.98	0.00	0.00	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Out-of-way travel for Farm Equipment during Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.59	4.59	4.66	3.82	4.66	3.82	1.66	0.85	4.55	3.04	4.59	4.59	4.66	3.82	4.66
Cost															
Life Cycle Cost	20.94	20.05	20.94	5.35	22.27	6.24	15.37	4.90	15.37	5.57	16.48	15.15	16.04	0.00	17.82
Total	20.94	20.05	20.94	5.35	22.27	6.24	15.37	4.90	15.37	5.57	16.48	15.15	16.04	0.00	17.82
Final Score	64.12	77.86	72.45	46.98	73.83	47.92	51.17	33.04	47.01	30.51	63.39	76.69	71.28	45.36	73.11

Table 6.4: MATS Evaluation Weighted Scores for Bridge Structure Alternatives (Alternatives A2-6 to B2-10)

	Alt A2-6	Alt A2-7	Alt A2-8	Alt A2-9	Alt A2-10	Alt B2-1	Alt B2-2	Alt B2-3	Alt B2-4	Alt B2-5	Alt B2-6	Alt B2-7	Alt B2-8	Alt B2-9	Alt B2-10
Transportation															
Traffic Operations – Offset to ONroute Service Centre	0.22	3.47	1.83	0.00	0.00	0.60	0.60	3.43	0.22	3.43	0.22	3.73	0.22	0.15	0.15
Interchange Safety (Freeway Exits)	4.89	4.89	4.89	0.00	0.00	4.89	4.89	4.89	4.89	4.89	4.89	4.89	4.89	0.00	0.00
Interchange Design Consistency	2.86	2.86	2.86	0.00	0.00	1.43	1.43	2.86	2.86	2.86	2.86	2.86	2.86	0.00	0.00
Collision Potential –Highway 400 during Construction	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
Arterial Road Safety	1.72	0.00	1.72	0.00	0.00	0.00	3.44	0.00	1.72	0.00	1.72	0.00	1.72	0.00	0.00
Pedestrian Safety	0.00	0.80	0.00	0.80	0.00	1.59	1.59	0.80	0.00	0.80	0.00	0.80	0.00	0.80	0.00
Bicycle Safety	0.00	1.04	0.00	1.04	0.00	2.08	2.08	1.04	0.00	1.04	0.00	1.04	0.00	1.04	0.00
Out-of-way Travel (During Construction)	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22
Peak Directional Movements - GTA	2.87	2.87	2.87	0.00	0.00	0.00	2.87	2.87	2.87	2.87	2.87	2.87	2.87	0.00	0.00
Peak Directional Movements - Barrie	1.08	0.00	1.08	2.16	2.16	1.08	2.16	0.00	1.08	0.00	1.08	0.00	1.08	2.16	2.16
Traffic Capacity Potential on the Arterial	5.99	0.00	5.99	0.00	0.00	0.00	5.99	0.00	5.99	0.00	5.99	0.00	5.99	0.00	0.00
Total	23.66	19.95	25.27	8.01	6.18	15.69	29.07	19.91	23.66	19.91	23.66	20.21	23.66	8.16	6.33
Natural Environment															
Cool water fish habitat impacted – Realigned Creek	1.48	0.00	0.00	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48
Cool water fish habitat impacted – Length of Culverts	0.48	0.96	0.96	0.96	0.00	0.96	0.96	0.96	0.48	0.96	0.48	0.96	0.48	0.96	0.00
Warm water fish habitat affected – Realigned Creek	0.54	0.00	0.00	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.00	0.54	0.54	0.54
Warm water fish habitat affected – Length of Culverts	0.27	0.38	0.27	0.22	0.27	0.38	0.38	0.38	0.27	0.38	0.27	0.38	0.22	0.00	0.27
Water quality – stormwater runoff	0.12	0.53	0.16	0.71	0.00	1.06	1.11	0.88	0.07	0.92	0.12	0.53	0.16	0.71	0.00
Regionally significant natural areas and habitat (Stream Valley Ravine)	3.53	0.75	0.00	0.75	0.66	4.00	4.00	4.70	3.62	4.70	3.62	1.88	0.99	1.03	0.94
Significant Wildlife Habitat Impacted	1.01	0.22	0.00	0.22	0.19	1.14	1.14	1.35	1.04	1.35	1.04	0.54	0.28	0.30	0.27
Specimen Trees Removed	0.00	0.61	0.00	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61

Table 6.4: MATS Evaluation Weighted Scores for Bridge Structure Alternatives (Alternatives A2-6 to B2-10)

	Alt A2-6	Alt A2-7	Alt A2-8	Alt A2-9	Alt A2-10	Alt B2-1	Alt B2-2	Alt B2-3	Alt B2-4	Alt B2-5	Alt B2-6	Alt B2-7	Alt B2-8	Alt B2-9	Alt B2-10
Woodlands and other Vegetated Areas	0.61	0.23	0.00	0.72	0.72	0.76	0.76	0.94	0.71	0.94	0.71	0.40	0.17	0.77	0.77
Transformed Landscape (active and regenerating agricultural area)	0.41	0.24	0.12	0.52	0.30	0.48	0.48	0.50	0.31	0.50	0.31	0.19	0.00	0.50	0.21
Special Concern Species at Risk (SAR) Impacted	0.00	1.72	0.00	0.00	0.00	0.00	0.00	1.72	0.00	1.72	0.00	1.72	0.00	0.00	0.00
SAR Loss of Habitat (Barn Swallows in Barn)	1.58	0.00	0.00	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	0.00	0.00	1.58	1.58
Total	10.03	5.64	1.51	8.31	6.35	12.99	13.04	15.64	10.70	15.68	10.75	8.71	4.93	8.48	6.67
Structures															
Constructability of Structure Type	0.00	0.00	0.00	0.00	0.00	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34
Durability of Structure	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Complexity of Future Rehabilitation Staging	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37
Ease of Future Widening of Highway 400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.29	3.29	3.29	3.29	3.29	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63
Heritage															
Cultural Heritage Landscape Impact – Northwest Remnant Farm Complex	0.00	0.00	0.00	0.66	0.33	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.33
Cultural Heritage Landscape Impact – Southwest Remnant Farm Complex	0.65	1.30	0.65	0.00	0.00	0.65	0.65	1.30	0.65	1.30	0.65	1.30	0.65	0.00	0.00
Existing Barn Structure Property Impacts	0.89	0.00	0.00	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.00	0.00	0.89	0.89
3573 6th Line Impacts	0.00	1.42	0.00	1.42	1.42	1.42	1.42	1.42	0.00	1.42	0.00	1.42	0.00	1.42	1.42
Total	1.54	2.72	0.65	2.97	2.64	3.29	3.29	3.61	1.54	3.61	1.54	2.72	0.65	2.97	2.64
Social and Cultural Environment															
Prehistoric Archaeological Potential Areas Impacted	3.07	1.36	0.30	3.32	2.26	3.83	3.83	4.26	2.73	4.26	2.73	1.62	0.00	3.37	1.75
Sound Level Increases for Stop and Go Traffic	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.07	1.36	0.30	3.32	2.26	3.83	5.03	4.26	2.73	4.26	2.73	1.62	0.00	3.37	1.75
Land Use and Property															
Number of Property Acquisitions (Residential)	0.00	4.91	0.00	4.91	4.91	4.91	4.91	4.91	0.00	4.91	0.00	4.91	0.00	4.91	4.91
Total	0.00	4.91	0.00	4.91	4.91	4.91	4.91	4.91	0.00	4.91	0.00	4.91	0.00	4.91	4.91
Economic Environment															
Loss of farmland	2.84	1.66	0.85	3.57	2.06	3.28	3.28	3.42	2.14	3.42	2.14	1.33	0.00	3.42	1.44
Impact to Existing Barn Structure (North)	0.98	0.00	0.00	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.00	0.00	0.98	0.98
Out-of-way travel for Farm Equipment during Construction	0.00	0.00	0.00	0.00	0.00	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34
Total	3.82	1.66	0.85	4.55	3.04	5.60	5.60	5.74	4.45	5.74	4.45	2.66	1.34	5.74	3.75
Cost															
Life Cycle Cost	2.00	11.14	0.22	10.47	0.45	18.26	15.15	17.82	4.23	19.60	6.01	13.14	3.79	11.58	5.35
Total	2.00	11.14	0.22	10.47	0.45	18.26	15.15	17.82	4.23	19.60	6.01	13.14	3.79	11.58	5.35
Final Score	47.42	50.67	32.09	45.84	29.12	69.20	**80.72**	76.52	51.95	78.35	53.78	58.60	38.99	49.84	36.02

6.5 Sensitivity Testing

It should be recognized that the scope of the evaluation and determination of weights for the evaluation criteria are a matter of professional judgment. Accordingly, it is considered essential to conduct sensitivity testing to determine if the nature of the evaluation is sensitive to the weights assigned to each criterion.

There is a spread of values among the groups of evaluators for the selection of weights. The range is dependent on the value judgment of individuals and specialists. Using the average of the group does not necessarily capture what the standard deviation was among the individual scores. Therefore, sensitivity testing is conducted to test a range of weights either higher or lower than the group's average.

For this study an independent test was undertaken which placed greater or less emphasis on a global factor and redistributing the weight to the other factors using the average values of the TAC. In fact, a separate test was completed for each factor using the highest weight given by anyone in the TAC as well as the lowest weight.

Following this methodology a series of tests was completed varying the weight for each global factor. The three tests included:

- Average TAC Weight
- Highest Weight in a factor group by any TAC member
- Lowest Weight in a factor group by any TAC member

Following this series of tests, the results were reviewed to assess whether the preferred alternative changed when the weights were varied.

Using this information alone is not the only justification for selecting a particular option, but it provides a level of confidence in the selection and the ability to assess trade-offs. This information is considered and used in the decision-making process before a TPA is recommended to be carried forward. The sensitivity testing will be presented at POH No. 2 and is shown in **Table 6.5**.

The sensitivity test results shows that there are trade-offs for low transportation where Alternative B2-5 rated high for this trade-off.

6.6 Interchange Alternative Technically Preferred Alternative

The Technically Preferred Alternative is Alternative B2-2. The TPA is shown in **Figure 6.5**.

Table 6.5: Sensitivity Testing Results for Interchange Alternatives

Alternative		A1-1	A1-2	A1-3	A1-4	A1-5	A1-6	A1-7	A1-8	A1-9	A1-10	A2-1	A2-2	A2-3	A2-4	A2-5	A2-6	A2-7	A2-8	A2-9	A2-10	B2-1	B2-2	B2-3	B2-4	B2-5	B2-6	B2-7	B2-8	B2-9	B2-10
Rank		**11**	**3**	**8**	**22**	**6**	**19**	**16**	**27**	**21**	**29**	**12**	**4**	**9**	**24**	**7**	**20**	**17**	**28**	**23**	**30**	**10**	**1**	**5**	**15**	**2**	**14**	**13**	**25**	**18**	**26**
Transportation	High	14	3	9	21	8	19	20	25	27	30	11	2	7	18	6	16	17	24	26	29	10	1	5	15	4	13	12	22	23	28
	Low	11	5	6	22	4	21	16	29	15	26	12	8	9	24	7	23	19	30	18	28	10	3	2	20	1	17	13	27	14	25
Natural Environment	High	11	4	8	21	6	17	18	28	22	27	12	5	9	23	7	19	20	30	24	29	10	1	3	15	2	14	13	25	16	26
	Low	11	2	8	22	6	19	15	27	20	29	12	3	9	24	7	21	16	28	23	30	10	1	5	17	4	14	13	25	18	26
Structures	High	11	3	8	22	6	19	16	27	21	29	12	5	9	24	7	20	18	28	23	30	10	1	4	15	2	14	13	25	17	26
	Low	11	2	8	22	6	19	16	27	21	29	12	4	9	24	7	20	17	28	23	30	10	1	5	15	3	14	13	25	18	26
Heritage	High	11	3	8	23	6	21	15	28	19	27	12	5	9	24	7	22	16	29	20	30	10	1	4	18	2	14	13	25	17	26
	Low	11	3	8	21	6	19	16	27	22	29	12	4	9	23	7	20	17	28	24	30	10	1	5	15	2	14	13	25	18	26
Social and Cultural Environment	High	11	2	8	22	6	19	17	27	21	28	12	4	9	24	7	20	18	29	23	30	10	1	5	15	3	14	13	25	16	26
	Low	11	3	8	21	6	19	15	27	22	29	12	5	9	24	7	20	17	28	23	30	10	1	4	16	2	14	13	25	18	26
Land Use and Property	High	11	3	8	23	6	21	14	29	18	27	12	4	9	24	7	22	15	30	20	28	10	1	5	19	2	17	13	26	16	25
	Low	11	3	8	20	6	17	16	27	23	29	12	4	9	22	7	19	18	28	24	30	10	1	5	15	2	14	13	25	21	26
Economic Environment	High	11	3	8	22	6	19	17	27	20	28	12	5	9	24	7	21	18	29	23	30	10	1	4	15	2	14	13	25	16	26
	Low	11	2	8	21	6	19	15	27	22	29	12	4	9	23	7	20	16	28	24	30	10	1	5	17	3	14	13	25	18	26
Cost	High	11	3	7	22	5	21	14	27	18	28	12	6	9	24	8	23	16	29	20	30	10	1	4	19	2	15	13	25	17	26
	Low	12	5	9	20	8	18	22	28	24	30	11	2	7	17	6	16	19	27	23	29	10	1	4	15	3	14	13	25	21	26

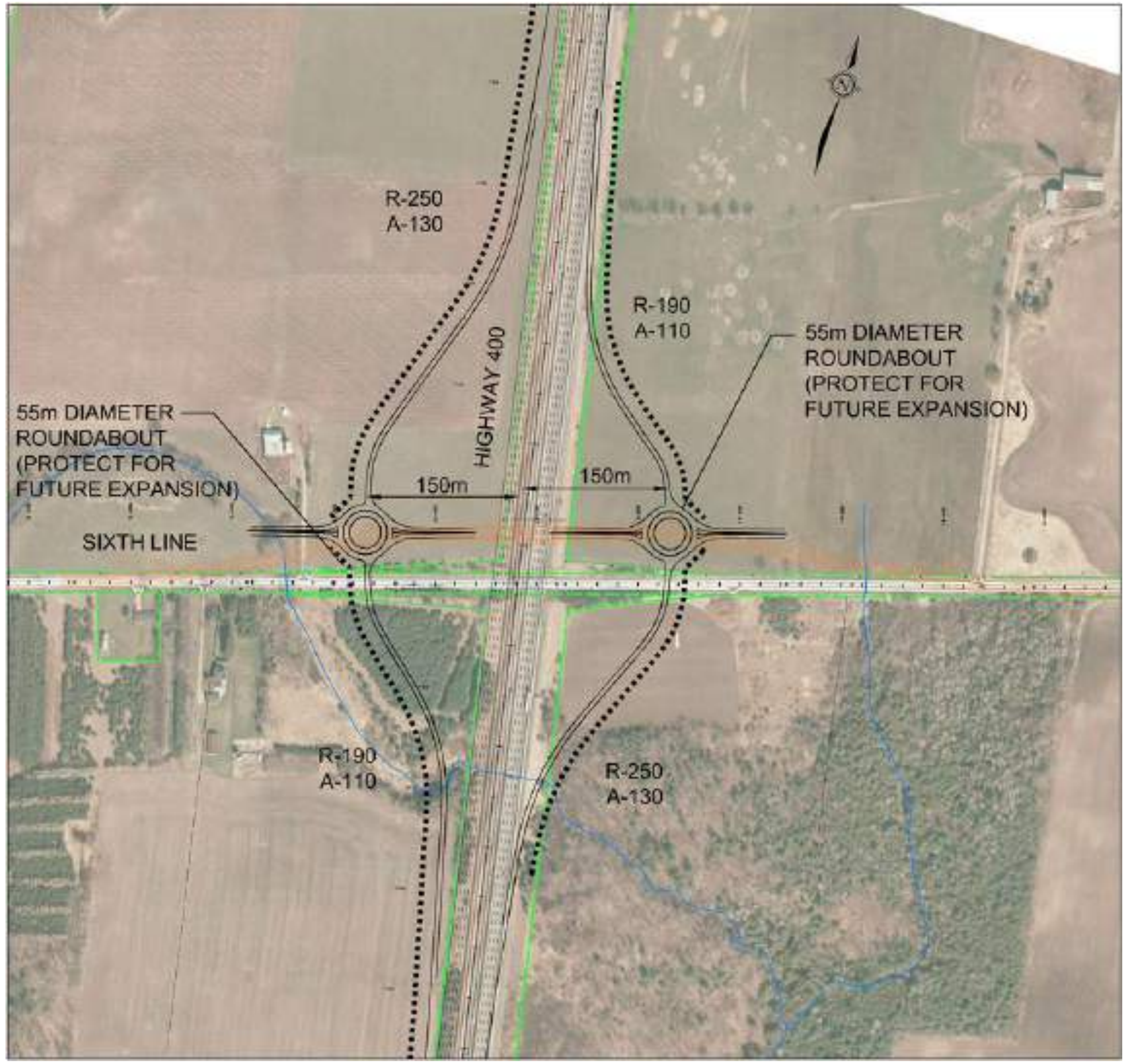

Figure 6.5: Technically Preferred Interchange Alternative B2-2

7 RECOMMENDED PLAN

The Recommended Plan is a combination of the Technically Preferred Alternatives for the interchange alternative described in the sections above and refinements to the alternative post evaluation. The highest ranked alternative in each of the horizontal and vertical combined alternative categories (i.e. whether the alternative was on the existing alignment under Highway 400, on the existing alignment over Highway 400 or on the northerly shift alignment over Highway 400) was determined to be interchange configuration Alternative 2: Diamond with roundabout. The second highest ranked alternative in the horizontal and vertical combined alternative was determined to be interchange configuration Alternative 5: Parclo A2 with 110 m direct taper on 6th Line, design speed of 80 km/h. It was of the opinion of the TAC that the Recommended Plan should allow for future expansion of the alternative to a Parclo A2, allowing for the expansion of the interchange for future traffic demands. This is described as the Refined Technically Preferred Alternative illustrated in **Figure 7.1**.

A traffic capacity analysis performed afterwards (dated September 2016) has determined that the west side of the interchange (southbound ramps) would perform more efficiently with a Parclo A2 configuration instead of a diamond configuration. Consequently, it has been decided to implement the inner loop before the E-S direct ramp and to protect the property for future expansion of the interchange; this has the added benefits of reducing upfront capital costs. This is described as the Recommended Plan to be implemented for the project, as illustrated in **Figure 7.2**.

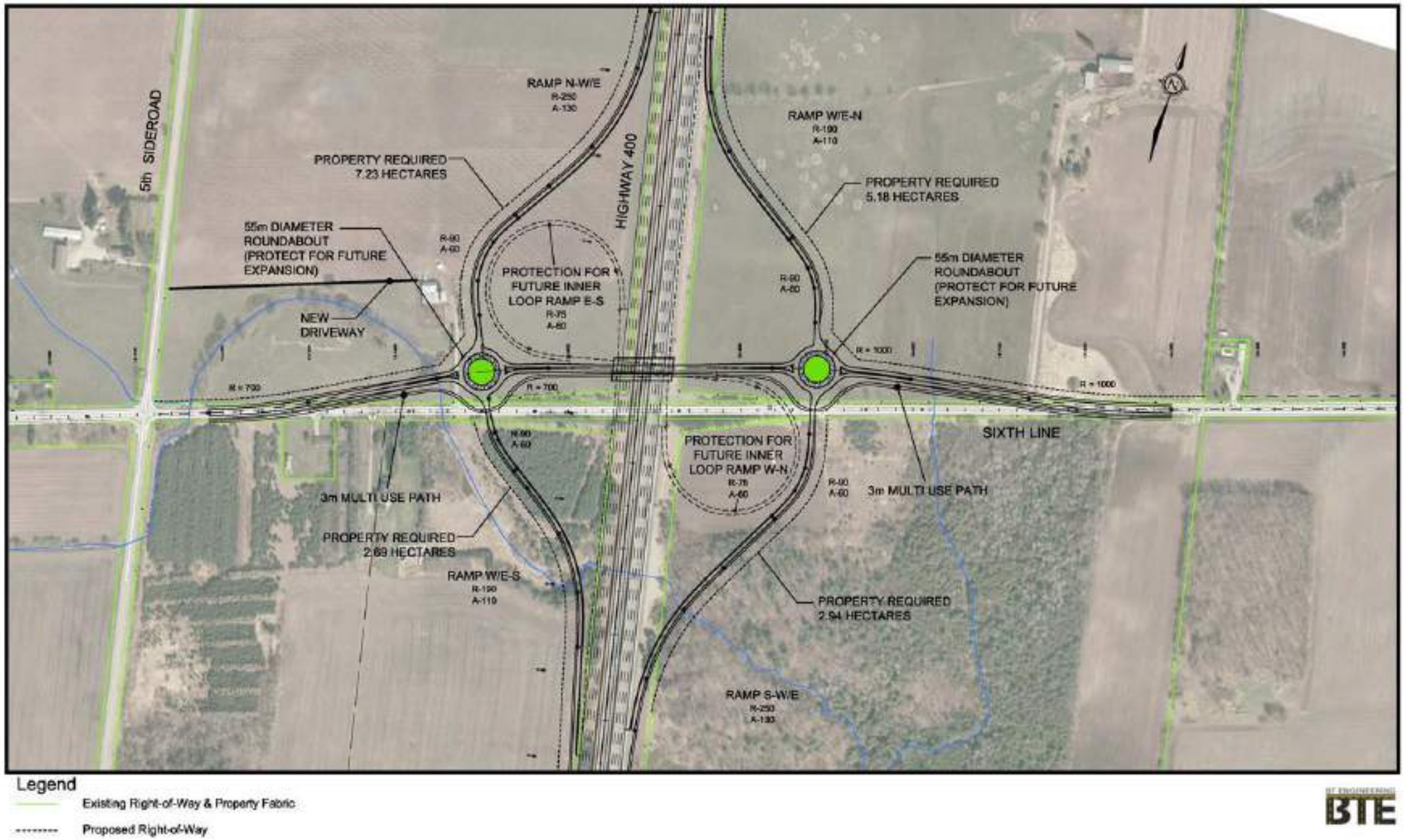

Figure 7.1: Refined Technically Preferred Alternative

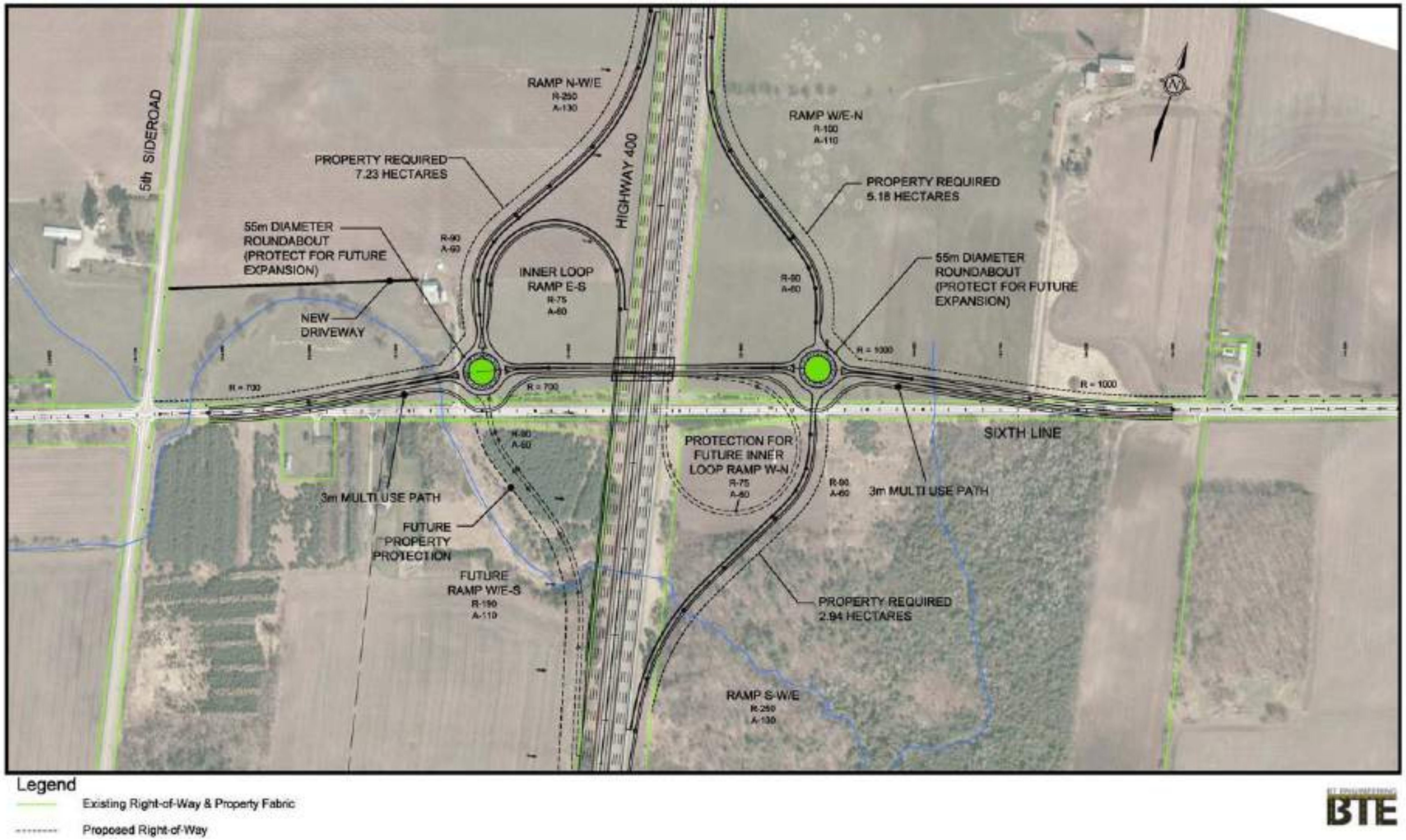

Figure 7.2: Recommended Plan

APPENDIX A: Assessment of Preliminary Planning Solutions

ASSESSMENT OF ALTERNATIVE PLANNING SOLUTIONS

6TH LINE INTERCHANGE ENVIRONMENTAL ASSESSMENT (EA) STUDY

Presented to:

Town of Innisfil
2101 Innisfil Beach Road
Innisfil, ON
L9S 4B4

July 20, 2016

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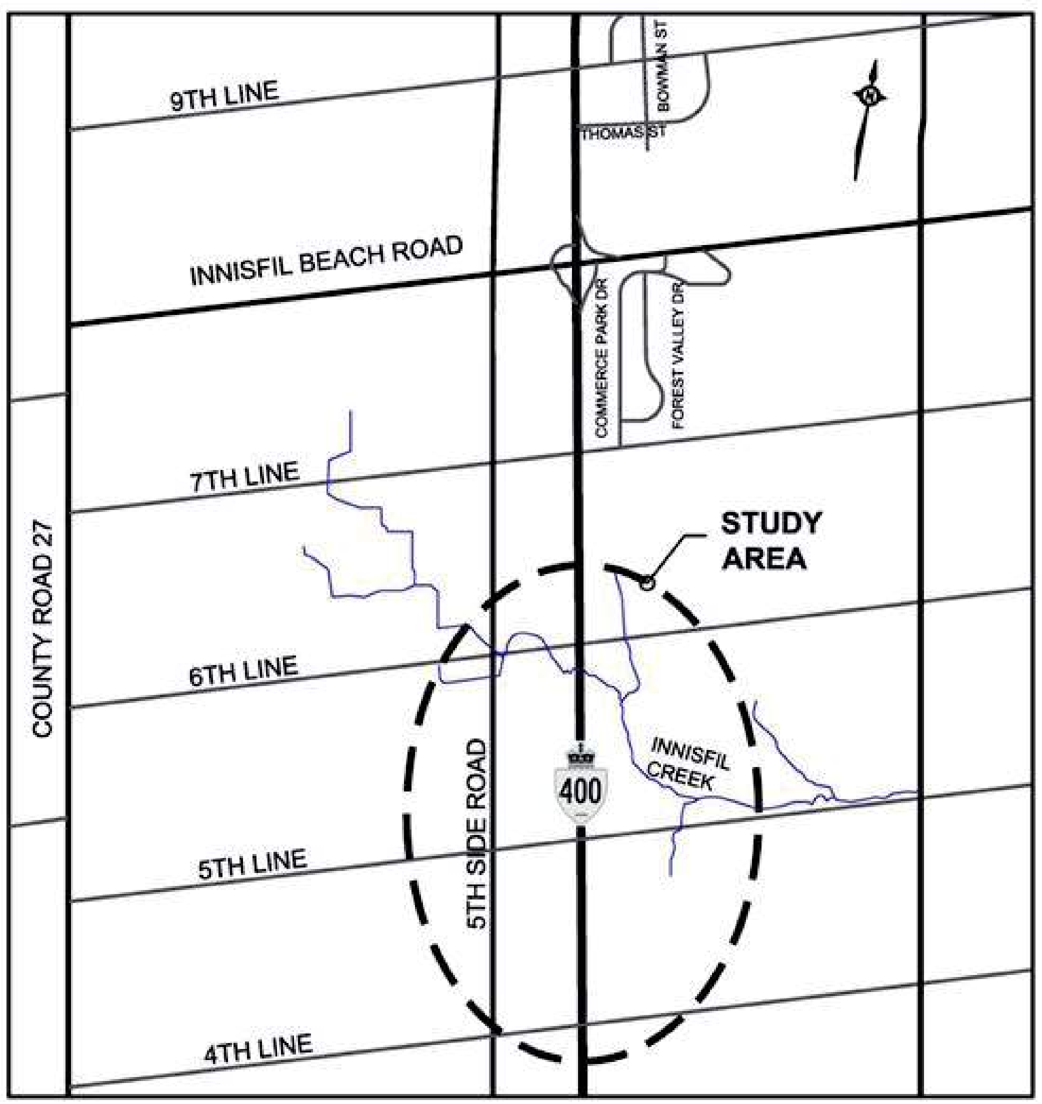
1. INTRODUCTION

The Town of Innisfil, through their consultant BT Engineering Inc., has initiated a Schedule 'C' Municipal Class Environmental Assessment (Class EA) for the planning of a new interchange on Highway 400 at 6th Line. This interchange has been identified in the Town's Official Plan (OP) and Transportation Master Plan (TMP). The TMP is the Town's response to the planning initiatives set forth by the Province, Simcoe County and adjacent municipalities. A request was made from a resident in the area to also review a potential 4th Line interchange at Highway 400, broadening the Study Area as shown in **Figure 1.**

Figure 1 - Study Area



2. BACKGROUND

This current environmental assessment study focuses on a new interchange in the Town of Innisfil on Highway 400.

2.1 Purpose of the Report

The purpose of this report is to document the analysis and evaluation of Alternative Planning Solutions for this environmental assessment that will be carried forward to address the new interchange. Most of the assessment of the need for the project and alternative means to address transportation demand associated with planned use occurred during a previous study that defined a Regional Transportation Master Plan. The discussion of the TMP analysis is in **Section 3**.

2.2 Municipal Class EA

The Municipal Class EA describes a planning process for municipalities in Ontario to plan new infrastructure. The Class EA, 2015, also allows proponents to complete a Transportation Master Plan by defining Regional needs and carry forward a plan of future projects to address these needs. The Town of Innisfil completed this Regional Needs analysis for the planning horizon from 2013 to 2031. The TMP satisfies Phases 1 and 2 of the Municipal Class EA process.

2.3 Scope

This project will identify the location and configuration of a new interchange on Highway 400.

This assignment is following the Class Environmental Assessment process for a Schedule C project. At the completion of this study, an Environmental Study Report (ESR) will be prepared and published for public review.

The assessment of Alternative Planning Solutions is a mandatory requirement of the Municipal Class EA and is completed early in the preliminary design process.

3. TMP VISION STATEMENT

As part of the Transportation Master Plan process, the Town has adopted a transportation vision statement which is as follows: *"Innisfil's transportation network connects people and communities, fostering healthy living and operates efficiently across the Town as an environmentally and financially sustainable system."*

By 2031, the population within the Town of Innisfil is projected to grow to approximately 65,000 people, more than double its current size. The TMP recognized the transportation needs within the Town will also be impacted by the City of Barrie's plans for the Barrie Annexed lands, projected to grow from greenfield to a population of 41,000 and employment of 7,000 by 2031.

Further to this vision statement, the Town's 2014 TMP has identified an additional Highway 400 interchange as one of the Town's long term transportation priorities to address future increased traffic demands. The TMP discusses the Ontario Growth Plan for Simcoe County and identifies the settlement of Alcona, located to the northeast of the Study Area, as a Primary Settlement area. Alcona is expected to see the highest population growth in the area and developers intend to build new homes south of Alcona in the development area called Sleeping Lion.

4. ALTERNATIVE PLANNING SOLUTIONS

4.1 Municipal TMP Alternative Planning Solutions

The following documents key components of TMP; refer to the full report for further details and documentation of the consultation that occurred at that time.

Alternative Planning Solutions represent alternative ways or methods of addressing the Vision Statement. These reflect different strategies and include the "Do Nothing" approach (maintaining the status quo but not addressing the Vision Statement).

Following the assessment of Alternative Planning Solutions, those alternatives judged to address the Vision Statement were carried forward and formed the Recommended Planning Solution.

In developing "Preliminary Design" Alternative Planning Solutions, a number of general principles and objectives were considered including:

- Provide for the efficient movement of people and goods during the staging of the project;
- Ensure the safety of the travelling public;
- Ensure the technical feasibility of construction, operation and maintenance; and,
- Minimize the environmental impacts and the use of non-renewable natural resources such as aggregates.

The following Alternative Planning Solutions were identified in the TMP:

1. Alternative 1: The "Do Nothing" Alternative.
2. Alternative 2: Business as Usual.
3. Alternative 3: Balanced Approach
4. Alternative 4: Aggressive Approach

Alternative 1 tested the transportation conditions in 2031 assuming that no road, transit, or active transportation improvements are made beyond the existing network. This is also known as the "Do Nothing" scenario. The results of screenline analysis show that without any investments into road or transit networks all major roads within Innisfil would be significantly over capacity by 2031. This test illustrates that improvements to the transportation network are necessary in support of the planned growth.

Alternative 2 analyzed 2031 transportation network performance assuming current provincial, County and municipal plans are carried out by 2031. Provincial plans such as widening Highway 400 and the Cookstown Bypass take significant congestion off of Highways 400 and 89. Simcoe County road improvements are focused on north-south traffic with widenings of County Road 27 and 10th Sideroad north of Innisfil Beach Road and Yonge Street throughout the Town. Innisfil Beach Road is also proposed to be widened to 4 lanes but will continue to be congested by 2031.

Alternative 3 builds upon current plans and includes Town of Innisfil investment in local transportation improvements including:

- Road improvements including reconstruction, urbanization, new construction and traffic signals to support future development and traffic demand;
- Active Transportation infrastructure (sidewalks, trails, bike lanes, multi-use paths) to provide mobility and safety for non-motorists and to connect the Innisfil communities; and
- Implement Travel Demand Management (TDM) measures including carpool, bike to work, work from home programs, etc., to help to reduce traffic.

Alternative 4 builds upon the road improvements, active transportation and travel demand management recommendations and adds a transit service as a key component of Innisfil's transportation future. A very broad structure for service has been identified as part of this alternative, and includes the following major connections:

- North-south service along 25th Sideroad and other waterfront arterial roads, connecting all of the waterfront communities
- East-west service on Mapleview Road connecting Big Bay Point and Sandy Cove with key destinations within Barrie
- East-west service on Innisfil Beach Road, connecting Innisfil Heights employment with the Alcona Growth area
- East-west service on Killarney Beach Road or 5th Line, connecting Churchill with Lefroy and the potential GO Station on Belle Aire Beach Road
- East-west service on County Road 89, connecting Cookstown with Fennel's Corners and Gilford

Implementation of this service has the potential to improve traffic conditions along Big Bay Point Road, Innisfil Beach Road, and Shore Acres Drive.

4.2 Alternative Planning Solutions for Alcona Growth

In determining the preferred planning alternative for the Town (Alternative 3: Balanced Approach), Alternative Planning Solutions are further analyzed for the growth of Alcona. This further review and validation follows the process for the Class EA. The planning alternatives include:

Alternative 1: "Do Nothing"

Alternative 2: Restrict Development

Alternative 3: Transportation Demand Management (TDM)

Alternative 4: Transportation System Management (TSM)

Alternative 5: New Infrastructure (Interchange on Highway 400)

The "Do Nothing" Alternative – as mandated by the Class EA, must be considered. It represents a baseline from which other approaches can be compared.

Restrict Development – this strategy would be an approach that would limit any new residential development and therefore eliminate the need for a new interchange.

Transportation Demand Management (TDM) – This strategy would reduce vehicular demand and would encourage more active modes of transportation (cycling and walking).

Transportation System Management (TSM) – This strategy would consider operational improvements to existing infrastructure to improve the performance of traffic operations. System improvements may include signal timing improvements, signal coordination or introduction of improvements such as turn lanes.

New Infrastructure – This strategy would be to provide roadway improvements and a new interchange to accommodate future demand.

Widening of Innisfil Beach Road to 4 lanes is scheduled as part of the County of Simcoe's TMP. The ability of interchange improvements at Highway 400 and Innisfil Beach Road to accommodate the planned development will be restricted by the capacity of roadway corridor. The TMP identified that with the proposed widening of Innisfill Beach Road the traffic demands would still exceed the available roadway capacity as identified in Figure 2 and Figure 3.

Figure 2: Simcoe County TMP Proposed Roadway Improvements

Table 5.3-4: Additional Improvements for Inclusion in the Draft 2031 Road Network

Road	Limits	Improvement(1) 2011	Improvement(1) 2031	GM	CON	AT	TRA	ENV	$	TOTAL	MAE Pass?
CR 4, Innisfil	Innisfil 10th Line to CR 21	2	4	CONGESTED DESPITE IMPROVEMENT							
CR 53, Innisfil	CR 21 to Barrie City Limit	2	4	0	4	10	5	10	4	33	✓
CR 10 Clearview	CR 9 to Highway 26	2	4	0	6	10	5	6	4	31	✓
CR 90, Springwater	CR 28 to the Barrie City Limit	2	5	CONGESTED DESPITE IMPROVEMENT							
CR 43, Springwater	CR 28 to Highway 26	2	4	0	0	10	1	10	4	25	✓
CR 93, Oro-Medonte	CR 11 to Barrie City Limit	2	4	6.7	0	0	7.7	[illegible]	[illegible]	24.3	✓
CR 21, Innisfil	CR 53 to CR 4	2	4	CONGESTED DESPITE IMPROVEMENT							
CR 89 / CR 3, Innisfil	CR 53 to CR 39	2	4	0	6	0	2	5.5	4	17.5	✗
4th Line, Innisfil	CR 53 to CR 39	LOCAL	CR	0	6	0	1	5	4	16	✗
CR 93, Midland	CR 25 to Highway 12	2	4	0	0	0	10	10	4	24	✓
Line 3 N, Oro-Medonte	CR 20 to CR 19	LOCAL	CR	0	10	10	0	5	8	33	✓
Line 7 N, Oro-Medonte	CR 19 to Highway 400	LOCAL	CR	0	10	0	0	7	8	25	✓

Figure 3: 2031 Traffic Conditions (With Simcoe County TMP Recommended Improvements)

Exhibit 7-2: Alternative 2 – Business as Usual 2031 Traffic Conditions

Without the provision of a new interchange as had been identified in the Town of Innisfil's Official Plan and as recommended as part of the Town of Innisfil TMP, the projected travel demands on Innisfil Beach Road would exceed the capacity of a 6-lane arterial, and increased congestion was also projected on north/south arterials.

The capacity constraint along the Innisfil Beach Road corridor was reaffirmed by the Innisfil TMP. Long term improvements to provide an interchange on Highway 400 at 6th Line is projected to attract an estimated 35,000 vehicles/day to 6th Line (upgraded to a 4-lane arterial standard). The TMP still projected that congestion would remain on the widened Innisfil Beach Road, as presented in Figure 4.

Figure 4: 2031 Traffic Conditions with 6th Line Interchange at Highway 400

Exhibit 8-23: 2031 Traffic Conditions with 6th Line Interchange at Highway 400

5. EVALUATION OF ALTERNATIVE PLANNING SOLUTIONS

5.1 Evaluation of Municipal TMP Alternative Planning Solutions

The analysis and evaluation of Alternative Planning Solutions is a critical requirement of the Environmental Assessment process.

A qualitative evaluation process was utilized for the assessment of Alternative Planning Solutions, as the number of alternatives and evaluation criteria were limited. The alternatives were assessed using the following evaluation factors:

- **TRANSPORTATION SERVICE:** Does the transportation network efficiently move both people and goods? Does the network provide access to all people and ensure their safety? Are there opportunities to walk and cycle throughout the Town?
- **NATURAL ENVIRONMENT:** Protect natural environment areas, local streams and aquatic resources, and air quality
- **POLICY ENVIRONMENT:** Compatibility with provincial Growth Plan and Simcoe County objectives. Meet's the Town's Official Plan, Inspiring Innisfil 2020, and other planning policy objectives
- **SOCIO-ECONOMIC ENVIRONMENT:** Minimizes property requirements. Supports the existing and potential business community. Maximizes land development potential and provides opportunities for planned growth
- **FINANCIAL IMPLICATIONS:** Minimize capital and maintenance costs, and impacts to the residential tax base

The description and assessment of the Alternative Planning Solutions are summarized in Figure 5.

Criterion	Alternative 1: Do Nothing	Alternative 2: Business As Usual	Alternative 3: Balanced Approach	Alternative 4: Aggressive Approach
Transportation Service	○	◑	◕	●
Natural Environment	●	◕	◕	◕
Policy Environment	○	◔	●	◕
Socio-Economic Environment	○	◑	◕	●
Financial Implications	●	◕	◑	○
Preliminary Findings:	Screened Out	Screened Out	Carried Forward	Carried Forward

Legend: Does Not Meet Criterion ○ ◔ ◑ ◕ ● Meets Criterion

Figure 5: Evaluation Summary of Alternative Planning Solutions (Source: Innisfil 2013 TMP)

5.2 Evaluation of Alternative Planning Solutions for Alcona Growth

Based on planned developments in the area (Sleeping Lion and Innisfil Heights) and projected increase in traffic, the "Do Nothing" alternative and Restricting Development do not address the Province's planning initiatives and are not recommended to be carried forward.

TDM and TSM would not be effective enough individually to address the projected transportation deficiencies and therefore are not carried forward as standalone solutions, but rather will be incorporated with the New Infrastructure alternative as a Recommended Solution. This recommendation is consistent with the findings of the 2013 TMP as presented to the public at POH No. 1.

6. SUMMARY AND PRELIMINARY RECOMMENDATIONS

To address the future traffic demand in the Town of Innisfil, it is recommended that the Town of Innisfil consider planning for a new interchange on Highway 400 and determine the feasibility, cost of implementation and environmental effects.

The preliminary assessment of Alternative Planning Solutions was presented at Public Open House (POH) No. 1 for public comment. In addition, POH 1 presented a comparison of the alternative interchange locations. These candidate locations included the 4th, 5th, and 6th Lines. See **Appendix** A for the assessment of interchange locations. The comparison table is illustrated in **Table 1**.

Table 1: Interchange Location Evaluation Summary

Criteria	4th Line Interchange	5th Line Interchange	6th Line Interchange
Network Wide Benefit (addresses Innisfil Beach Road Capacity Constraint)	×	×	✓
Supports Future Growth Areas	×	-	✓
Environmental Impacts	-	-	-
Property Impacts	-	-	-
Constructability and Cost	-	×	✓
Proximity to Current Development	×	-	✓
Proximity to Projected Development	×	-	✓
Interchange Spacing	✓	✓	-
Highway Geometry - Spatial Separation from Travel Centre	×	×	-
Recommended to be carried forward?	No	No	Yes

Consistent with the Innisfil TMP, an interchange on Highway 400 at 6th Line is recommended. Further analysis of traffic / freeway operations will be completed and documented in the Environmental Study Report following the identification of a technically preferred interchange configuration.

APPENDIX B: Evaluation Methodology Report

BT ENGINEERING

EVALUATION METHODOLOGY REPORT

6th Line Interchange Environmental Assessment Study

Presented to:

Town of Innisfil
2101 Innisfil Beach Road
Innisfil, ON

BTE Project No. 2016-006 July 2016

BT ENGINEERING BTE

EXECUTIVE SUMMARY

A Schedule 'C' Environmental Assessment (EA) is being carried out by the Town of Innisfil, under the Municipal Class Environmental Assessment (2007 as amended in 2011 and 2015), to plan for a new interchange on Highway 400 at 6th Line.

The analysis and evaluation process is a requirement of the EA process; the framework is provided by the Ministry of the Environment and Climate Change (MOECC) Evaluation Methods in Environmental Assessment.

This document describes the qualitative and the quantitative methods of evaluation and which approaches will be utilized for different groups of alternatives. An evaluation method may be defined as a formal procedure for establishing an order of preference among alternatives.

BT ENGINEERING BTE

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GLOSSARY OF TERMS

AASHTO	American Association of State and Highway Transportation Officials
Adjacent	Adjacent indicates lying near MTO or Municipal roadway rights-of-way, although not necessarily contiguous to them.
Aesthetics	Methods of providing visual relief and appealing characteristics to planned noise barriers thorough the application of landscaping designs.
Alternative	Well-defined and distinct course of action that fulfills a given set of requirements. The EA Act distinguishes between Alternatives to the Undertaking and Alternative Methods of Carrying out the Undertaking.
Coarse Screening	Initial screening of a group of alternatives. Also see Screening.
Criterion(a)	Explicit feature or consideration used for comparison of alternatives.
Dichotomous Utility Function	A utility function that represents a desirable or undesirable response from a criterion (yes/no, present/absent, true/false).
Dimensionless Number	A number that does not have a unit of measurement, such as length (m), time (s), mass (kg) associated with it. Examples include Utility Score and Overall Score.
Do Nothing Alternative	This alternative is a mandatory requirement of the Class EA. This option is the null or no action alternative and it becomes the baseline to which all alternatives are compared.
Double Counting	Unintentional accounting for a particular factor or attribute more than once in the evaluation.
EA	Environmental Assessment
Evaluation	The outcome of a process that appraises the advantages and disadvantages of alternatives.
Evaluation Criteria	See Criteria.

Evaluation Process	The process involving the identification of criteria, rating of predicted impacts, assignment of weights to criteria, aggregation of weights, and rating to produce an ordering of preference of alternatives.
Factor	See Global Factors.
Freeway	Freeway is defined as an existing completed, partially developed (staged) or proposed divided highway with full control of access and grade separated intersections. This definition may include some highways that are not officially designated as freeways.
Function Form	See Utility Function
Global Factors	The main categories of factors, (i.e. Transportation, Economic Environment, Natural Environment, Social and Cultural, Land Use and Property and Cost). All sub-factors are components or a subset of global factors.
Linear Utility Function	A function that can be defined using a linear equation of the form: y = a + bx, where y is the dependent variable (raw score) x is the independent variable (measurement) b is the slope of the function, and a is the y intercept, normalized in this study to be equal to one or zero
Matrix	A rectangular array of criteria and values.
Mitigation	Taking actions that either remove or alleviate to some degree the negative impacts associated with the implementation of alternatives.
Overall Score	The final value of an alternative's score derived by summing all of the weighted scores.
Performance Factor	See Utility Function
POH	Public Open House
Ranking	The ordering of alternatives from first to last for comparison purposes.

Raw Data	The measurement of the impact, or measured data, under each criterion.
Risk	Probability that a given outcome will or will not materialize. Distinct from uncertainty in that the alternative outcomes are known or defined and that the probability of each is measureable.
Screening	Process of eliminating alternatives from further consideration, which do not meet minimum conditions or categorical requirements.
Step Function	A utility function can be defined by several linear functions within separate ranges that have a slope equal to zero. For this study, two step functions are used: Case A: y = 1, for x = desirable and y = 0, for x = undesirable Case B: y = 1 for x = desirable, y = 0.5 for x = medium performance and y = o for x = undesirable
Sub-factor	A single criterion used for the evaluation. Each sub-factor is grouped under one of the factors.
TPA	Technically Preferred Alternative
Traceability	Characteristic of an evaluation process which enables its development and implementation to be followed with ease.
Environmental Study Report (ESR)	This report is prepared in compliance with the EA Act requirements and the Ministry of the Environment for acceptance, approval, informational or monitoring purposes and the public record.
Utility Function	A function (linear, step, dichotomous) that represents the Utility Score versus the criterion measurement or desirableness.
Utility Score	The "y" value derived from the Utility Function of the measurement of the impact induced by a particular alternative's criterion. A measurement of the usefulness or attractiveness of an alternative with respect to an individual evaluation criterion based on its measured effect (a number between 0 and 1). The utility score is dimensionless.

Weight	The importance attributed to a criterion relative to other criterion. The value of the weight is expressed in a percentage and the sum of all criterion weights is equal to 100%.
Weighted Additive Method	The method used in the quantitative evaluation of alternatives, which reduces the project's numerous criteria into a dimensionless number for each alternative suitable for comparison.
Weighted Score	A raw score that has been multiplied by the criterion weights. The weighted scores reflect the social value or importance of the specific group providing weights.

1 INTRODUCTION

The analysis and evaluation process is a requirement of the Environmental Assessment (EA) Process; the framework is provided by the Ministry of the Environment and Climate Change (MOECC) Evaluation Methods in Environmental Assessment.

This document describes the qualitative and quantitative methods of evaluation and which approaches will be utilized for different groups of alternatives for this study. An evaluation method may be defined as a formal procedure for establishing an order of preference among alternatives[1]. The use of a formal evaluation method has two main advantages: it provides a better basis for decision-making than would otherwise exist and it results in reasons for decisions that, on examination, can be traced.

The selection of an evaluation methodology should consider:

- Various methods have different capabilities which make possible different planning processes that may be better suited to a particular project or stage of the EA.
- With any particular planning process, all the steps (such as identifying alternatives, selecting criteria, consulting and involving interested parties, as well as evaluating) must be reasonable and provide a systematic assessment of the net effects of the project.

The selection of the appropriate evaluation methodology depends upon:

- Complexity of the decision-making;
- The number of alternatives;
- The number of criteria; and,
- The sensitivity of the decision.

These issues are described in the succeeding sections and explain the rationale for utilizing the most appropriate evaluation methodology in each stage of the EA study.

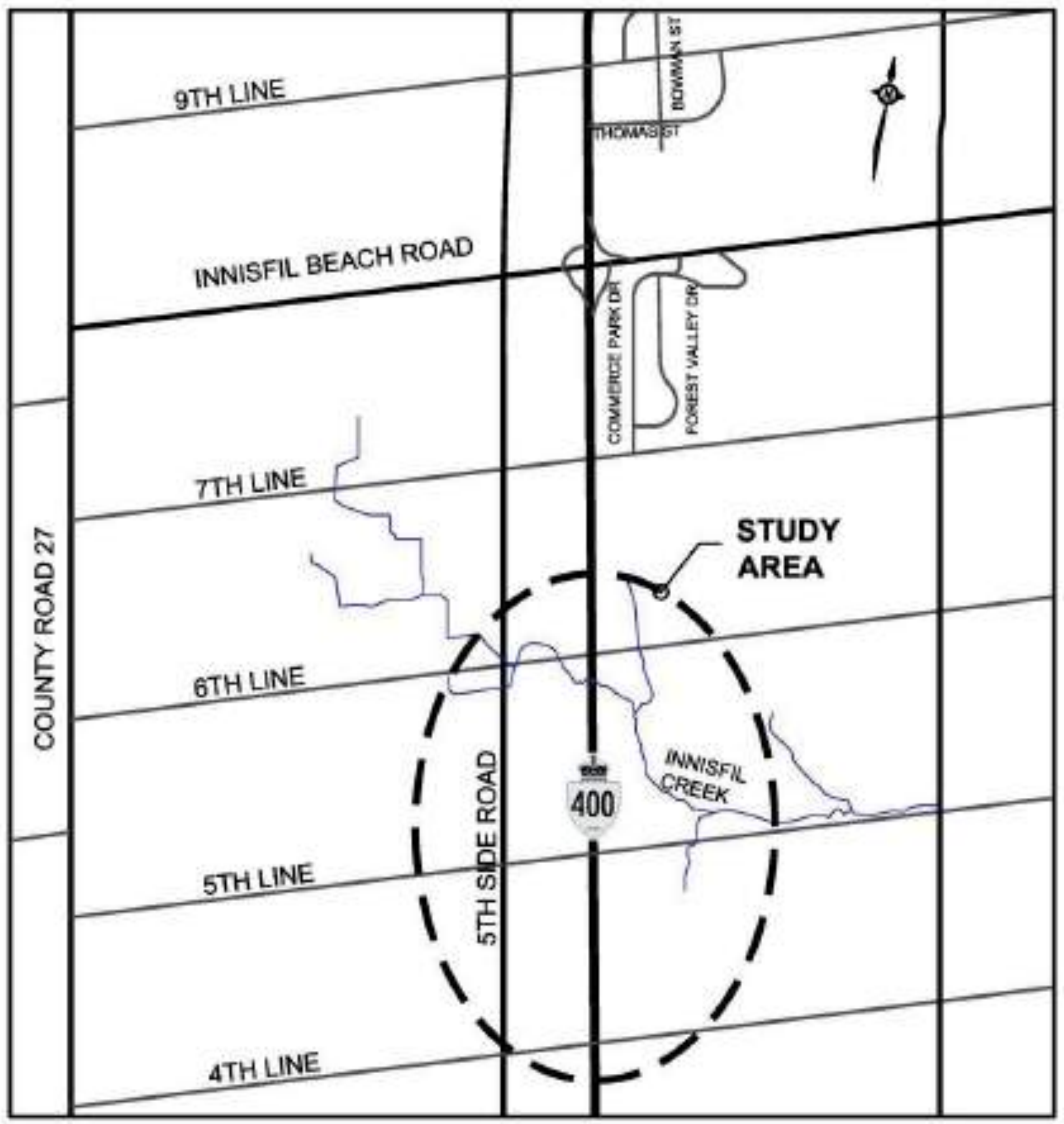
2 STUDY AREA

The Town of Innisfil has retained BT Engineering Inc. (BTE) to undertake a preliminary design and environmental assessment study to plan for a new interchange on Highway 400 at 6th Line. This study will determine the appropriate strategy for the interchange including roadway improvements at the interchange location. The Study Area, as shown in **Figure 2.1**, is located in the Town of Innisfil.

Several alternatives will be reviewed for the interchange configuration, over or underpass on Highway 400 and roadway alignment. In addition, engineering, environmental, and property requirements will be established, along with the identification of mitigation measures to reduce or negate short and long term residual effects.

[1] Evaluation Methods in Environmental Assessment, Ministry of Environment, 1990.

Figure 2.1: Study Area



3 PUBLIC PARTICIPATION

Public participation is a key component to the success of this project. Early public involvement is encouraged to establish a sound understanding of the public's concerns and views, to identify areas of concern and major study issues, and to promote a working relationship with the public that is amicable and co-operative rather than adversarial.

BT ENGINEERING BTE
Town of Innisfil
6th Line Interchange Environmental Assessment Study
Evaluation Methodology Report

3.1 Public, Property Owner, and Stakeholder Consultation

The public will be engaged through the use of Public Open House (POH) meetings and one-on-one meetings with directly affected property owners. This includes meetings and consultation with utilities, businesses and stakeholders who have an interest in providing comments on the design.

3.2 Public Open House (POH) No. 1

The purpose of the first POH is to present background information, inventories, a preliminary list of evaluation factors and a long list of Preliminary Design Alternatives.

3.3 Public Open House (POH) No. 2

The second POH will present the Technically Preferred Alternative (TPA) for the interchange configuration and roadway alignment and respond to questions and concerns from the public.

4 QUALITATIVE EVALUATION METHODOLOGY

A qualitative evaluation method involves describing impacts in narrative terms, or through qualitative measures, without the explicit specification of criteria, ratings or weights. This method, often termed "professional judgment" is widely used in EA's to assess 'alternative planning solutions'. For example, an EA involving the selection of a corridor might evaluate alternative routes in considerable detail using a formal quantitative evaluation, but the evaluation of 'alternatives to' might be done using a qualitative approach; no specific measureable criteria are identified and systematically applied to all alternatives, and the dismissal of alternatives is done using a narrative approach. See **Table 4.1** for an example of the qualitative evaluation approach.

A disadvantage of the qualitative approach is the difficulty in recognizing when a comparison will have intuitive choice or universal support (public), i.e. a simple decision easily accepted. A qualitative approach may also be less defensible or subject to criticism. Risk management is an important issue and should the public or stakeholders question these early decisions, additional information may be required to substantiate or detail the rationale for the early decisions. When alternatives are not systematically compared against a specified set of criteria, it may be difficult to follow how the decision was made and what evidence supports it.

Some advantages of using a qualitative approach over a quantitative approach include: reduced cost, reduced time, and ease of presentation to the public. A qualitative approach is predominantly used to evaluate alternatives where there is a clear conclusion and low public scrutiny.

The use of a qualitative approach is best suited where there are few alternatives and few criteria where there are measureable and meaningful differences between options being considered.

Table 4.1: Sample Qualitative Evaluation			
Factor Group	Alternatives		
	Alt 1 Two Leg Stop Control	Alt 2 Three Leg Stop Control	Alt 3 Roundabout
Transportation			
Traffic Operations	-	-	✓
Safety	-	-	✓
Property/Land Use			
Property Impacts	✓	✓	×
Natural Environment			
Impacts to Natural Environment	-	-	-
Social/Cultural			
Social Environment	-	-	✓
Cost			
Cost	✓	✓	-
Evaluation Results	×	×	✓ Carried forward

✓ Good in Comparison - Fair in Comparison ✖ Poor in Comparison Preferred Alternative

Where there are few criteria, such as in **Table 4.1**, it is generally acceptable to use a qualitative analysis because the trade-offs are clear and understandable. The more rigorous definition of the attributes of each alternative, as would be possible using a quantitative approach, is not required because there are too few variables. In this study, the qualitative approach will be used to assess Alternatives to the Undertaking and for the Coarse Screening of the initial long list of preliminary design alternatives.

The use of a more comprehensive evaluation technique becomes necessary as the complexity increases (i.e. number of alternatives and number of criteria). In these situations, as described in **Section 5**, this study will utilize a quantitative approach.

5 QUANTITATIVE EVALUATION METHOD

Key principles of the EA Act and MOECC's Guidelines on Environmental Assessment Planning and Approval are that there be accountability and traceability. A quantitative evaluation method allows both of these key principles to be maintained. A quantitative

method based on the simple "Weighted Additive Method" will be used for this study and is referred to as the "Multi-Attribute Trade-off System" (MATS).

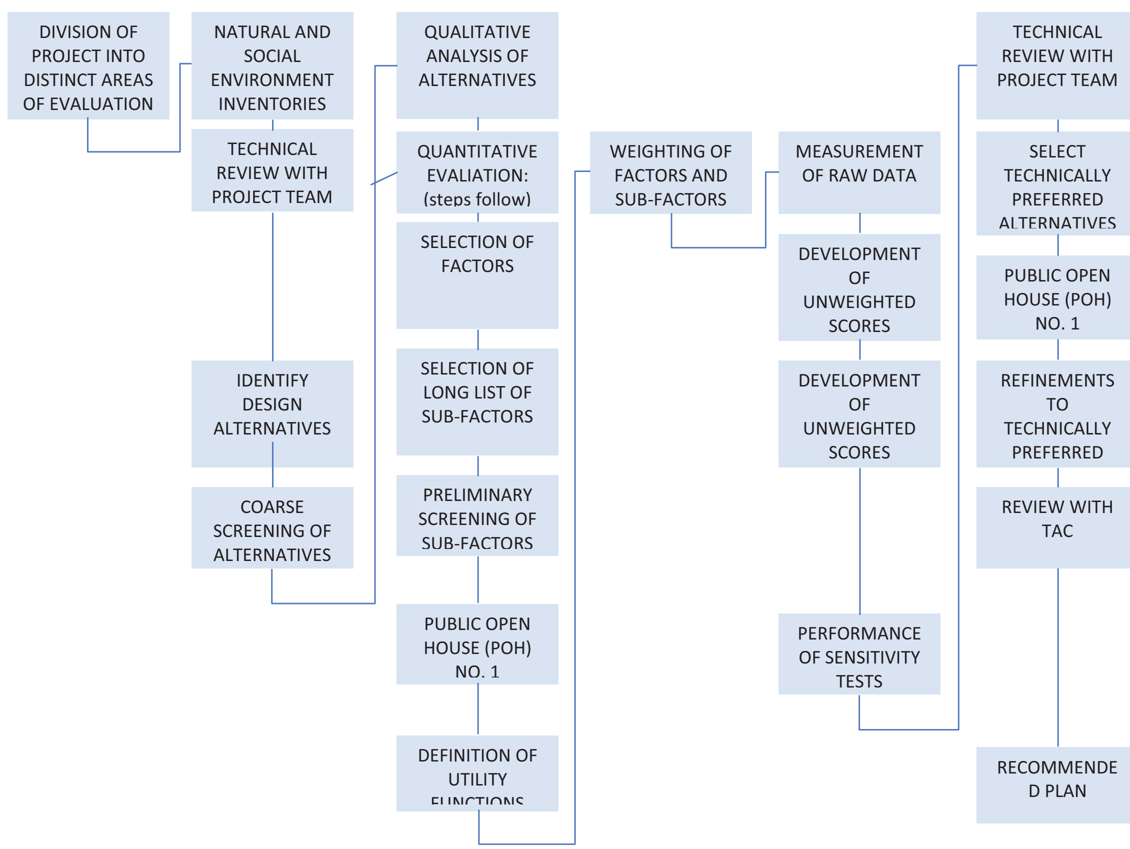
The Weighted Additive Method has proven to be invaluable for the evaluation of complex groups of alternatives. The methodology allows for sensitivity testing and the ability to answer "what if" questions. This method is used on projects where alternatives are to be evaluated and the decision making process is faced with either a large number of alternatives or a large number of competing criteria among the alternatives being evaluated.

This systematic approach is consistent with MOECC practices for the evaluation of alternatives. It avoids many of the pitfalls associated with qualitative assessments by using an analytical approach that measures scores based on a mathematical relationship, i.e. the degree of subjectivity by the Study Team is minimized. A traceable process allows the Study Team and public an opportunity to assess trade-offs involved in the evaluation and use this information in the decision-making process. In addition, this quantitative method allows sensitivity tests to be performed to determine if the highest ranked alternative is affected by changing the weights (perspective of importance) of the assessment factors.

For this study, preliminary design alternatives will be compared and scores assigned to each of the various assessment factors and a sensitivity-testing program will be completed in consultation with the public and external agency interaction.

When using the Weighted Additive Method, each member of the Study Team assigns a weight to the Global Factors and sub-factors. The Average Study Team Weight is assigned to each of the alternatives. The alternative with the highest score is selected as the TPA. The steps followed to arrive at an overall score for each alternative are shown in **Figure 5.1**.

Figure 5.1: Quantitative Evaluation Process



This systematic approach includes the following steps:

- Collection of data/environmental inventories
- Development of a long list of reasonable alternatives (including options screened out as unfeasible or unreasonable in comparison to those being carried forward)
- Development of a long list of evaluation criteria/performance factors
- Short listing of sub-factors to those where there are meaningful differences among the alternatives to be compared
- Establish Social Utility Functions (Performance Factors or Function Forms) for the short listed sub-factors
- Weighting of Evaluation Criteria (assigning importance based on the specific set of alternatives)
- Rating of Alternatives
- Sensitivity Testing
- Selection of TPAs
- Public Review
- Refinements to the Technically Preferred Plan
- Recommended Plan

These steps, as they relate to this study, are briefly described in the following sections.

5.1 Evaluation Criteria – Factors

The initial test in the evaluation is to develop evaluation criteria from which alternatives will be assessed. This is broken down into a two-step process that involves the selection of a “global” group of factors and a number of “local” sub-factors under the global groups.

The global factors groups will be presented to the public, and following this consultation will be accepted as describing the broad definition of the environment to be evaluated. Factors considered for this study may include:

- Traffic and Transportation;
- Natural Environment;
- Hydraulics;
- Structures;
- Heritage;
- Social and Cultural Environment;
- Land Use and Property;
- Economic Environment; and
- Cost.

While these factor groups are the starting point for the evaluation, one or more factors could be removed if it was determined that there was no sub-factor in this category i.e. there is not a meaningful and measureable difference among the alternatives being assessed in this category. When a particular factor is carried forward, then one or more sub-factors are considered under this group. These sub-factors are the individual descriptors for the evaluation. The selection of the sub-factors is very important to the decision making process because they must adequately describe the issue to be evaluated and the alternatives being compared. See **Table 5.1** for a sample preliminary listing of sub-factors. Any information regarding an alternative, where there are differences among alternatives, is incorporated into the decision-making process by including it as a sub-factor. The benefit to incorporating two levels of evaluation criteria (global factors and local sub-factors) is the prevention of the unbalancing of the evaluation (that could occur by adding more criteria under one group). Weights are assigned to the global factors to eliminate any possibility of skewing the results by selecting a large number of sub-factors in one particular factor group.

Table 5.1: Sample Long List of Evaluation Criteria (Global Factors and Sub-factors)

Traffic and Transportation	
1. Highway 401 Safety	✗
2. Highway 401 Detour Duration	✓
3. Cornwall Centre Road Detour Duration	✓
4. Out-of-Way Travel	✓
5. Traffic Delay, Highway 401	✗
6. Risk of Queuing	✓
7. Disruption to Bicycles and Pedestrians	✓
8. Design Standard	✓
9. Design Speed	✗
10. Radius of Horizontal Curves	✗
11. Radius of Vertical Curves	✗
12. Consistency with Adjacent Highway Design Elements	✗
13. Safety of Residential Entrances	✗
14. Sight Distances	✗
15. Level of Service on Cross Streets	✗
16. Ability to be implemented for 2011 construction contract	✗
17. Consistency with Southern Ontario Highways Plan	✗
18. Ease of driver task	✗
Natural Environment	
1. Area of Wetland Impacted	✗
2. Fish Habitat Impacted	✓
3. Impact to Natural Woodland Habitat	✗
4. Wildlife Corridors Impacted	✗
5. Number of Watercourse Crossings	✗
6. Number of Groundwater Wells Impacted	✗
7. Stormwater Impact	✓
Cultural Environment	
1. Areas of Archaeological Potential Impacted	✓
2. Loss of Visual Screening along the north side of Hwy 401	✓
3. Cultural Landscape Features Impacted	✗
4. Built Heritage Features Impacted	✗
5. Community Cohesion	✗
6. Impact to Existing Bicycle Path	✗
7. Snowmobile Trails Impacted	✗
8. Vibration Impacts	✗
9. Bridge Aesthetics	✓
Socio-Economic Environment	
1. Out-of-way travel to businesses	✓
2. Impact to Cornwall Motor Speedway	✓
3. Impact to McGregor Grain Impact to McGregor Grain	✗
4. Impact to Cornwall Landfill	✗
5. Impact to Aggregate Resources	✗
6. Impact to Farming Activities	✓
7. Impact to Existing Utilities	✓
8. Number of Noise-Sensitive Areas Impacted	✓
9. Out-of-Way Travel, Emergency Services	✗
10. Out-of-Way Travel, School Buses	✗
11. Potential to Support Regional Development	✗
12. Loss of Surface and Mineral Rights	✗
Land Use and Property	
1. Temporary Limited Interest Required	✓
2. Number of Properties Impacted (Total)	✓
3. Number of Buyouts (Total)	✗
4. Area of Residential Property Required	✗
5. Number of Residential Buyouts	✗
6. Area of Industrial Property Required	✗
7. Number of Industrial Buyouts	✗
8. Area of Institutional Land Required	✗
9. Number of Institutional Buyouts	✗
10. Area of Public Service Facility Land Required	✗

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11. Number of Public Service Facility Buyouts	✗
12. Area of Prime Agricultural Land Required	✗
13. Number of Agricultural Buyouts	✗
14. Area of Commercial Land Required	✗
15. Number of Commercial Buyouts	✗
16. Parks/Open Space Area Required	✗
17. Utility Corridors Impacted	✗
18. Potentially Contaminated Sites Impacted	✗
Cost	
1. Life Cycle Cost	✓
2. Durability	✓
3. Maintenance	✓
4. Constructability	✓
5. Long Term Lighting	✓
6. Potential for Settlement	✗
Legend: ✓ Carried Forward ✗ Not Carried Forward	

Generally, the process begins by establishing a long list of potential or candidate sub-factors through discussions with community associations, the Study Team and interest groups or from previous studies of the same nature. Then, for each group of alternatives being evaluated, the sub-factors are reviewed and screened by eliminating those that are considered equal among alternatives being considered as well as those that do not apply to the study area, based on the site inventories carried out.

Table 5.2 provides a sample of a typical Factor, Sub-Factor, Unit and Utility Function Type from a similar Transportation Study. Similar Factor, Sub-factor and Utility functions will be developed for this study.

Table 5.2: Typical Evaluation Factors and Sub-Factors

Factor	Sub-Factor	Unit	Utility Function Type
Traffic and Transportation	• Level of Service (LOS)	Letter (A, B, C, D, E or F)	Stepped Function
	• Number of conflicts	Number	Linear
	• Number of intersections	Number	Linear
	• Number of entrances	Number	Linear
	• Out-of-way travel	Minutes	Linear
	• Flexibility for staged construction	Yes/No	Dichotomous
	• Ease to implement detour for new structure	Yes/No	Dichotomous
	• Design consistency	Yes/No	Dichotomous
	• Ability to stage construction	Yes/No	Dichotomous

5.2 Factor and Sub-factor Weights

The selection of weights for the factors and the sub-factors is based on assessments by the Study Team of their relative importance. Within a group of factors, inevitably there is an ordering, with some factors having more importance than others. This is accounted for by each individual assigning a weight to each factor, which is reflected in the "Factor Weight" and "Sub-Factor Weight" columns. An example of typical weights is shown in **Table 5.3**.

Table 5.3: Sample Study Team Average Weights for a Factor Group and Sub-Factors in that Group

Factors	TAC	
	Factor Weight	**Sub-Factor Weight**
Traffic and Transportation	40.9%	
• Level of Service (LOS)		27.6%
• Number of conflicts		13.5%
• Number of intersections		7.3%
• Number of entrances		6.1%
• Out-of-way travel		2.6%
• Flexibility for staged construction		9.6%
• Ease to implement detour for new structure		13.9%
• Design consistency		9.2%
• Ability to stage construction		10.2%
	Total	**100%**

As shown in **Table 5.3**, in this example, the group of evaluators judged the Traffic and Transportation Factor Group to be valued at 40.9% of the overall importance of the decision between the alternatives being considered.

Within each Factor Group the sum of the percentage weights of all sub-factors listed under each factor totals 100%. As shown in Table 5.3 several of the sub-factors were judged to be more important /less important when compared to each other for this specific evaluation of alternatives being considered.

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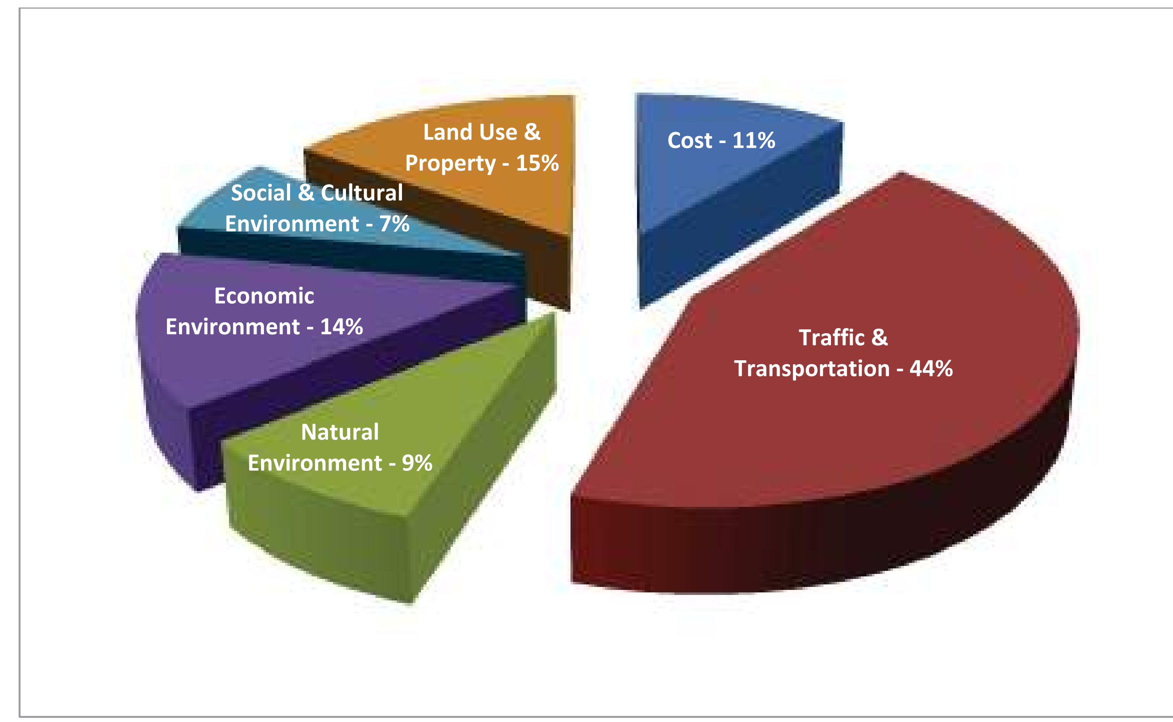
The weights for each factor and sub-factor are determined by averaging the weights assigned by the Study Team (Evaluation Committee). Each member gives a judgement of the importance of each global factor and local sub-factor (a percentage value) based on his or her personal assessment and professional judgement, considering the net effects and input of stakeholders and the public.

There is usually a range of perspectives in deciding the weights (importance) of factors and sub-factors. Every person assigning weights has a personal perspective and understanding of the scope of the project. Hence, there is an advantage to having a diversified team of professionals with varied backgrounds performing the evaluation.

An example of the weighting of each of the global factors is shown in **Figure 5.2**. The weighting of sub-factors within each factor group would be a similar distribution among the available sub-factors.

Figure 5.2: Sample Weighting of Global Factors



5.3 Social Utility Functions

The Weighted Additive Method used to evaluate alternatives relates the performance or attractiveness of alternatives using a mathematical relationship. This includes two variables: the first is the raw data or measured or modelled data and the second is the utility or utility score, which is the measure of attractiveness of the alternative.

For this project, the relationship between these two variables was described, as shown in **Figure 5.3**, by either a dichotomous, stepped, or linear social utility function. A dimensionless utility score between zero (0) and 1 is assigned to an alternative for each sub-factor. The shape of this function can vary from linear to stepped or exponential, and is defined by a subject area specialist.

The use of utility curves or functions is a step that transforms each of the measured effects to a dimensionless number and measure of utility. This step is required because the effects of each sub-factor are measured in different units (length, area, time, volume, dollars etc). To produce a mathematical measure of the performance, each effect is transformed to a measure of utility. The combined effect or performance of each alternative is a measure of utility (attractiveness) which is a dimensionless measure. The utility function (also commonly described as performance factor or function form) defines the relationship of effect to the attractiveness (utility). These utility functions are defined by subject area specialists in the field of study.

Examples of Social Utility Functions for the 'Ease of Maintenance' sub-factor definition are shown below in **Figure 5.4**.

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Figure 5.3: Sample Utility Functions

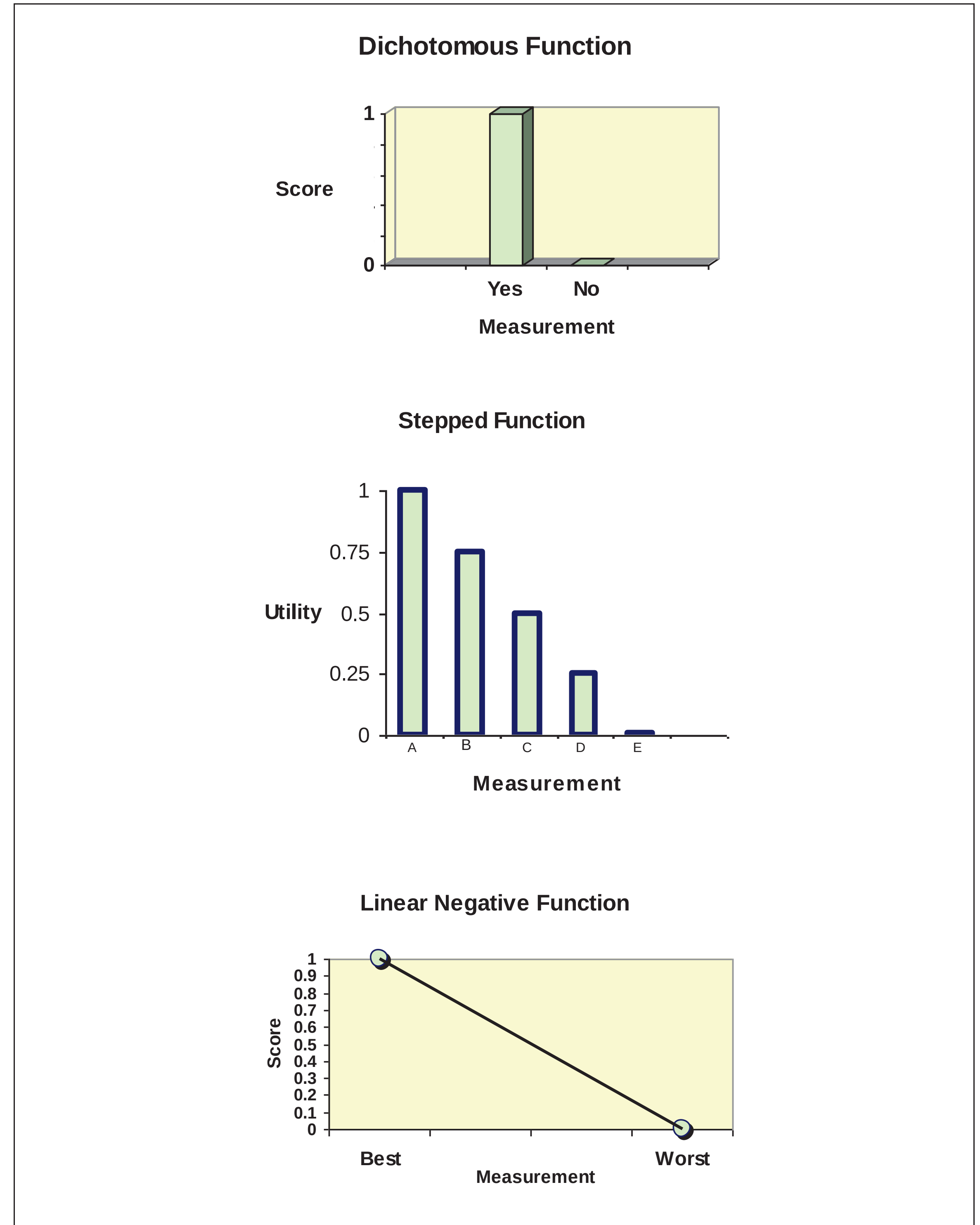
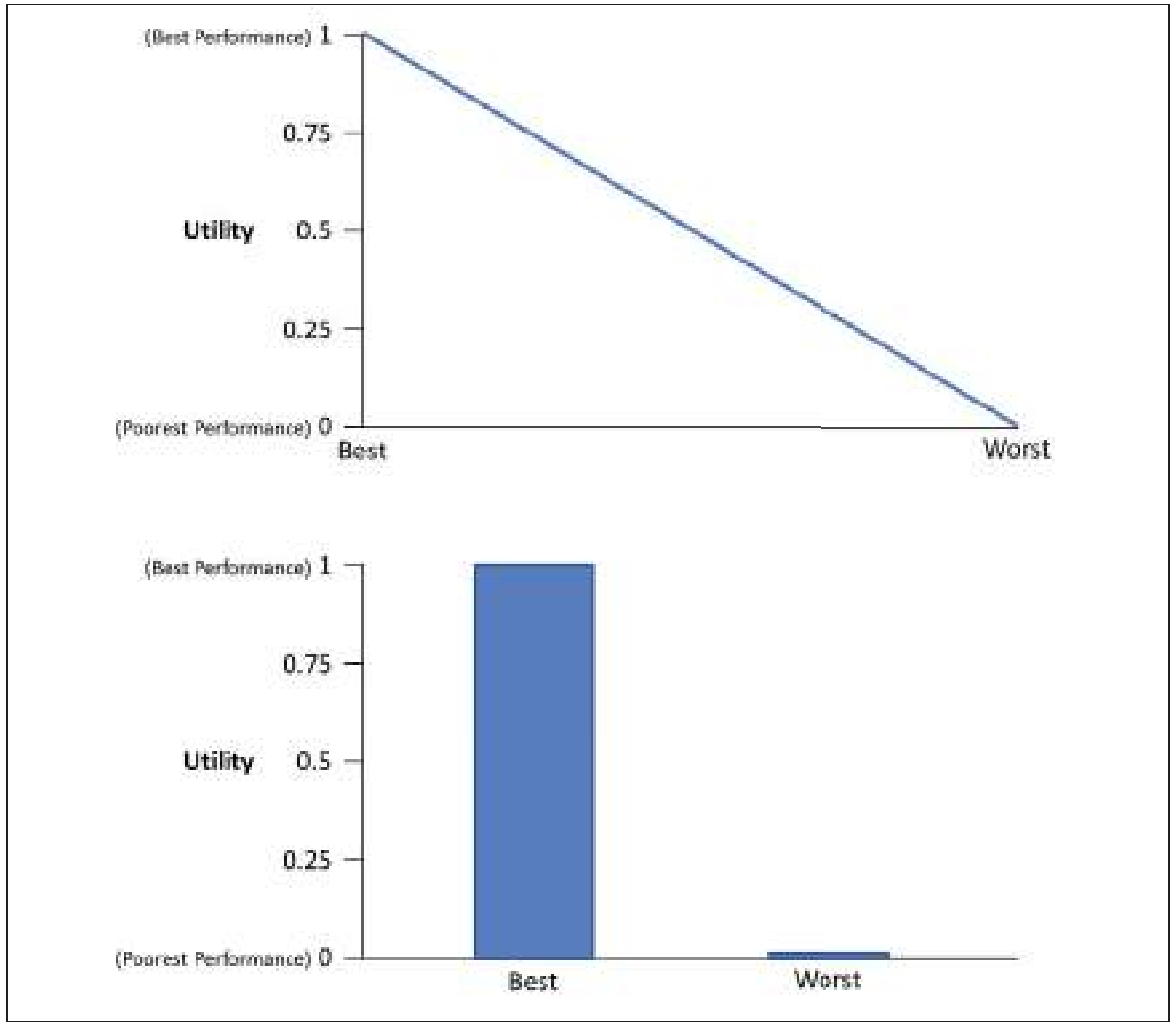


Figure 5.4: Social Utility Function



A dichotomous utility function enables the decision-maker to establish criteria that presents an “either–or” situation (desirable or undesirable, negative or positive, present or absent). If it were decided beforehand that a “yes” answer is desirable, then a utility score of one would be assigned to this criterion, otherwise zero would be assigned. Only one or zero are the available options, no other utility score is available.

A linear function is used to convert scores for sub-factors that have varying measurements. Given a measurement, a unique utility score between zero and one can be assigned to a sub-factor. The slope of the linear utility function can be negative or positive depending on desirability of the impact.

5.4 Weighted Score

The total un-weighted utility score of a given alternative can be expressed as:

U (Alternative A) = $\varnothing_1 X_1 + \varnothing_2 X_2 ..... + \varnothing_n X_n$, where

U (A) = Total un-weighted utility score for Alternative A

$\varnothing_1$ = attractiveness with respect to parameters

X_1 = measurement of parameter X

Weighted scores are computed using the weights selected by the TAC. The weighted score for each alternative under a specific sub-factor is calculated as follows:

(weighted score) = (utility score x [(factor weight) x (sub-factor weight)])

Using this approach, a generic weighted attractiveness function can be expressed as:

U_w (Alternative A) = $U_1 W_1 + U_2 W_2 + ... + U_n W_n$

OR

U_w (Alternative A) = $W_1 \varnothing_1 X_1 + W_2 \varnothing_2 X_2 .... + W_n \varnothing_n X_n$

Where: U = Total un-weighted utility score for Alternative A

U_w (A) = Total weighted utility score for Alternative A

W_1= Weighted parameter (factor weight x sub-factor weight)

$\varnothing_1$ = Attractiveness with respect to parameter 1

X_1 = Measurement of parameter

The weighted scores of all the sub-factors are then added to give total score for each alternative.

$$U_w(A) = \sum_{X=1}^{n} W_n \varnothing_n X_n$$

5.5 Rating Alternatives

Following the selection of evaluation factors and sub-factors, measurements of the impacts are made using topographic plans, field surveys, and numerical modelling. These measurements result in data being available under each of the evaluation criteria from which ratings are made for each alternative.

The Weighted Additive Method focuses on the differences of the alternative, addresses the complexity of the base data collected and provides a traceable and defensible decision-making process. This process is a numerical calculation where alternative scores are determined through the use of a mathematical relationship to equate impacts to scores. It eliminates any possible subjective opinions of scores for alternatives because the team does not estimate the score for an alternative.

The scores for each alternative under each of the respective sub-factors are normalized based on measured impacts. Social utility functions are defined to relate impacts to the attractiveness of an alternative. This means that under each sub-factor, the alternative receives an un-weighted rating of between zero and one based on these measurements. The mathematical relationships for calculating scores are developed in consultation with the Study Team.

5.6 Sensitivity Testing Program

It should be recognized that the scope of the evaluation and determination of weights for the evaluation criteria are a matter of personal and professional judgement. Accordingly, it is considered essential to conduct sensitivity testing to determine the effect of changing weights assigned to each criterion.

To test how sensitive the outcome of the evaluation is with respect to the assigned weights (i.e. would the result have changed if different weights were used), a sensitivity testing program is undertaken. This results in greater confidence in the selection process and reduces the potential that the average weights bias the outcome of the evaluation.

Often, there is a diversity of opinion in the group as to what weight is appropriate for a factor or sub-factor. When an average weight is used to capture the preferences of the group it loses valuable information on the range of values of the group. To test the range of perspective of the Study Team, the highest and lowest weights suggested by anyone in the group are defined as a reasonable range of weights to test. A series of sensitivity tests are performed for the evaluation of alternatives. This allows the team an opportunity to assess the outcome of the evaluation if different weights (different perspectives of importance) are assigned to the factors and sub-factors from the average weights defined by the Study Team members. In this way, trade-offs can be identified, credibility can be achieved with the public, and "what if" questions can be answered quickly. See **Figure 5.5** for an example of the typical range of project team weights and **Table 5.4** for a sample ranking of alternatives.

Following the above methodology, a series of tests can be performed varying the weights for each factor. These tests include:

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- Average Study Team Weight
- Highest Weight by any Team Member
- Lowest Weight by any Team Member

Following this series of tests, the results can be reviewed to assess whether the preferred alternative changes when the weights are varied.

Using this information alone is not the only justification for selecting a particular alternative, but it does provide a level of confidence in the selection. This information is used in the decision-making process before the TPAs are recommended to be carried forward.

Figure 5.5: Sample Range of Weights for Traffic and Transportation

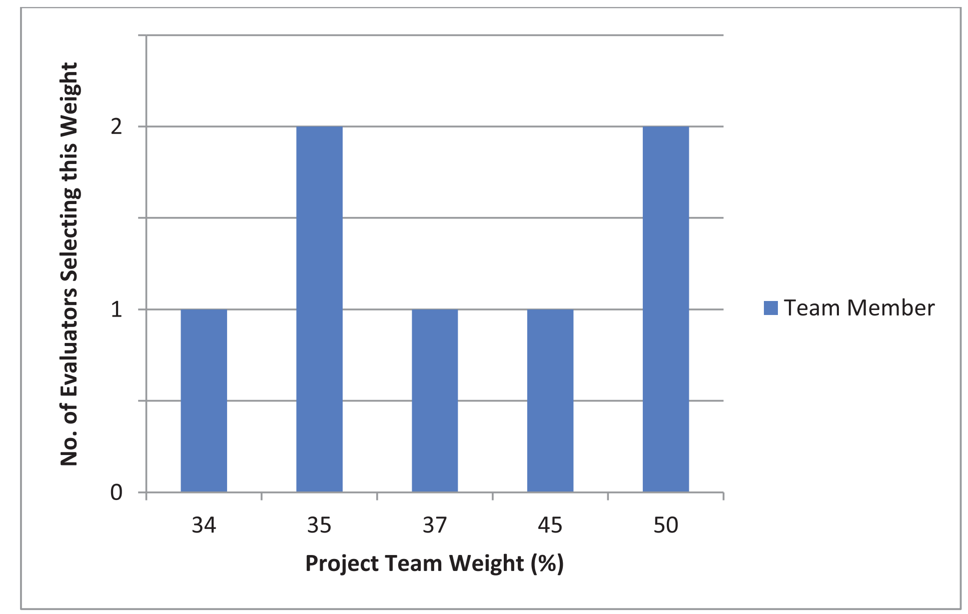

Table 5.4: Sample Ranking of Alternatives					
Testing	Weight	Alt 1A	Alt 1A'	Alt 1B	Alt 1C
Study Team Average Team Scores	N/A	2	1	3	4
High Traffic and Transportation	65%	2	1	3	4
Low Traffic and Transportation	30%	2	1	3	4
High Natural Environment	20%	2	1	3	4
Low Natural Environment	5%	1	2	3	4
High Economic Environment	30%	1	2	3	4
Low Economic Environment	5%	2	1	3	4

5.7 Selection of Technically Preferred Alternatives

The TPA identifies the preferred solution by taking into account the technical analysis, environmental considerations and comments of all study participants.

The TPA is then presented to the public and external stakeholders at the second POH. This allows for any comments or questions regarding the proposed design.

It should be recognized that the information and conclusions obtained using the evaluation method are only tools used to assist in the evaluation process and identifying trade-offs. In the end, it is the Study Team (Evaluation Committee) which makes the final decision on the selection of the TPA(s), using both the information obtained throughout the evaluation process and their individual experience and expertise, and through additional input from senior management on funding availability or other program constraints.

The findings of the analysis and evaluation process will be included as a component of the EA Process and documented in the Environmental Study Report (ESR). The principles and methodology of the EA process assist the Study Team in the analysis and evaluation of alternatives and the selection of the TPA. The public and government agencies have the opportunity to provide input throughout the course of the study.

APPENDIX C: Long List of Candidate Sub-factors

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LONG LIST OF EVALUATION CRITERIA

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July 25, 2016

Factors and Sub-Factors	Unit of Measure	Carried Forward	Remarks
Transportation			
Traffic Operations – Offset to ONroute Service Centre	m	Y	
Interchange Safety (Freeway Exits)	High/Low	Y	
Interchange Design Consistency	High/Medium/Low	Y	
Collision Potential –Highway 400 during Construction	High/Low	Y	
Arterial Road Safety	High/Medium/Low	Y	
Municipal Traffic Operations (Delays)	Veh h	N	
Ramp Safety	High/Medium/Low	N	See Interchange Safety
Travel Time	min	N	
Fuel Consumption	l	N	
Road User Costs	$	N	
Movement of Goods	h	N	
Pedestrian Safety	High/Medium/Low	Y	
Bicycle Safety	High/Medium/Low	Y	
Out-of-way Travel (During Construction)	High/Low	Y	
Ability to Accommodate Emergency Vehicles	Yes/No	N	
Movement of Farm Equipment	Yes/No	N	See Economic Environment
Flexibility to Accommodate Barrie Bypass	Yes/No	Y	
Peak Directional Movements - GTA	High/Low	Y	
Peak Directional Movements - Barrie	High/Medium/Low	Y	
Traffic Capacity Potential on the Arterial	High/Low	Y	
Natural Environment			
Air Quality	High/Medium/Low	N	Vehicle exhaust emissions - equal
Endangered species (SAR)	No.	N	Not within Study Area
Cold water fish habitat impacted	m^2	N	Not within Study Area
Cool water fish habitat impacted – Realigned Creek	m	Y	
Cool water fish habitat impacted – Length of Culverts	m	Y	
Warm water fish habitat Affected – Realigned Creek	m	Y	
Warm water fish habitat Affected – Length of Culverts	m	Y	
Water quality – stormwater runoff	m^2	Y	
Migratory Bird Nesting Impact/Loss of Existing vegetated areas	Yes/No	N	Not within Study Area
Provincially significant (PS) natural areas and habitat	ha	N	Not within Study Area
Regionally significant natural areas and habitat (Stream Valley Ravine)	m^2	Y	
Significant Wildlife Habitat Impacted	m^2	Y	
Upland Habitat Impacted	m^2	N	
Natural habitat impacted	m^2	N	Reflection of existing vegetation
Specimen Trees Removed	Yes/No	Y	
Impact to Wildlife Travel Corridor	m^2	N	
Wildlife habitat, including, reptiles, mammals	m^2	N	Reflection of existing

Factors and Sub-Factors	Unit of Measure	Carried Forward	Remarks
and insects, amphibians and flora			habitat
Climate Change	High/Medium/Low	N	Carbon emissions measured under air quality criteria – negligible change
Unclassified Wetlands	m^2	N	Not within Study Area
Woodlands and other Vegetated Areas	m^2	Y	
Transformed Landscape (active and regenerating agricultural area)	m^2	Y	
Groundwater	Yes/No	N	Equal
ANSI's	Yes/No	N	Not within Study Area
Special Concern Species At Risk (SAR) Impacted	Yes/No	Y	
SAR Loss of Habitat (Barn Swallows in Barn)	Yes/No	Y	
Loss of Floodplain Storage	Yes/No	N	Not within Study Area
Hydraulics			
Length of Realigned Innisfil Creek	m	N	
Highway 400 Innisfil Creek Culvert Extension Length	m	N	
Structures			
Structure Length	m	N	See Cost
Operational Maintenance	Yes/No	N	
Constructability of Structure Type	High/Medium/Low	Y	
Durability of Structure	High/Low	Y	
Complexity of Future Rehabilitation Staging	High/Low	Y	
Ease of Future Widening of Highway 400	Yes/No	Y	
Heritage			
Built Heritage Impact	Yes/No	N	No designated / listed properties within interchange limits.
Cultural Heritage Landscape Impact – Northwest Remnant Farm Complex	High/Medium/Low	Y	
Cultural Heritage Landscape Impact – Southwest Remnant Farm Complex	High/Medium/Low	Y	
Bridge Impacts	Yes/No	N	
3654 6th Line Impacts (Old Schoolhouse)	Yes/No	N	Not within interchange limits
3653 6th Line Impacts (Previous Post Office)	Yes/No	N	Not within interchange limits
Existing Barn Structure Property Impacts	Yes/No	Y	
3573 6th Line Impacts	High/Medium/Low	Y	
Social and Cultural Environment			
Historic Archaeological potential	ha	N	Not within Study Area
Prehistoric Archaeological Potential Areas Impacted	m^2	Y	
Sound Level Increases for Stop and Go Traffic	Yes/No	Y	
Noise impacts	dBA	N	Equal
Vibration impacts	No.	N	
Community Cohesion	High/Medium/Low	N	
Green Spaces Impacted	Yes/No	N	Not within Study Area
Excess Materials Management	Yes/No	N	Equal
Water wells impacted	No.	N	

Factors and Sub-Factors	Unit of Measure	Carried Forward	Remarks
Lighting and Visual impacts	No.	N	
3581 6th Line Impacts	High/Medium/Low	N	
3573 6th Line Impacts	High/Medium/Low	N	
Land Use and Property			
Property required (Residential)	Yes/No	N	
Private Driveways within Influence of Interchange	High/Medium/Low	N	Measured under Number of Property Acquisitions
Number of Property Acquisitions (Residential)	No. Acquisitions	Y	
Number of potentially contaminated sites	No.	N	Not applicable
Impact to Barn Structure	Yes/No	N	
Economic Environment			
Loss of farmland	m^2	Y	
Impact to Existing Barn Structure (North)	Yes/No	Y	
Out-of-way travel for Farm Equipment during Construction	Yes/No	Y	Equal
Cost			
Capital Cost	$	N	
Life Cycle Cost	$M	Y	
Utility Relocation	Yes/No	N	

APPENDIX D: Sub-factor Definitions

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Horizontal / Vertical Alignment	Alternative Number	Interchange Type	Design Speed on Sixth Line	Taper on Sixth Line
Alternative A1: Current / 6th Line under Highway 400	Alt A1-1	Diamond		
	Alt A1-2	Diamond with Roundabout		
	Alt A1-3	Parclo A2	100 km/h Design Speed	180 m Direct Taper on Sixth Line
	Alt A1-4	Parclo A4		
	Alt A1-5	Parclo A2	80 km/h Design Speed	110 m Direct Taper on Sixth Line
	Alt A1-6	Parclo A4		
	Alt A1-7	Parclo A2		110 m Direct Taper on Sixth Line Beyond Structure
	Alt A1-8	Parclo A4		
	Alt A1-9	Parclo B2		
	Alt A1-10	Parclo B4		
Alternative A2: Current / 6th Line over Highway 400	Alt A2-1	Diamond		
	Alt A2-2	Diamond with Roundabout		
	Alt A2-3	Parclo A2	100 km/h Design Speed	180 m Direct Taper on Sixth Line
	Alt A2-4	Parclo A4		
	Alt A2-5	Parclo A2	80 km/h Design Speed	110 m Direct Taper on Sixth Line
	Alt A2-6	Parclo A4		
	Alt A2-7	Parclo A2		110 m Direct Taper on Sixth Line Beyond Structure
	Alt A2-8	Parclo A4		
	Alt A2-9	Parclo B2		
	Alt A2-10	Parclo B4		
Alternative B2: Northerly / 6th Line over Highway 400	Alt B2-1	Diamond		
	Alt B2-2	Diamond with Roundabout		
	Alt B2-3	Parclo A2	100 km/h Design Speed	180 m Direct Taper on Sixth Line
	Alt B2-4	Parclo A4		
	Alt B2-5	Parclo A2	80 km/h Design Speed	110 m Direct Taper on Sixth Line
	Alt B2-6	Parclo A4		
	Alt B2-7	Parclo A2		110 m Direct Taper on Sixth Line Beyond Structure
	Alt B2-8	Parclo A4		
	Alt B2-9	Parclo B2		
	Alt B2-10	Parclo B4		

Town of Innisfil
6th Line Interchange Municipal Class Environmental Assessment
ANALYSIS AND EVALUATION REPORT – SUB-FACTOR DEFINITION PAGES
July 2016

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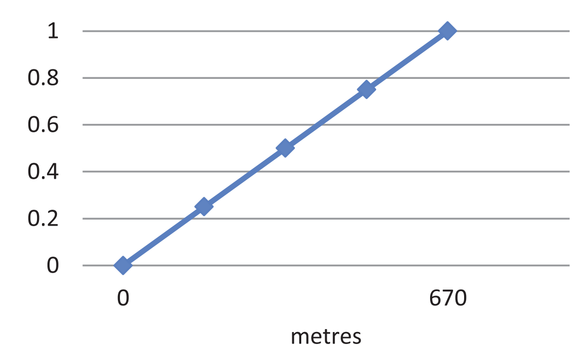
Transportation

Traffic Operations – Offset to ONroute Service Centre



Definition: This sub-factor measures traffic operations on Highway 400 southbound. The sub-factor unit of measurement is the distance between the most southerly on-ramp from 6th Line and the off-ramp to the ONroute Service Centre for each alternative interchange configuration, measured between the end of tapers. A short distance may cause operational and safety issues because of traffic weaving. Alternatives with the greatest distance separation are preferred.

Mitigation: None.

Alternatives:

Alternative	m	Utility Score	Alternative	m	Utility Score	Alternative	m	Utility Score
Alt A1-1	65	0.10	Alt A2-1	65	0.10	Alt B2-1	105	0.16
Alt A1-2	65	0.10	Alt A2-2	65	0.10	Alt B2-2	105	0.16
Alt A1-3	565	0.84	Alt A2-3	565	0.84	Alt B2-3	615	0.92
Alt A1-4	40	0.06	Alt A2-4	40	0.06	Alt B2-4	40	0.06
Alt A1-5	565	0.84	Alt A2-5	565	0.84	Alt B2-5	615	0.92
Alt A1-6	40	0.06	Alt A2-6	40	0.06	Alt B2-6	40	0.06
Alt A1-7	620	0.93	Alt A2-7	620	0.93	Alt B2-7	670	1.00
Alt A1-8	565	0.49	Alt A2-8	565	0.49	Alt B2-8	40	0.06
Alt A1-9	0	0.00	Alt A2-9	0	0.00	Alt B2-9	25	0.04
Alt A1-10	0	0.00	Alt A2-10	0	0.00	Alt B2-10	25	0.04

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

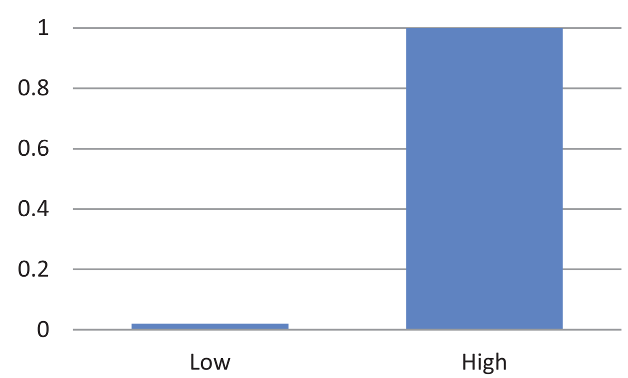
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Transportation

Interchange Safety (Freeway Exits)



Definition: This sub-factor measures the safety of the interchange ramps along Highway 400. The Parclo B type requires exiting traffic to decelerate more quickly to negotiate the loop and the exit ramp/bullnose is hidden by the structure. This results in higher crash potential. Under this sub-factor, a conventional Parclo A or diamond interchange are preferred.

Mitigation: Traffic Signage.

Alternatives:

Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score
Alt A1-1	High	1	Alt A2-1	High	1	Alt B2-1	High	1
Alt A1-2	High	1	Alt A2-2	High	1	Alt B2-2	High	1
Alt A1-3	High	1	Alt A2-3	High	1	Alt B2-3	High	1
Alt A1-4	High	1	Alt A2-4	High	1	Alt B2-4	High	1
Alt A1-5	High	1	Alt A2-5	High	1	Alt B2-5	High	1
Alt A1-6	High	1	Alt A2-6	High	1	Alt B2-6	High	1
Alt A1-7	High	1	Alt A2-7	High	1	Alt B2-7	High	1
Alt A1-8	High	1	Alt A2-8	High	1	Alt B2-8	High	1
Alt A1-9	Low	0	Alt A2-9	Low	0	Alt B2-9	Low	0
Alt A1-10	Low	0	Alt A2-10	Low	0	Alt B2-10	Low	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

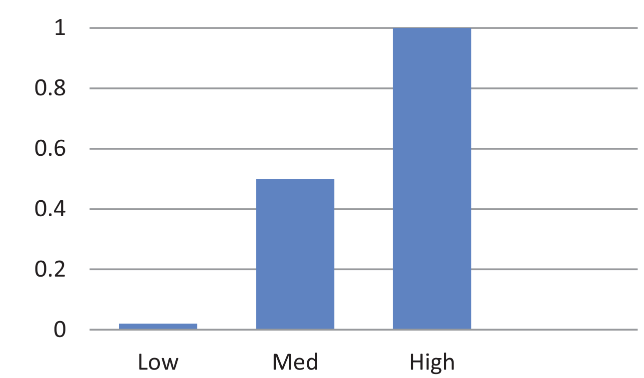
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Transportation

Interchange Design Consistency



Definition: This sub-factor measures the level of consistency of the type of interchange compared to what is expected in Ontario. The Parclo A configuration, with its single off-ramps and inner access loops, is the most common and is typically preferred in Ontario. Diamond configurations are less common but they maintain a similar configuration for the higher speed freeway exit ramps. The Parclo B type, often with 2 freeway exit ramps and higher speeds into the exit loops from the freeway, is less frequent and therefore least desirable.

Mitigation: Signage.

Alternatives:

Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score
Alt A1-1	Medium	0.5	Alt A2-1	Medium	0.5	Alt B2-1	Medium	0.5
Alt A1-2	Medium	0.5	Alt A2-2	Medium	0.5	Alt B2-2	Medium	0.5
Alt A1-3	High	1	Alt A2-3	High	1	Alt B2-3	High	1
Alt A1-4	High	1	Alt A2-4	High	1	Alt B2-4	High	1
Alt A1-5	High	1	Alt A2-5	High	1	Alt B2-5	High	1
Alt A1-6	High	1	Alt A2-6	High	1	Alt B2-6	High	1
Alt A1-7	High	1	Alt A2-7	High	1	Alt B2-7	High	1
Alt A1-8	High	1	Alt A2-8	High	1	Alt B2-8	High	1
Alt A1-9	Low	0	Alt A2-9	Low	0	Alt B2-9	Low	0
Alt A1-10	Low	0	Alt A2-10	Low	0	Alt B2-10	Low	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

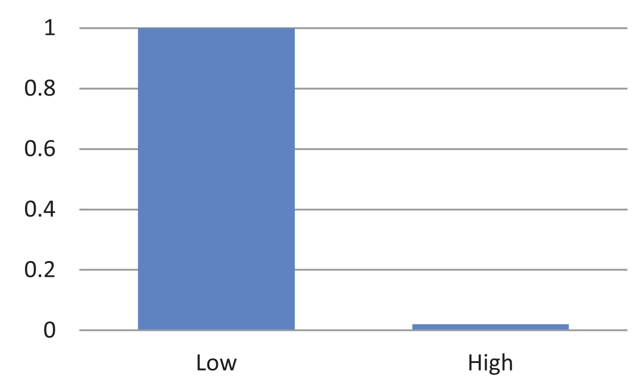
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Transportation

Collision Potential – Highway 400 during Construction



Definition: This sub-factor measures the collision potential of multi-stage construction staging required to remove and replace the existing Highway 400 overpass. Alternatives that maintain 6th Line under the freeway require a complex traffic staging plan in an area of high travel demand. The introduction of narrow lanes, multiple lane shifts, narrow shoulders (0.5 m) and reduced operating speeds will increase the risk of collisions. Alternatives with a new 6th Line structure over the freeway do not require as complex a staging plan and are preferred.

Mitigation: None

Alternatives:

Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score
Alt A1-1	High	0	Alt A2-1	Low	1	Alt B2-1	Low	1
Alt A1-2	High	0	Alt A2-2	Low	1	Alt B2-2	Low	1
Alt A1-3	High	0	Alt A2-3	Low	1	Alt B2-3	Low	1
Alt A1-4	High	0	Alt A2-4	Low	1	Alt B2-4	Low	1
Alt A1-5	High	0	Alt A2-5	Low	1	Alt B2-5	Low	1
Alt A1-6	High	0	Alt A2-6	Low	1	Alt B2-6	Low	1
Alt A1-7	High	0	Alt A2-7	Low	1	Alt B2-7	Low	1
Alt A1-8	High	0	Alt A2-8	Low	1	Alt B2-8	Low	1
Alt A1-9	High	0	Alt A2-9	Low	1	Alt B2-9	Low	1
Alt A1-10	High	0	Alt A2-10	Low	1	Alt B2-10	Low	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

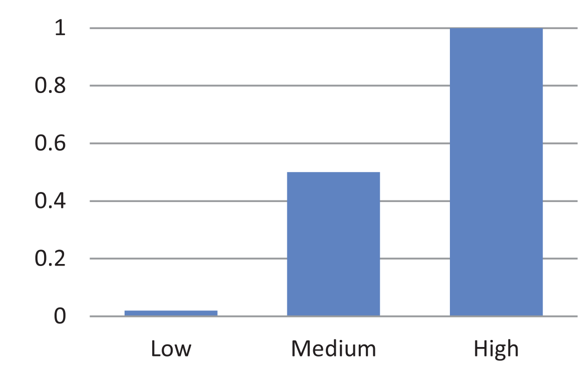
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Transportation

Arterial Road Safety



Definition: This sub-factor measures road safety at ramp terminals on 6th Line. Under this evaluation criterion, the roundabout intersection alternative is rated as having low collision potential. According to AASHTO, roundabouts reduce the risk of injury/fatal collisions by 76% compared to a conventional intersection in a rural area. Alternatives featuring roundabouts are preferred under this sub-factor. Parclo A4 configurations eliminate left turn movements from the arterial road so although not as effective as a roundabout at improving safety they do result in some reduction in collision potential.

Mitigation: It is noted that any alternative could be provided with a roundabout, thus increasing safety to a level similar to Alternatives A2, B2, and C2.

Alternatives:

Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score
Alt A1-1	Low	0	Alt A2-1	Low	0	Alt B2-1	Low	0
Alt A1-2	High	1	Alt A2-2	High	1	Alt B2-2	High	1
Alt A1-3	Low	0	Alt A2-3	Low	0	Alt B2-3	Low	0
Alt A1-4	Medium	0.5	Alt A2-4	Medium	0.5	Alt B2-4	Medium	0.5
Alt A1-5	Low	0	Alt A2-5	Low	0	Alt B2-5	Low	0
Alt A1-6	Medium	0.5	Alt A2-6	Medium	0.5	Alt B2-6	Medium	0.5
Alt A1-7	Low	0	Alt A2-7	Low	0	Alt B2-7	Low	0
Alt A1-8	Medium	0.5	Alt A2-8	Medium	0.5	Alt B2-8	Medium	0.5
Alt A1-9	Low	0	Alt A2-9	Low	0	Alt B2-9	Low	0
Alt A1-10	Low	0	Alt A2-10	Low	0	Alt B2-10	Low	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

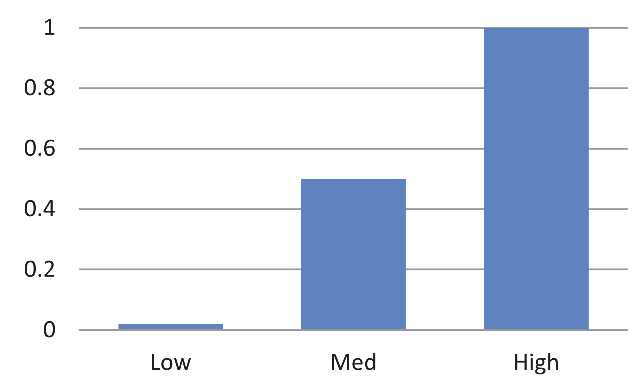
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Transportation

Pedestrian Safety



Definition: This sub-factor measures the ability of the alternatives to provide protection for pedestrians crossing the ramp terminals on 6th Line. Right-angle intersections and roundabouts provide increased safety for pedestrian movements compared to free-flow ramps. Four-quadrant Parclo interchange configurations result in the greatest number of free-flow ramps for pedestrians to cross and would therefore be least preferred.

Mitigation: Compact channelization, roundabout.

Alternatives:

Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score
Alt A1-1	High	1	Alt A2-1	High	1	Alt B2-1	High	1
Alt A1-2	High	1	Alt A2-2	High	1	Alt B2-2	High	1
Alt A1-3	Medium	0.5	Alt A2-3	Medium	0.5	Alt B2-3	Medium	0.5
Alt A1-4	Low	0	Alt A2-4	Low	0	Alt B2-4	Low	0
Alt A1-5	Medium	0.5	Alt A2-5	Medium	0.5	Alt B2-5	Medium	0.5
Alt A1-6	Low	0	Alt A2-6	Low	0	Alt B2-6	Low	0
Alt A1-7	Medium	0.5	Alt A2-7	Medium	0.5	Alt B2-7	Medium	0.5
Alt A1-8	Low	0	Alt A2-8	Low	0	Alt B2-8	Low	0
Alt A1-9	Medium	0.5	Alt A2-9	Medium	0.5	Alt B2-9	Medium	0.5
Alt A1-10	Low	0	Alt A2-10	Low	0	Alt B2-10	Low	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

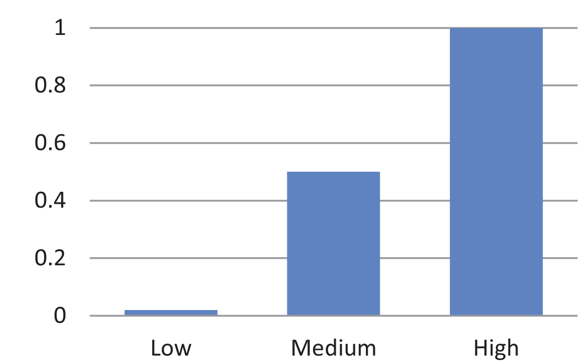
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Transportation

Bicycle Safety



Definition: This sub-factor measures the ability of the alternatives to provide protection for cyclists crossing the 6th Line high-speed freeway ramps. Direct-taper free-flow ramps require cyclists to cross an unprotected high-speed traffic flow. A right-angle intersection or a roundabout provides the best protection for cyclists. Four-quadrant Parclo interchange configurations result in the greatest number of free-flow ramps for cyclists to cross and would therefore be least preferred.

Mitigation: Pavement markings and signage, compact channelization, roundabout.

Alternatives:

Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score
Alt A1-1	High	1	Alt A2-1	High	1	Alt B2-1	High	1
Alt A1-2	High	1	Alt A2-2	High	1	Alt B2-2	High	1
Alt A1-3	Medium	0.5	Alt A2-3	Medium	0.5	Alt B2-3	Medium	0.5
Alt A1-4	Low	0	Alt A2-4	Low	0	Alt B2-4	Low	0
Alt A1-5	Medium	0.5	Alt A2-5	Medium	0.5	Alt B2-5	Medium	0.5
Alt A1-6	Low	0	Alt A2-6	Low	0	Alt B2-6	Low	0
Alt A1-7	Medium	0.5	Alt A2-7	Medium	0.5	Alt B2-7	Medium	0.5
Alt A1-8	Low	0	Alt A2-8	Low	0	Alt B2-8	Low	0
Alt A1-9	Medium	0.5	Alt A2-9	Medium	0.5	Alt B2-9	Medium	0.5
Alt A1-10	Low	0	Alt A2-10	Low	0	Alt B2-10	Low	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

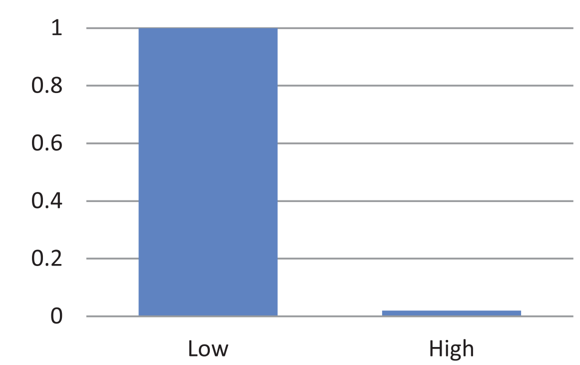
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Transportation

Out-of-Way Travel (During Construction)



Definition: This sub-factor measures the length of the required detour route that local 6th Line traffic, which can include farm machinery, will be required to travel to cross Highway 400 during construction. Alternatives that can maintain traffic flow on 6th Line during construction, eliminating out-of-way travel would be preferred. High out-of-way travel is up to 11 km, and low out-of-way traffic is 0 km.

Effects to farmers are considered under Economic Environment – Out of Way Travel for Farm Equipment during Construction.

Mitigation: Detour signage.

Alternatives:

Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score
Alt A1-1	High	0	Alt A2-1	Low	1	Alt B2-1	Low	1
Alt A1-2	High	0	Alt A2-2	Low	1	Alt B2-2	Low	1
Alt A1-3	High	0	Alt A2-3	Low	1	Alt B2-3	Low	1
Alt A1-4	High	0	Alt A2-4	Low	1	Alt B2-4	Low	1
Alt A1-5	High	0	Alt A2-5	Low	1	Alt B2-5	Low	1
Alt A1-6	High	0	Alt A2-6	Low	1	Alt B2-6	Low	1
Alt A1-7	High	0	Alt A2-7	Low	1	Alt B2-7	Low	1
Alt A1-8	High	0	Alt A2-8	Low	1	Alt B2-8	Low	1
Alt A1-9	High	0	Alt A2-9	Low	1	Alt B2-9	Low	1
Alt A1-10	High	0	Alt A2-10	Low	1	Alt B2-10	Low	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

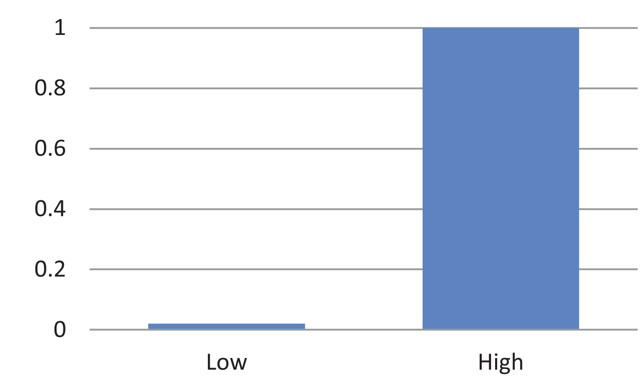
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Transportation

Peak Directional Movements - GTA



Definition: This sub-factor measures whether the interchange type facilitates free-flow vehicular traffic movement from the east (residential development areas) to the south and vice versa. Alternatives providing roundabouts or right-turn movements for the peak direction are preferred while left-turn movements from the arterial road are likely to generate delays and congestion. This reflects approximately 700-1000 vehicles during the peak hour.

Mitigation: None.

Alternatives:

Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score
Alt A1-1	Low	0	Alt A2-1	Low	0	Alt B2-1	Low	0
Alt A1-2	High	1	Alt A2-2	High	1	Alt B2-2	High	1
Alt A1-3	High	1	Alt A2-3	High	1	Alt B2-3	High	1
Alt A1-4	High	1	Alt A2-4	High	1	Alt B2-4	High	1
Alt A1-5	High	1	Alt A2-5	High	1	Alt B2-5	High	1
Alt A1-6	High	1	Alt A2-6	High	1	Alt B2-6	High	1
Alt A1-7	High	1	Alt A2-7	High	1	Alt B2-7	High	1
Alt A1-8	High	1	Alt A2-8	High	1	Alt B2-8	High	1
Alt A1-9	Low	0	Alt A2-9	Low	0	Alt B2-9	Low	0
Alt A1-10	Low	0	Alt A2-10	Low	0	Alt B2-10	Low	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

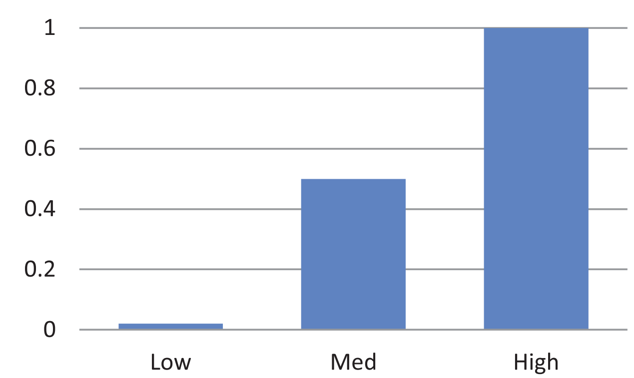
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Transportation

Peak Directional Movements - Barrie



Definition: This sub-factor measures whether the interchange type facilitates free-flow vehicular traffic movement from the east to the north and vice versa. Alternatives providing right-turn movements or roundabouts for the peak direction are preferred while left-turn movements from the arterial road are likely to generate delays and congestion. This reflects approximately 350-450 vehicles during the peak hour.

Mitigation: None.

Alternatives:

Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score
Alt A1-1	Medium	0.5	Alt A2-1	Medium	0.5	Alt B2-1	Medium	0.5
Alt A1-2	High	1	Alt A2-2	High	1	Alt B2-2	High	1
Alt A1-3	Low	0	Alt A2-3	Low	0	Alt B2-3	Low	0
Alt A1-4	Medium	0.5	Alt A2-4	Medium	0.5	Alt B2-4	Medium	0.5
Alt A1-5	Low	0	Alt A2-5	Low	0	Alt B2-5	Low	0
Alt A1-6	Medium	0.5	Alt A2-6	Medium	0.5	Alt B2-6	Medium	0.5
Alt A1-7	Low	0	Alt A2-7	Low	0	Alt B2-7	Low	0
Alt A1-8	Medium	0.5	Alt A2-8	Medium	0.5	Alt B2-8	Medium	0.5
Alt A1-9	High	1	Alt A2-9	High	1	Alt B2-9	High	1
Alt A1-10	High	1	Alt A2-10	High	1	Alt B2-10	High	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

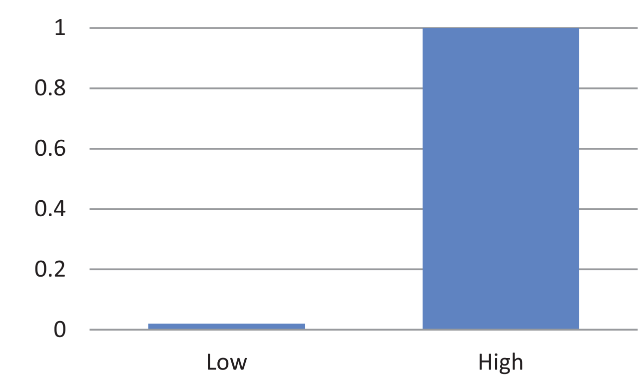
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Transportation

Traffic Capacity Potential on the Arterial



Definition: This sub-factor measures the potential traffic capacity on 6th Line at the interchange. Roundabouts and right-turn channelization (either compact or free-flow) are preferred while left-turn movements from the arterial road are not preferred because of potential queuing issues. Conventional Diamond, Parclo B2, B4 and Parclo A2 alternatives increase the risk of congestion.

Mitigation: None.

Alternatives:

Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score
Alt A1-1	Low	0	Alt A2-1	Low	0	Alt B2-1	Low	0
Alt A1-2	High	1	Alt A2-2	High	1	Alt B2-2	High	1
Alt A1-3	Low	0	Alt A2-3	Low	0	Alt B2-3	Low	0
Alt A1-4	High	1	Alt A2-4	High	1	Alt B2-4	High	1
Alt A1-5	Low	0	Alt A2-5	Low	0	Alt B2-5	Low	0
Alt A1-6	High	1	Alt A2-6	High	1	Alt B2-6	High	1
Alt A1-7	Low	0	Alt A2-7	Low	0	Alt B2-7	Low	0
Alt A1-8	High	1	Alt A2-8	High	1	Alt B2-8	High	1
Alt A1-9	Low	0	Alt A2-9	Low	0	Alt B2-9	Low	0
Alt A1-10	Low	0	Alt A2-10	Low	0	Alt B2-10	Low	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

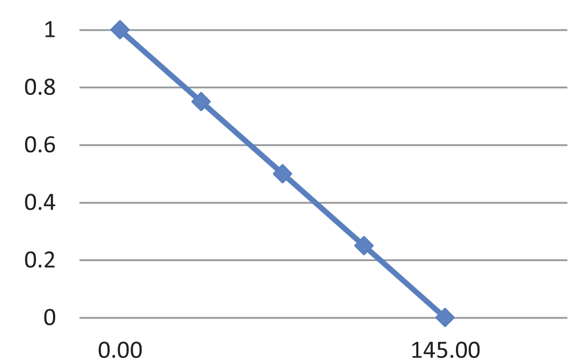
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Cool Water Fish Habitat Impacted – Realigned Creek



Definition: This sub-factor measures the impact of the alternatives on realigning the creek to the east of Highway 400, where cool fish habitat occurs in Innisfil Creek. Alternatives with the least impact on the fish habitat are preferred.

Mitigation: Natural channel design**.**

Alternatives:

Alternative	m	Utility Score	Alternative	m	Utility Score	Alternative	m	Utility Score
Alt A1-1	0	1	Alt A2-1	0	1	Alt B2-1	0	1
Alt A1-2	0	1	Alt A2-2	0	1	Alt B2-2	0	1
Alt A1-3	0	1	Alt A2-3	0	1	Alt B2-3	0	1
Alt A1-4	0	1	Alt A2-4	0	1	Alt B2-4	0	1
Alt A1-5	0	1	Alt A2-5	0	1	Alt B2-5	0	1
Alt A1-6	0	1	Alt A2-6	0	1	Alt B2-6	0	1
Alt A1-7	145	0	Alt A2-7	145	0	Alt B2-7	0	1
Alt A1-8	145	0	Alt A2-8	145	0	Alt B2-8	0	1
Alt A1-9	0	1	Alt A2-9	0	1	Alt B2-9	0	1
Alt A1-10	0	1	Alt A2-10	0	1	Alt B2-10	0	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

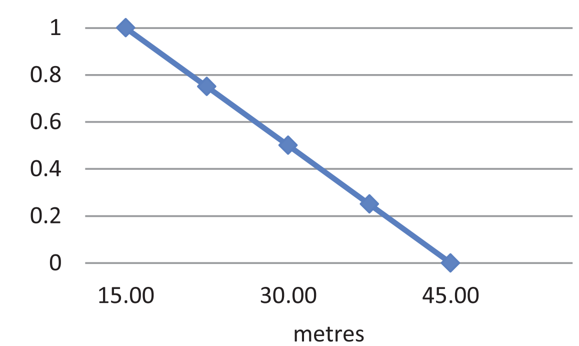
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Cool Water Fish Habitat Impacted – Length of Culverts



Definition: This sub-factor measures the impact of the alternatives on increasing the length of culverts on the east side of Highway 400 in cool water fish habitat in Innisfil Creek. Alternatives with the least impact on the fish habitat are preferred.

Mitigation: Imbedding new culverts, un-perch current Highway 400 culvert.

Alternatives:

Alternative	m	Utility Score	Alternative	m	Utility Score	Alternative	m	Utility Score
Alt A1-1	15	1	Alt A2-1	15	1	Alt B2-1	15	1
Alt A1-2	15	1	Alt A2-2	15	1	Alt B2-2	15	1
Alt A1-3	15	1	Alt A2-3	15	1	Alt B2-3	15	1
Alt A1-4	30	0.5	Alt A2-4	30	0.5	Alt B2-4	30	0.5
Alt A1-5	15	1	Alt A2-5	15	1	Alt B2-5	15	1
Alt A1-6	30	0.5	Alt A2-6	30	0.5	Alt B2-6	30	0.5
Alt A1-7	15	1	Alt A2-7	15	1	Alt B2-7	15	1
Alt A1-8	15	1	Alt A2-8	15	1	Alt B2-8	30	0.5
Alt A1-9	15	1	Alt A2-9	15	1	Alt B2-9	15	1
Alt A1-10	45	0	Alt A2-10	45	0	Alt B2-10	45	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

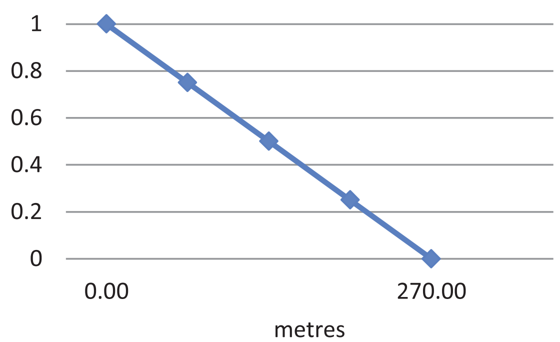
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Warm Water Fish Habitat Affected – Realigned Creek



Definition: This sub-factor measures the impact of the alternatives on realigning the creek to the west of Highway 400, where warm fish habitat occurs in Innisfil Creek. Alternatives with the least impact on the fish habitat are preferred.

Mitigation: Natural channel design.

Alternatives:

Alternative	m	Utility Score	Alternative	m	Utility Score	Alternative	m	Utility Score
Alt A1-1	0	1	Alt A2-1	0	1	Alt B2-1	0	1
Alt A1-2	0	1	Alt A2-2	0	1	Alt B2-2	0	1
Alt A1-3	0	1	Alt A2-3	0	1	Alt B2-3	0	1
Alt A1-4	0	1	Alt A2-4	0	1	Alt B2-4	0	1
Alt A1-5	0	1	Alt A2-5	0	1	Alt B2-5	0	1
Alt A1-6	0	1	Alt A2-6	0	1	Alt B2-6	0	1
Alt A1-7	270	0	Alt A2-7	270	0	Alt B2-7	270	0
Alt A1-8	270	0	Alt A2-8	270	0	Alt B2-8	0	1
Alt A1-9	0	1	Alt A2-9	0	1	Alt B2-9	0	1
Alt A1-10	0	1	Alt A2-10	0	1	Alt B2-10	0	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

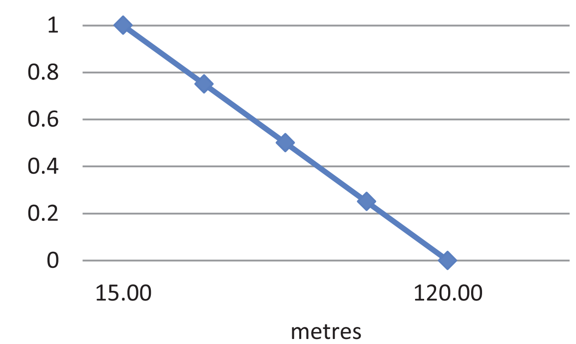
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Warm Water Fish Habitat Affected – Length of Culverts



Definition: This sub-factor measures the impact of the alternatives on increasing the length of culverts on the west side of Highway 400 in warm water fish habitat in Innisfil Creek. Alternatives with the least impact on the fish habitat are preferred.

Mitigation: Imbedding new culverts, un-perching current Highway 400 culvert.

Alternatives:

Alternative	m	Utility Score	Alternative	m	Utility Score	Alternative	m	Utility Score
Alt A1-1	15	1	Alt A2-1	15	1	Alt B2-1	15	1
Alt A1-2	15	1	Alt A2-2	15	1	Alt B2-2	15	1
Alt A1-3	15	1	Alt A2-3	15	1	Alt B2-3	15	1
Alt A1-4	45	0.71	Alt A2-4	45	0.71	Alt B2-4	45	0.71
Alt A1-5	15	1	Alt A2-5	15	1	Alt B2-5	15	1
Alt A1-6	45	0.71	Alt A2-6	45	0.71	Alt B2-6	45	0.71
Alt A1-7	15	1	Alt A2-7	15	1	Alt B2-7	15	1
Alt A1-8	45	0.71	Alt A2-8	45	0.71	Alt B2-8	60	0.57
Alt A1-9	60	0.57	Alt A2-9	60	0.57	Alt B2-9	120	0
Alt A1-10	45	0.71	Alt A2-10	45	0.71	Alt B2-10	45	0.71

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

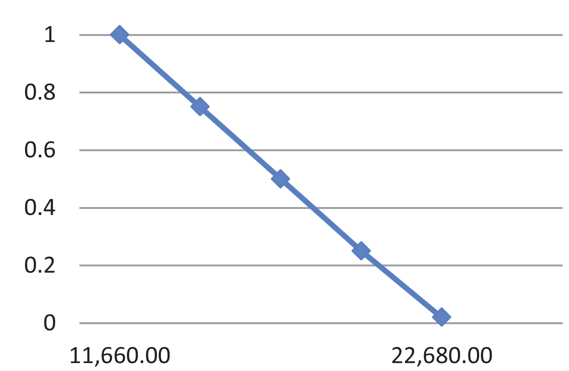
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Water Quality – Stormwater Runoff



Definition: This sub-factor measures (in terms of High, Medium and Low runoff) the impact of the resultant increase in pavement surface (and related stormwater runoff) on water quality of the receiving watercourse for the alternative considered. The alternative which has least runoff (smaller area of impervious pavement) is preferred.

Mitigation: Stormwater management facilities.

Alternatives:

Alternative	m²	Utility Score	Alternative	m²	Utility Score	Alternative	m²	Utility Score
Alt A1-1	12180	0.95	Alt A2-1	12180	0.95	Alt B2-1	12180	0.95
Alt A1-2	11660	1	Alt A2-2	11660	1	Alt B2-2	11660	1
Alt A1-3	13970	0.79	Alt A2-3	13970	0.79	Alt B2-3	13970	0.79
Alt A1-4	21980	0.06	Alt A2-4	21980	0.06	Alt B2-4	21980	0.06
Alt A1-5	13480	0.83	Alt A2-5	13480	0.83	Alt B2-5	13480	0.83
Alt A1-6	21420	0.11	Alt A2-6	21420	0.11	Alt B2-6	21420	0.11
Alt A1-7	17400	0.48	Alt A2-7	17400	0.48	Alt B2-7	17400	0.48
Alt A1-8	21180	0.14	Alt A2-8	21180	0.14	Alt B2-8	21180	0.14
Alt A1-9	15580	0.64	Alt A2-9	15580	0.64	Alt B2-9	15580	0.64
Alt A1-10	22680	0	Alt A2-10	22680	0	Alt B2-10	22680	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

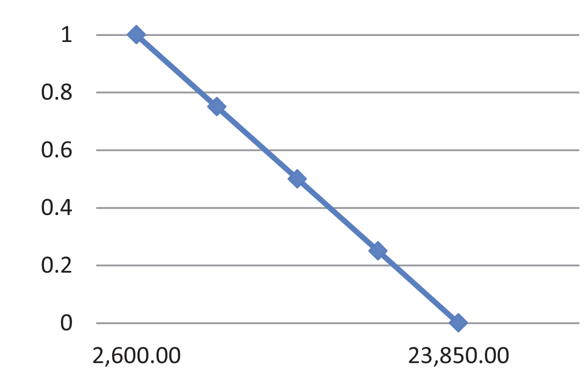
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Regionally Significant Natural Areas and Habitat (Stream Valley Ravine)



Definition: This sub-factor measures the area of the Significant Natural Area (Stream Valley Ravine) impacted by an interchange alternative. Alternatives that impact the least amount of the ravine are preferred.

Mitigation: Maintenance/restoration of natural vegetation on slopes and free flow of natural drainage across roadway (i.e. culverts, etc.).

Alternatives:

Alternative	m²	Utility Score	Alternative	m²	Utility Score	Alternative	m²	Utility Score
Alt A1-1	10600	0.62	Alt A2-1	10600	0.62	Alt B2-1	5700	0.85
Alt A1-2	10600	0.16	Alt A2-2	10600	0.16	Alt B2-2	5700	0.56
Alt A1-3	4550	0.91	Alt A2-3	4550	0.91	Alt B2-3	2600	1
Alt A1-4	7910	0.75	Alt A2-4	7910	0.75	Alt B2-4	7500	0.77
Alt A1-5	4550	0.91	Alt A2-5	4550	0.91	Alt B2-5	2600	1
Alt A1-6	7910	0.75	Alt A2-6	7910	0.75	Alt B2-6	7500	0.77
Alt A1-7	20500	0.16	Alt A2-7	20500	0.16	Alt B2-7	15350	0.40
Alt A1-8	23850	0	Alt A2-8	23850	0	Alt B2-8	19400	0.21
Alt A1-9	20370	0.16	Alt A2-9	20370	0.16	Alt B2-9	19200	0.22
Alt A1-10	20920	0.14	Alt A2-10	20920	0.14	Alt B2-10	19650	0.20

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

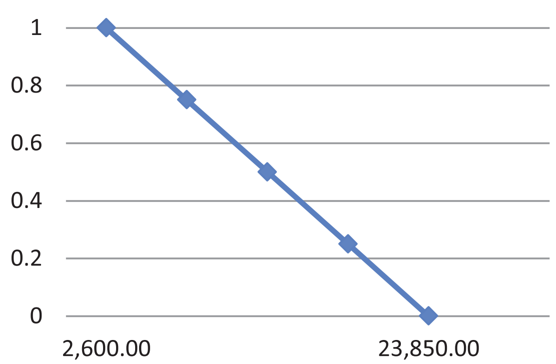
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Significant Wildlife Habitat Impacted



Definition: This sub-factor measures whether there is any impact on significant wildlife habitat as a result of an interchange alternative. The travel corridor for wildlife is the ravine/Innisfil Creek corridor. This sub-factor measures the loss of wildlife area.

Mitigation: Provision of continuity of travel corridor along corridor and minimizing vegetation removal.

Alternatives:

Alternative	m²	Utility Score	Alternative	m²	Utility Score	Alternative	m²	Utility Score
Alt A1-1	10600	0.62	Alt A2-1	10600	0.62	Alt B2-1	5700	0.85
Alt A1-2	10600	0.16	Alt A2-2	10600	0.16	Alt B2-2	5700	0.56
Alt A1-3	4550	0.91	Alt A2-3	4550	0.91	Alt B2-3	2600	1
Alt A1-4	7910	0.75	Alt A2-4	7910	0.75	Alt B2-4	7500	0.77
Alt A1-5	4550	0.91	Alt A2-5	4550	0.91	Alt B2-5	2600	1
Alt A1-6	7910	0.75	Alt A2-6	7910	0.75	Alt B2-6	7500	0.77
Alt A1-7	20500	0.16	Alt A2-7	20500	0.16	Alt B2-7	15350	0.40
Alt A1-8	23850	0	Alt A2-8	23850	0	Alt B2-8	19400	0.21
Alt A1-9	20370	0.16	Alt A2-9	20370	0.16	Alt B2-9	19200	0.22
Alt A1-10	20920	0.14	Alt A2-10	20920	0.14	Alt B2-10	19650	0.20

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

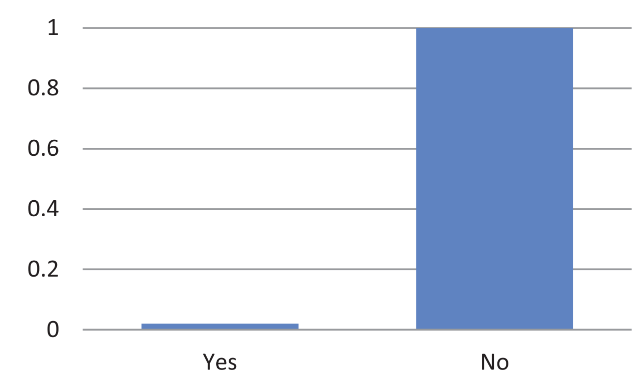
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Specimen Trees Removed



Definition: This sub-factor measures the impact to the mature maple tree at 3581 6th Line Road. Alternatives that do not impact the maple tree are preferred.

Mitigation: Replacement.

Alternatives:

Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score
Alt A1-1	No	1	Alt A2-1	No	1	Alt B2-1	No	1
Alt A1-2	No	1	Alt A2-2	No	1	Alt B2-2	No	1
Alt A1-3	No	1	Alt A2-3	No	1	Alt B2-3	No	1
Alt A1-4	Yes	0	Alt A2-4	Yes	0	Alt B2-4	No	1
Alt A1-5	No	1	Alt A2-5	No	1	Alt B2-5	No	1
Alt A1-6	Yes	0	Alt A2-6	Yes	0	Alt B2-6	No	1
Alt A1-7	No	1	Alt A2-7	No	1	Alt B2-7	No	1
Alt A1-8	Yes	0	Alt A2-8	Yes	0	Alt B2-8	No	1
Alt A1-9	No	1	Alt A2-9	No	1	Alt B2-9	No	1
Alt A1-10	No	1	Alt A2-10	No	1	Alt B2-10	No	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

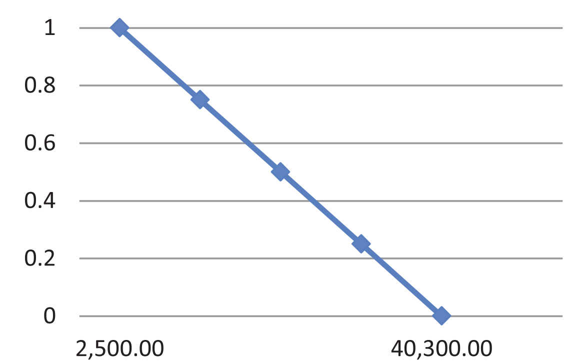
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Woodlands and Other Vegetated Areas



Definition: This sub-factor measures whether an alignment alternative impacts the woodlands and other vegetated areas. There is a woodlot in the southeast quadrant of 6th Line and Highway 400. Alternatives that do not impact the woodlot are preferred.

Mitigation: Planting replacement trees.

Alternatives:

Alternative	m²	Utility Score	Alternative	m²	Utility Score	Alternative	m²	Utility Score
Alt A1-1	12750	0.73	Alt A2-1	12750	0.73	Alt B2-1	9600	0.81
Alt A1-2	12750	0.73	Alt A2-2	12750	0.73	Alt B2-2	9600	0.81
Alt A1-3	6960	0.88	Alt A2-3	6960	0.88	Alt B2-3	2500	1
Alt A1-4	15900	0.65	Alt A2-4	15900	0.65	Alt B2-4	11900	0.75
Alt A1-5	6960	0.88	Alt A2-5	6960	0.88	Alt B2-5	2500	1
Alt A1-6	15900	0.65	Alt A2-6	15900	0.65	Alt B2-6	11900	0.75
Alt A1-7	31370	0.24	Alt A2-7	31370	0.24	Alt B2-7	24150	0.43
Alt A1-8	40300	0	Alt A2-8	40300	0	Alt B2-8	33550	0.18
Alt A1-9	11300	0.77	Alt A2-9	11300	0.77	Alt B2-9	9400	0.82
Alt A1-10	11300	0.77	Alt A2-10	11300	0.77	Alt B2-10	9400	0.82

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

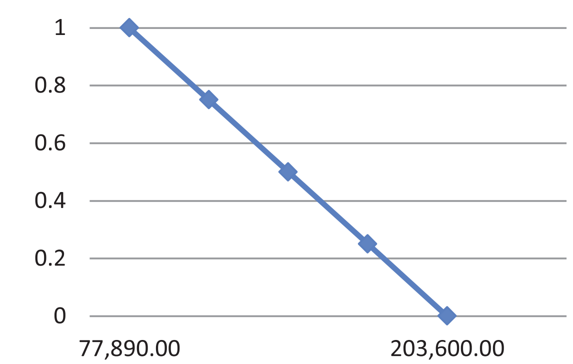
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Transformed Landscape (active and regenerating agricultural area)



Definition: This sub-factor measures whether an interchange alternative impacts the transformed landscape. Alternatives that do not impact the transformed landscape are preferred.

Mitigation: None.

Alternatives:

Alternative	m²	Utility Score	Alternative	m²	Utility Score	Alternative	m²	Utility Score
Alt A1-1	79850	0.98	Alt A2-1	79850	0.98	Alt B2-1	92300	0.89
Alt A1-2	79850	0.98	Alt A2-2	79850	0.98	Alt B2-2	92300	0.89
Alt A1-3	77890	1	Alt A2-3	77890	1	Alt B2-3	86400	0.93
Alt A1-4	106190	0.77	Alt A2-4	106190	0.77	Alt B2-4	130150	0.58
Alt A1-5	77890	1	Alt A2-5	77890	1	Alt B2-5	86400	0.93
Alt A1-6	106190	0.77	Alt A2-6	106190	0.77	Alt B2-6	130150	0.58
Alt A1-7	146830	0.45	Alt A2-7	146830	0.45	Alt B2-7	158150	0.36
Alt A1-8	175100	0.23	Alt A2-8	175100	0.23	Alt B2-8	203600	0
Alt A1-9	81580	0.97	Alt A2-9	81580	0.97	Alt B2-9	86550	0.93
Alt A1-10	132730	0.56	Alt A2-10	132730	0.56	Alt B2-10	154900	0.39

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

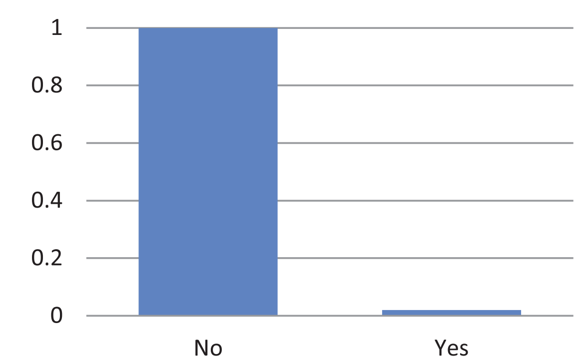
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

Special Concern Species at Risk (SAR) Impacted



Definition: This sub-factor measures whether an alignment alternative impacts any Species at Risk. There are grassland SAR north of 6th Line and several pairs of Bobolink (5+ birds) observed in the pasture east of Highway 400. Alternatives that do not impact the SAR are preferred.

Mitigation: No special measures are required to satisfy Ontario SAR Special Concern requirements. Grassland SAR investigation will be required in advance of the development of any alternative west of Highway 400 and north of 6th line.

Alternatives:

Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score
Alt A1-1	Yes	0	Alt A2-1	Yes	0	Alt B2-1	Yes	0
Alt A1-2	Yes	0	Alt A2-2	Yes	0	Alt B2-2	Yes	0
Alt A1-3	No	1	Alt A2-3	No	1	Alt B2-3	No	1
Alt A1-4	Yes	0	Alt A2-4	Yes	0	Alt B2-4	Yes	0
Alt A1-5	No	1	Alt A2-5	No	1	Alt B2-5	No	1
Alt A1-6	Yes	0	Alt A2-6	Yes	0	Alt B2-6	Yes	0
Alt A1-7	No	1	Alt A2-7	No	1	Alt B2-7	No	1
Alt A1-8	Yes	0	Alt A2-8	Yes	0	Alt B2-8	Yes	0
Alt A1-9	Yes	0	Alt A2-9	Yes	0	Alt B2-9	Yes	0
Alt A1-10	Yes	0	Alt A2-10	Yes	0	Alt B2-10	Yes	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

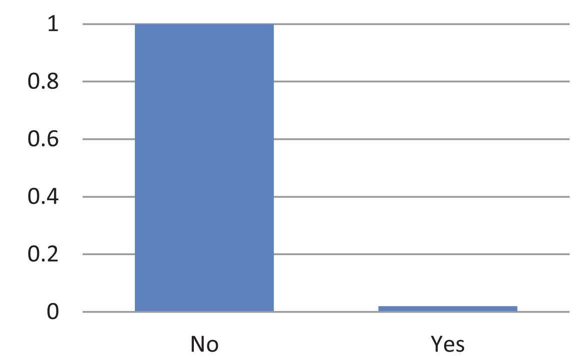
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Natural Environment

SAR Loss of Habitat (Barn Swallows in Barn)



Definition: This sub-factor measures whether an interchange configuration impacts the barn in the northwest quadrant of the Highway 400 and 6th Line interchange location. Barn Swallows were observed in the area and are likely nesting in the old barn. Alternatives that do not impact the barn are preferred.

Mitigation: None.

Alternatives:

Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score
Alt A1-1	No	1	Alt A2-1	No	1	Alt B2-1	No	1
Alt A1-2	No	1	Alt A2-2	No	1	Alt B2-2	No	1
Alt A1-3	No	1	Alt A2-3	No	1	Alt B2-3	No	1
Alt A1-4	No	1	Alt A2-4	No	1	Alt B2-4	No	1
Alt A1-5	No	1	Alt A2-5	No	1	Alt B2-5	No	1
Alt A1-6	No	1	Alt A2-6	No	1	Alt B2-6	No	1
Alt A1-7	Yes	0	Alt A2-7	Yes	0	Alt B2-7	Yes	0
Alt A1-8	Yes	0	Alt A2-8	Yes	0	Alt B2-8	Yes	0
Alt A1-9	No	1	Alt A2-9	No	1	Alt B2-9	No	1
Alt A1-10	No	1	Alt A2-10	No	1	Alt B2-10	No	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

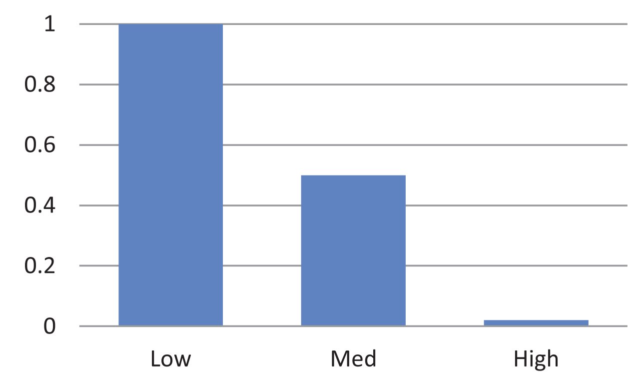
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Structures

Constructability of Structure Type



Definition: This sub-factor measures the complexity of constructing the structure with live traffic. Alternatives with the least complex construction involving live traffic are preferred. Alternatives where 6th line goes over Highway 400 but on the existing alignment and have to build a centre pier through the existing rigid frame have high complexity. Alternatives where 6th line goes under Highway 400 have a medium complexity involving traffic staging under the bridge. The least complex alternative goes over Highway 400 on a new alignment.

Mitigation: None.

Alternatives:

Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score
Alt A1-1	High	0	Alt A2-1	Medium	0.5	Alt B2-1	Low	1
Alt A1-2	High	0	Alt A2-2	Medium	0.5	Alt B2-2	Low	1
Alt A1-3	High	0	Alt A2-3	Medium	0.5	Alt B2-3	Low	1
Alt A1-4	High	0	Alt A2-4	Medium	0.5	Alt B2-4	Low	1
Alt A1-5	High	0	Alt A2-5	Medium	0.5	Alt B2-5	Low	1
Alt A1-6	High	0	Alt A2-6	Medium	0.5	Alt B2-6	Low	1
Alt A1-7	High	0	Alt A2-7	Medium	0.5	Alt B2-7	Low	1
Alt A1-8	High	0	Alt A2-8	Medium	0.5	Alt B2-8	Low	1
Alt A1-9	High	0	Alt A2-9	Medium	0.5	Alt B2-9	Low	1
Alt A1-10	High	0	Alt A2-10	Medium	0.5	Alt B2-10	Low	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

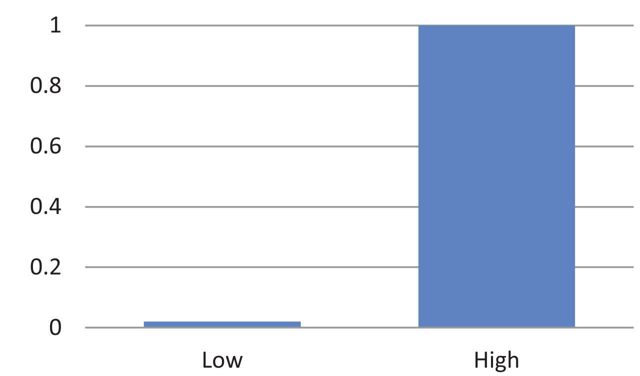
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Structures

Durability of Structure



Definition: This sub-factor measures the salt loading on the new structure. Vertical alignment alternatives with the 6th line over Highway 400 are preferred.

Mitigation: None.

This sub-factor is considered to have only a marginal difference between alternatives. Salt spray on the underside is very hard to mitigate, but good results are achievable for over or under.

Alternatives:

Alternative	High/ Low	Utility Score	Alternative	High/ Low	Utility Score	Alternative	High/ Low	Utility Score
Alt A1-1	Low	0	Alt A2-1	High	1	Alt B2-1	High	1
Alt A1-2	Low	0	Alt A2-2	High	1	Alt B2-2	High	1
Alt A1-3	Low	0	Alt A2-3	High	1	Alt B2-3	High	1
Alt A1-4	Low	0	Alt A2-4	High	1	Alt B2-4	High	1
Alt A1-5	Low	0	Alt A2-5	High	1	Alt B2-5	High	1
Alt A1-6	Low	0	Alt A2-6	High	1	Alt B2-6	High	1
Alt A1-7	Low	0	Alt A2-7	High	1	Alt B2-7	High	1
Alt A1-8	Low	0	Alt A2-8	High	1	Alt B2-8	High	1
Alt A1-9	Low	0	Alt A2-9	High	1	Alt B2-9	High	1
Alt A1-10	Low	0	Alt A2-10	High	1	Alt B2-10	High	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

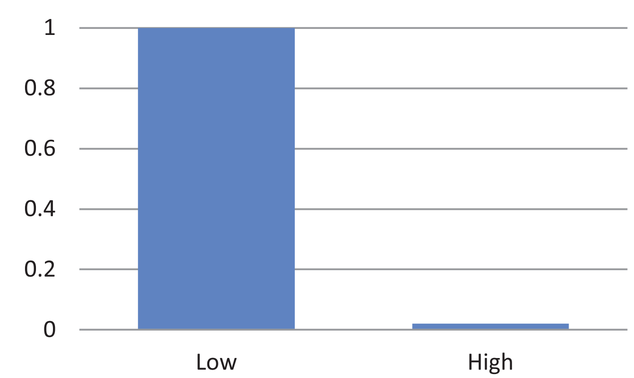
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Structures

Complexity of Future Rehabilitation Staging



Definition: This sub-factor measures the complexity of traffic staging for a future bridge rehabilitation for the new structure. Vertical alignment alternatives with the 6th line over Highway 400 are preferred i.e. less staging required for Highway 400 traffic.

Mitigation: None.

Alternatives:

Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score	Alternative	High/Low	Utility Score
Alt A1-1	High	0	Alt A2-1	Low	1	Alt B2-1	Low	1
Alt A1-2	High	0	Alt A2-2	Low	1	Alt B2-2	Low	1
Alt A1-3	High	0	Alt A2-3	Low	1	Alt B2-3	Low	1
Alt A1-4	High	0	Alt A2-4	Low	1	Alt B2-4	Low	1
Alt A1-5	High	0	Alt A2-5	Low	1	Alt B2-5	Low	1
Alt A1-6	High	0	Alt A2-6	Low	1	Alt B2-6	Low	1
Alt A1-7	High	0	Alt A2-7	Low	1	Alt B2-7	Low	1
Alt A1-8	High	0	Alt A2-8	Low	1	Alt B2-8	Low	1
Alt A1-9	High	0	Alt A2-9	Low	1	Alt B2-9	Low	1
Alt A1-10	High	0	Alt A2-10	Low	1	Alt B2-10	Low	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

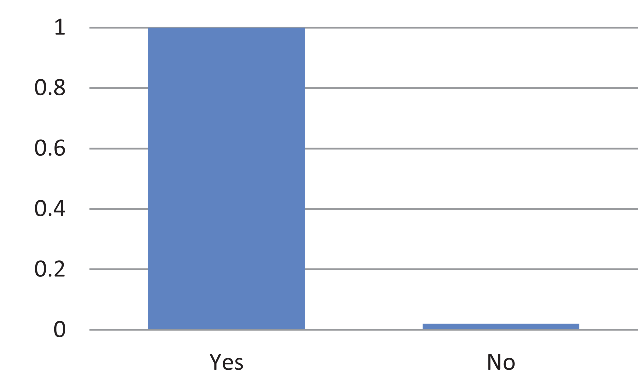
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Structures

Ease of Future Widening of Highway 400



Definition: This sub-factor measures the complexity of traffic staging for a future widening of Highway 400. This factor favours structures which can be easily lengthened to accommodate widening of the Highway 400 corridor. Structures with simple requirements for lengthening can be built at the current requirement and lengthened when required, deferring some of the cost.

Mitigation: None.

Alternatives:

Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score
Alt A1-1	Yes	1	Alt A2-1	No	0	Alt B2-1	No	0
Alt A1-2	Yes	1	Alt A2-2	No	0	Alt B2-2	No	0
Alt A1-3	Yes	1	Alt A2-3	No	0	Alt B2-3	No	0
Alt A1-4	Yes	1	Alt A2-4	No	0	Alt B2-4	No	0
Alt A1-5	Yes	1	Alt A2-5	No	0	Alt B2-5	No	0
Alt A1-6	Yes	1	Alt A2-6	No	0	Alt B2-6	No	0
Alt A1-7	Yes	1	Alt A2-7	No	0	Alt B2-7	No	0
Alt A1-8	Yes	1	Alt A2-8	No	0	Alt B2-8	No	0
Alt A1-9	Yes	1	Alt A2-9	No	0	Alt B2-9	No	0
Alt A1-10	Yes	1	Alt A2-10	No	0	Alt B2-10	No	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

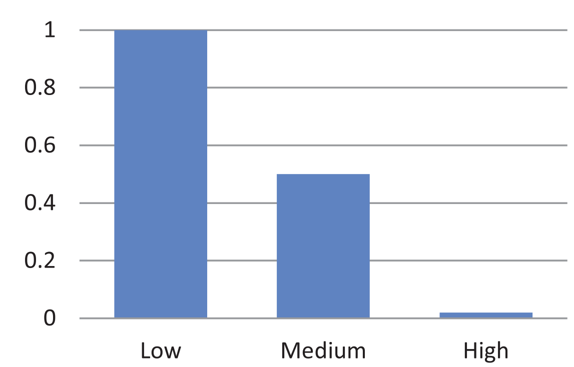
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Heritage

Cultural Heritage Landscape Impact – Northwest Remnant Farm Complex



Definition: This sub-factor measures the level of impacts on the potential cultural heritage landscape associated with the remnant farm complex located north of 6th Line and west of Highway 400. Alternatives with no / low impact are preferred.

Mitigation: None.

Alternatives:

Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score
Alt A1-1	Medium	0.5	Alt A2-1	Medium	0.5	Alt B2-1	Medium	0.5
Alt A1-2	Medium	0.5	Alt A2-2	Medium	0.5	Alt B2-2	Medium	0.5
Alt A1-3	High	0	Alt A2-3	High	0	Alt B2-3	High	0
Alt A1-4	High	0	Alt A2-4	High	0	Alt B2-4	High	0
Alt A1-5	High	0	Alt A2-5	High	0	Alt B2-5	High	0
Alt A1-6	High	0	Alt A2-6	High	0	Alt B2-6	High	0
Alt A1-7	High	0	Alt A2-7	High	0	Alt B2-7	High	0
Alt A1-8	High	0	Alt A2-8	High	0	Alt B2-8	High	0
Alt A1-9	Low	1	Alt A2-9	Low	1	Alt B2-9	Low	1
Alt A1-10	Medium	0.5	Alt A2-10	Medium	0.5	Alt B2-10	Medium	0.5

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

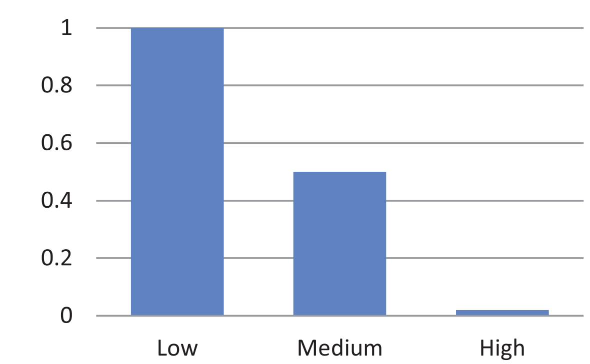
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Heritage

Cultural Heritage Landscape Impact – Southwest Remnant Farm Complex



Definition: This sub-factor measures the level of impacts on the potential cultural heritage landscape associated with the farm complex located south of 6th Line and west of Highway 400 (3573 6th Line). Alternatives with no / low impact are preferred. Impacts to the residential building are included in Heritage - 3573 6th Line Impacts.

Mitigation: None.

Alternatives:

Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score
Alt A1-1	Medium	0.5	Alt A2-1	Medium	0.5	Alt B2-1	Medium	0.5
Alt A1-2	Medium	0.5	Alt A2-2	Medium	0.5	Alt B2-2	Medium	0.5
Alt A1-3	Low	1	Alt A2-3	Low	1	Alt B2-3	Low	1
Alt A1-4	Med	0.5	Alt A2-4	Med	0.5	Alt B2-4	Med	0.5
Alt A1-5	Low	1	Alt A2-5	Low	1	Alt B2-5	Low	1
Alt A1-6	Medium	0.5	Alt A2-6	Medium	0.5	Alt B2-6	Medium	0.5
Alt A1-7	Low	1	Alt A2-7	Low	1	Alt B2-7	Low	1
Alt A1-8	Medium	0.5	Alt A2-8	Medium	0.5	Alt B2-8	Medium	0.5
Alt A1-9	High	0	Alt A2-9	High	0	Alt B2-9	High	0
Alt A1-10	High	0	Alt A2-10	High	0	Alt B2-10	High	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

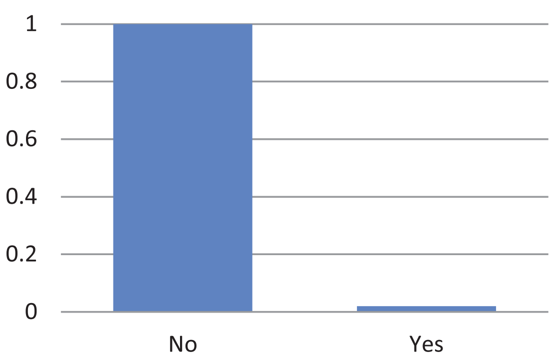
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Heritage

Existing Barn Structure Property Impacts



Definition: This sub-factor measures whether the existing barn structure in the northwest quadrant is impacted by the interchange alternatives. Alternatives that do not impact the structure are preferred.

Mitigation: Photo documentation of barn.

Alternatives:

Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score
Alt A1-1	No	1	Alt A2-1	No	1	Alt B2-1	No	1
Alt A1-2	No	1	Alt A2-2	No	1	Alt B2-2	No	1
Alt A1-3	No	1	Alt A2-3	No	1	Alt B2-3	No	1
Alt A1-4	No	1	Alt A2-4	No	1	Alt B2-4	No	1
Alt A1-5	No	1	Alt A2-5	No	1	Alt B2-5	No	1
Alt A1-6	No	1	Alt A2-6	No	1	Alt B2-6	No	1
Alt A1-7	Yes	0	Alt A2-7	Yes	0	Alt B2-7	Yes	0
Alt A1-8	Yes	0	Alt A2-8	Yes	0	Alt B2-8	Yes	0
Alt A1-9	No	1	Alt A2-9	No	1	Alt B2-9	No	1
Alt A1-10	No	1	Alt A2-10	No	1	Alt B2-10	No	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

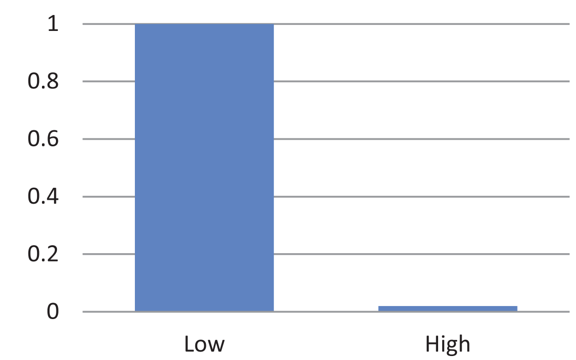
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Heritage

3573 6th Line Impacts



Definition: This sub-factor measures whether the interchange alternatives have the potential to impact the residential property at 3573 6th Line, which was identified in the preliminary screening as potentially being impacted by the project. Alternatives with no/low impact are preferred. Impacts to the cultural heritage landscape are included in Heritage – Cultural Heritage Landscape Impact – Southwest Remnant Farm Complex

Mitigation: None.

Alternatives:

Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score	Alternative	High/ Medium/ Low	Utility Score
Alt A1-1	Low	1	Alt A2-1	Low	1	Alt B2-1	Low	1
Alt A1-2	Low	1	Alt A2-2	Low	1	Alt B2-2	Low	1
Alt A1-3	Low	1	Alt A2-3	Low	1	Alt B2-3	Low	1
Alt A1-4	High	0	Alt A2-4	High	0	Alt B2-4	High	0
Alt A1-5	Low	1	Alt A2-5	Low	1	Alt B2-5	Low	1
Alt A1-6	High	0	Alt A2-6	High	0	Alt B2-6	High	0
Alt A1-7	Low	1	Alt A2-7	Low	1	Alt B2-7	Low	1
Alt A1-8	High	0	Alt A2-8	High	0	Alt B2-8	High	0
Alt A1-9	Low	1	Alt A2-9	Low	1	Alt B2-9	Low	1
Alt A1-10	Low	1	Alt A2-10	Low	1	Alt B2-10	Low	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

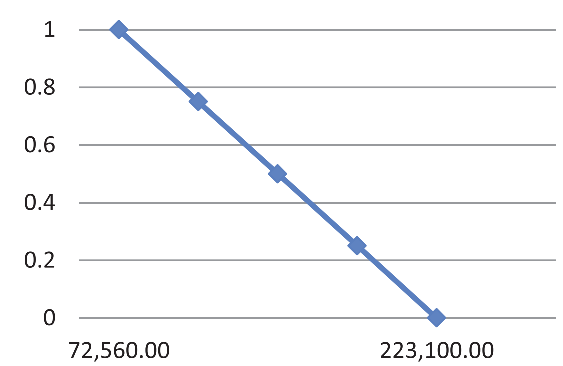
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Social and Cultural Environment

Prehistoric Archaeological Potential Areas Impacted



Definition: This sub-factor measures the prehistoric archaeological potential areas impacted, which are defined as being within 300 m from a watercourse. All alternatives are within 300 m.

Mitigation: Stage 2 Archaeological Assessment.

Alternatives:

Alternative	m²	Utility Score	Alternative	m²	Utility Score	Alternative	m²	Utility Score
Alt A1-1	88780	0.89	Alt A2-1	88780	0.89	Alt B2-1	88100	0.90
Alt A1-2	120780	0.68	Alt A2-2	120780	0.68	Alt B2-2	120300	0.68
Alt A1-3	76800	0.97	Alt A2-3	76800	0.97	Alt B2-3	72560	1
Alt A1-4	114840	0.72	Alt A2-4	114840	0.72	Alt B2-4	127050	0.64
Alt A1-5	76800	0.97	Alt A2-5	76800	0.97	Alt B2-5	72560	1
Alt A1-6	114840	0.72	Alt A2-6	114840	0.72	Alt B2-6	127050	0.64
Alt A1-7	174877	0.32	Alt A2-7	174877	0.32	Alt B2-7	165650	0.38
Alt A1-8	212550	0.07	Alt A2-8	212550	0.07	Alt B2-8	223100	0
Alt A1-9	105520	0.78	Alt A2-9	105520	0.78	Alt B2-9	104510	0.79
Alt A1-10	143870	0.53	Alt A2-10	143870	0.53	Alt B2-10	160990	0.41

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

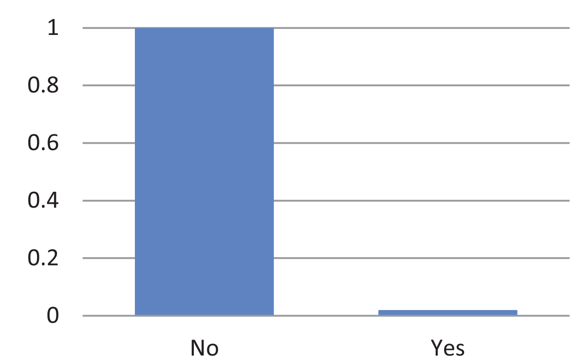
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Social and Cultural Environment

Sound Level Increases for Stop and Go Traffic



Definition: This sub-factor measures the acoustical effect of stop and go traffic on existing residential receivers. Those alternatives creating a new signalized intersection in close proximity to a receiver are less preferred.

Mitigation: Noise barriers.

Alternatives:

Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score
Alt A1-1	Yes	0	Alt A2-1	Yes	0	Alt B2-1	Yes	0
Alt A1-2	No	1	Alt A2-2	No	1	Alt B2-2	No	1
Alt A1-3	Yes	0	Alt A2-3	Yes	0	Alt B2-3	Yes	0
Alt A1-4	Yes	0	Alt A2-4	Yes	0	Alt B2-4	Yes	0
Alt A1-5	Yes	0	Alt A2-5	Yes	0	Alt B2-5	Yes	0
Alt A1-6	Yes	0	Alt A2-6	Yes	0	Alt B2-6	Yes	0
Alt A1-7	Yes	0	Alt A2-7	Yes	0	Alt B2-7	Yes	0
Alt A1-8	Yes	0	Alt A2-8	Yes	0	Alt B2-8	Yes	0
Alt A1-9	Yes	0	Alt A2-9	Yes	0	Alt B2-9	Yes	0
Alt A1-10	Yes	0	Alt A2-10	Yes	0	Alt B2-10	Yes	0

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

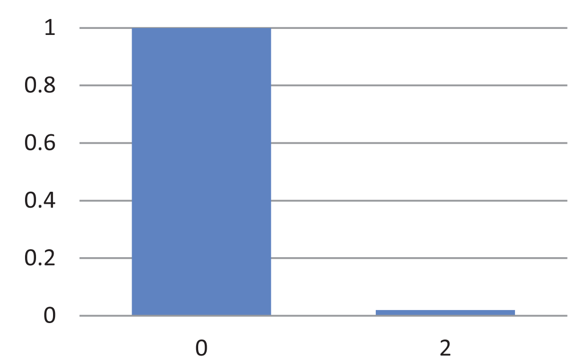
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Land Use and Property

Number of Property Acquisitions (Residential)



Definition: This sub-factor measures the number of property acquisitions required. The least number of property acquisitions are preferred.

Mitigation: Financial compensation.

Alternatives:

Alternative	Acquisitions	Utility Score	Alternative	Acquisitions	Utility Score	Alternative	Acquisitions	Utility Score
Alt A1-1	0	1	Alt A2-1	0	1	Alt B2-1	0	1
Alt A1-2	0	1	Alt A2-2	0	1	Alt B2-2	0	1
Alt A1-3	0	1	Alt A2-3	0	1	Alt B2-3	0	1
Alt A1-4	2	0	Alt A2-4	2	0	Alt B2-4	2	0
Alt A1-5	0	1	Alt A2-5	0	1	Alt B2-5	0	1
Alt A1-6	2	0	Alt A2-6	2	0	Alt B2-6	2	0
Alt A1-7	0	1	Alt A2-7	0	1	Alt B2-7	0	1
Alt A1-8	2	0	Alt A2-8	2	0	Alt B2-8	2	0
Alt A1-9	0	1	Alt A2-9	0	1	Alt B2-9	0	1
Alt A1-10	0	1	Alt A2-10	0	1	Alt B2-10	0	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

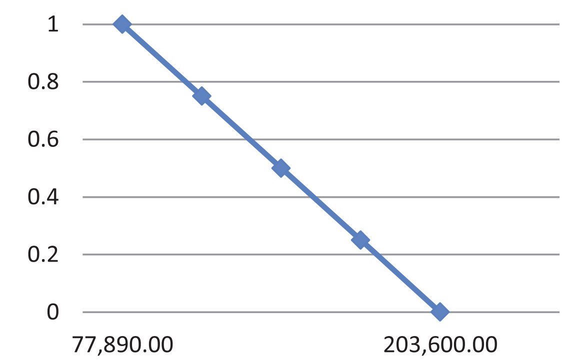
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Economic Environment

Loss of Farmland



Definition: This sub-factor measures whether an alternative requires farmland property. The alternative(s) with the least amount of required property are preferred.

Mitigation: Financial compensation.

Alternatives:

Alternative	m²	Utility Score	Alternative	m²	Utility Score	Alternative	m²	Utility Score
Alt A1-1	79850	0.98	Alt A2-1	79850	0.98	Alt B2-1	92300	0.89
Alt A1-2	79850	0.98	Alt A2-2	79850	0.98	Alt B2-2	92300	0.89
Alt A1-3	77890	1.00	Alt A2-3	77890	1.00	Alt B2-3	86400	0.93
Alt A1-4	106190	0.77	Alt A2-4	106190	0.77	Alt B2-4	130150	0.58
Alt A1-5	77890	1.00	Alt A2-5	77890	1.00	Alt B2-5	86400	0.93
Alt A1-6	106190	0.77	Alt A2-6	106190	0.77	Alt B2-6	130150	0.58
Alt A1-7	146830	0.45	Alt A2-7	146830	0.45	Alt B2-7	158150	0.36
Alt A1-8	175100	0.23	Alt A2-8	175100	0.23	Alt B2-8	203600	0
Alt A1-9	81580	0.97	Alt A2-9	81580	0.97	Alt B2-9	86550	0.93
Alt A1-10	132730	0.56	Alt A2-10	132730	0.56	Alt B2-10	154900	0.39

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

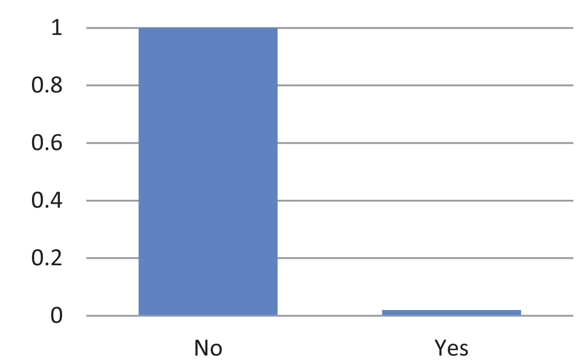
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Economic Environment

Impact to Existing Barn Structure (North)



Definition: This sub-factor measures whether an alternative impacts the barn in the northwest quadrant of the Highway 400 and 6th Line interchange location. Alternatives that do not impact the structure are preferred.

Mitigation: Financial compensation.

Alternatives:

Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score
Alt A1-1	No	1	Alt A2-1	No	1	Alt B2-1	No	1
Alt A1-2	No	1	Alt A2-2	No	1	Alt B2-2	No	1
Alt A1-3	No	1	Alt A2-3	No	1	Alt B2-3	No	1
Alt A1-4	No	1	Alt A2-4	No	1	Alt B2-4	No	1
Alt A1-5	No	1	Alt A2-5	No	1	Alt B2-5	No	1
Alt A1-6	No	1	Alt A2-6	No	1	Alt B2-6	No	1
Alt A1-7	Yes	0	Alt A2-7	Yes	0	Alt B2-7	Yes	0
Alt A1-8	Yes	0	Alt A2-8	Yes	0	Alt B2-8	Yes	0
Alt A1-9	No	1	Alt A2-9	No	1	Alt B2-9	No	1
Alt A1-10	No	1	Alt A2-10	No	1	Alt B2-10	No	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

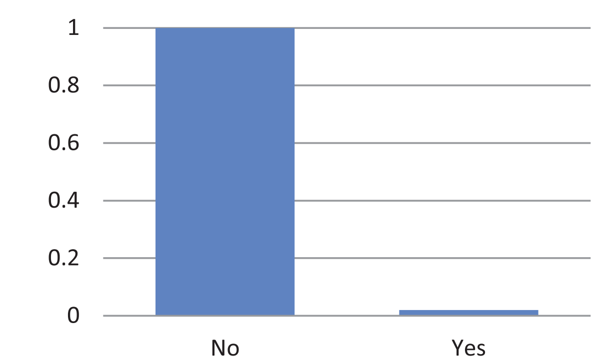
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Economic Environment

Out-of-way Travel for Farm Equipment during Construction



Definition: This sub-factor measures the out-of-way travel distance for farm equipment during construction. Alternatives that remain on the existing alignment would require road closure during the construction season to work on the bridge. Alternatives that do not require road closure during the construction season are preferred.

Mitigation: Signage.

Alternatives:

Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score	Alternative	Yes/No	Utility Score
Alt A1-1	Yes	0	Alt A2-1	Yes	0	Alt B2-1	No	1
Alt A1-2	Yes	0	Alt A2-2	Yes	0	Alt B2-2	No	1
Alt A1-3	Yes	0	Alt A2-3	Yes	0	Alt B2-3	No	1
Alt A1-4	Yes	0	Alt A2-4	Yes	0	Alt B2-4	No	1
Alt A1-5	Yes	0	Alt A2-5	Yes	0	Alt B2-5	No	1
Alt A1-6	Yes	0	Alt A2-6	Yes	0	Alt B2-6	No	1
Alt A1-7	Yes	0	Alt A2-7	Yes	0	Alt B2-7	No	1
Alt A1-8	Yes	0	Alt A2-8	Yes	0	Alt B2-8	No	1
Alt A1-9	Yes	0	Alt A2-9	Yes	0	Alt B2-9	No	1
Alt A1-10	Yes	0	Alt A2-10	Yes	0	Alt B2-10	No	1

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

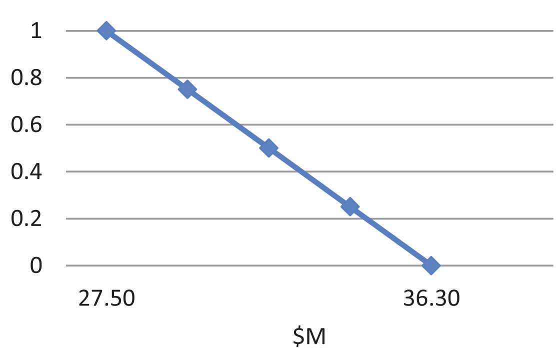
Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4

Cost

Life Cycle Cost



Definition: This sub-factor measures the estimated life cycle cost of the construction for each alternative. Alternatives with lower capital cost are preferred.

Mitigation: None.

Alternatives:

Alternative	$M	Utility Score	Alternative	$M	Utility Score	Alternative	$M	Utility Score
Alt A1-1	$28.0	0.94	Alt A2-1	$29.8	0.74	Alt B2-1	$29.1	0.82
Alt A1-2	$28.4	0.90	Alt A2-2	$29.4	0.73	Alt B2-2	$30.3	0.68
Alt A1-3	$28.0	0.94	Alt A2-3	$30.0	0.72	Alt B2-3	$29.3	0.80
Alt A1-4	$34.2	0.24	Alt A2-4	$36.3	0.00	Alt B2-4	$34.6	0.19
Alt A1-5	$27.5	1.00	Alt A2-5	$29.3	0.80	Alt B2-5	$28.6	0.88
Alt A1-6	$33.8	0.28	Alt A2-6	$35.5	0.09	Alt B2-6	$33.9	0.27
Alt A1-7	$30.2	0.69	Alt A2-7	$31.9	0.50	Alt B2-7	$31.1	0.59
Alt A1-8	$34.4	0.22	Alt A2-8	$36.2	0.01	Alt B2-8	$34.8	0.17
Alt A1-9	$30.2	0.69	Alt A2-9	$32.2	0.47	Alt B2-9	$31.6	0.53
Alt A1-10	$34.1	0.25	Alt A2-10	$36.1	0.02	Alt B2-10	$34.2	0.24

Legend:

AltA1 – Existing 6th Line Alignment, under Highway 400

Alt A2 – Existing 6th Line Alignment, over Highway 400

Alt B2 – Northerly 50 m shift 6th Line Alignment, Over Highway 400

-1	Diamond	-3	Parclo A2	-5	Parclo A2	-7	Parclo A2	-9	Parclo B2
-2	Diamond with Roundabout	-4	Parclo A4	-6	Parclo A4	-8	Parclo A4	-10	Parclo B4