

NOVEMBER 26, 2019
REFER TO FILE: 0892-4560
SENT VIA: EMAIL C/O
AGOLD@PLAZACORP.COM

City of Barrie
70 Collier Street
Barrie, ON L4M 4T5

Attention: Jeff Sharp, C.E.T.
Supervisor of Traffic Operation and Community Safety

RE: TRAFFIC OPINION LETTER
428 LITTLE AVENUE
CITY OF BARRIE, SIMCOE COUNTY

Dear Jeff,

This letter is in regard to the proposed residential development located at 428 Little Avenue in the City of Barrie, County of Simcoe.

A traffic safety assessment was conducted to review site entrance safety and geometrics. The assessment included a review of sight distances as well as Metrolinx rail setback and entrance spacing requirements. The trip generation of the site was also calculated to provide a qualitative review of the impacts to the boundary road network.

1 EXISTING CONDITIONS

The subject lands consist 2.04-hectare (5.04 acres) in size, with entrances at 428 Little Avenue and 237 Foster Drive. The lot is comprised of part of Lot 12 Concession 14 and Lot 46 on Registered Plan 1355. The lands are zoned R1, R2, R3 and R4 per City of Barrie Comprehensive Zoning By-Law 2009-141, and designated "Residential" in the City of Barrie Official Plan. The site is located in the northwest corner of the intersection of Little Avenue and Hurst Drive and is surrounded by low-density residential and open space zoned lots. The site is bounded by Metrolinx tracks and Hurst Avenue to the north and east, existing residential dwellings and MacLaren Avenue to the west, and Little Avenue to the south.

The location of the proposed development is illustrated in the Site Location Plan, included as **Figure 1**. The City of Barrie Zoning By-law Map has been included as **Attachment A**. The City of Barrie Official Plan "Schedule A – Land Use" has been included as **Attachment B**.

2 DEVELOPMENT PROPOSAL

The proposed development consists of 50 townhouse units and six stacked affordable units. A private condominium road is proposed through the site and will provide access to Little Avenue at the south end of the development, and connect with Foster Drive/MacLaren Avenue at the north end of the property. The proposed Little Avenue entrance is approximately 85 metres west of the intersection of Little Avenue and Hurst Drive.

Development details are summarized on the Preliminary Site Plan, included as **Figure 2**.

3 BOUNDARY ROAD NETWORK

With skewed directions, the directional orientation of the roadway system is ambiguous. To provide clarity throughout this report, Little Avenue and Foster Drive have been assigned an east-west orientation, and Hurst Drive and MacLaren Avenue have been assigned a north-south orientation.

Little Avenue is an east-west arterial road bounding the south side of the subject lands. The roadway consists of one approximate 5.5-metre lane in each direction with a painted centreline. Street parking is permitted in both directions unless otherwise noted by signage, beginning approximately 50 metres west of the intersection of Little Avenue and Hurst Drive. Little Avenue has a posted speed limit of 50 km/h within the study area.

Hurst Drive is a north-south arterial road that bounds the east side of the subject lands. The roadway has two 3.5-metre lanes per direction and a posted speed limit of 50 km/h. The east side of the roadway has a 3-metre paved pathway separated by an approximate 2.5-metre grass boulevard. South of Little Avenue, the west side of the roadway has a 1.5-metre paved sidewalk, separated by an approximate 2.5-metre grass boulevard.

The intersection of Little Avenue and Hurst Drive is a three-legged signalized intersection. The north approach (Hurst Drive) consists of one through lane and one shared through/right-turn lane. The south approach (Hurst Drive) consists of two through lanes and a left-turn lane with 30 metres of storage length. The west approach (Little Avenue) consists of a right-turn lane and a left-turn lane with 15 metres of storage length.

MacLaren Avenue and Foster Drive are local roads located on the west side of the subject lands. Both roadways are comprised of one 3.25-metre travel per direction and no painted centreline. Both roads have unpaved shoulders and allow street parking unless otherwise signed. There is no posted speed limit on either road and therefore it was assumed to be 50 km/h. Pedestrian facilities are not provided on either roadway.

The intersection of MacLaren Avenue and Little Avenue is stop-controlled in the southbound direction, while the intersection of MacLaren Avenue and Foster Drive is unrestricted.

The City of Barrie Official Plan "Schedule D – Road Plan" has been included as **Attachment C**.

4 TRIP GENERATION AND DISTRIBUTION

The proposed development will result in additional vehicles on the boundary road network that would otherwise not exist. The proposed development consists of 50 townhouse units and 6 stacked affordable units. Accordingly, site generated traffic for the proposed development was calculated using fitted curve equations provided in the Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th Edition using Land Use Category 220 "Multifamily Housing (Low-Rise)". The forecasted trips are tabulated in **Table 1** below. Excerpts from the ITE Trip Generation Manual, 10th Edition have been included as **Attachment D**.

Table 1: Trip Generation

Use	Peak Hour of Generator	Number of Trips		
		Inbound	Outbound	Total
LUC 220: Multifamily Low-Rise (56 units)	Weekday A.M.	6	21	27
	Weekday P.M.	22	13	35

These trip generation forecasts are low and are not typically associated with traffic operations issues. Therefore, no issues are expected to occur from a traffic operations perspective.

5 SITE ENTRANCE GEOMETRICS

The City of Barrie "Urban Design Manual" provides entrance widths and curb radii for development entrances. The site has entrances from Little Avenue and Foster Drive/MacLaren Avenue. As noted previously, Little Avenue is designated as an arterial road in the City of Barrie Official Plan, while Foster Drive and MacLaren Avenue are both local roads.

Per the City of Barrie "Urban Design Manual", an entrance from an arterial road to a multi-residential development should have a two-lane entrance width of nine metres, and curb radius of eight metres. An entrance from a local road to a multi-residential development should have a two-lane entrance width of six metres and curb radius of five metres. Relevant excerpts from the City of Barrie "Urban Design Manual" have been included as **Attachment E**.

The Preliminary Site Plan, included as **Figure 2**, reflects an adjusted entrance configuration at the Little Avenue entrance compared to what is described above. The Little Avenue entrance requires curb radii of 11 metres to support City services and associated truck manoeuvrability. The truck turning analysis has been included as **Attachment F**.

6 SITE ENTRANCE SAFETY

Sight lines at the Little Avenue site entrance were considered from stopping sight distance and intersection sight distance perspectives.

- Stopping sight distance refers to the minimum distance required for a vehicle to slow down or stop to avoid collision with a vehicle egressing the site.
- Intersection sight distance refers to the minimum distance required for a vehicle to enter a road and attain the assumed operating speed before being overtaken by a vehicle approaching in the same or opposite direction at the design speed.

Little Avenue has a posted speed limit of 50 km/h fronting the subject lands. The proposed entrance is located approximately 90 metres west of the signalized intersection of Little Avenue and Hurst Drive. Typically, the design speed on lower speed urban roads is 10 km/h above the posted speed limit. This assumption is reasonable for vehicles approaching the entrance from the west on Little Avenue. However, vehicles approaching from the east do so via turning movements since Little Avenue forms a T-intersection with Hurst Drive. Accordingly, it is not expected that vehicles would have attained operating speed by the site entrance. Regardless, a design speed of 60 km/h was assumed for vehicles approaching from the both the east and west.

The Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (GDGCR) (2017) provides minimum stopping sight distances (TAC Section 2.5.3) and intersection sight distances (TAC Section 9.9.2.3). The requirements for each of these sight distances are described in the subsequent sections. Relevant TAC GDGCR excerpts have been included in **Attachment G**.

6.1 STOPPING SIGHT DISTANCE

Stopping sight distance is calculated based on brake reaction time, design speed and deceleration rate. Little Avenue has a downward slope of 4.5 percent from MacLaren Avenue towards Hurst Drive. TAC GDGCR Table 2.5.3 provides stopping sight distances for downgrades and upgrades. **Table 2** provides minimum stopping sight distance requirements for vehicles approaching the site entrance from the west and east.

Table 2: Stopping Sight Distance

Approach	Design Speed	Downward/Upward Slope	Required Stopping Sight Distance	Available Sight Distance
West	60 km/h	-4.5%	90 m	+150 m
East	60 km/h	+4.5%	78.5 m	80 m

The measured sight distance on Little Avenue approaching the site entrance from both directions exceeds the minimum stopping sight distance described in TAC GDGCR.

6.2 INTERSECTION SIGHT DISTANCE

A sight distance analysis was conducted to confirm that there is sufficient sight distance for drivers turning eastbound or westbound onto Little Avenue from the site. The measured sight distances on Little Avenue were compared to the standards set out in TAC GDGCR. Section 9.9 in TAC GDGCR provides Intersection sight distance for different intersection controls. The applicable cases are as follows:

- Case B – Intersections with stop control on the minor road
 - Case B1 – Left turn from the minor road
 - Case B2 – Right turn from the minor road
- Case F – Left turns from the major road

Intersection sight distance is calculated using equation 9.9.1 from the GDGCR as outlined below:

$$ISD = 0.278 * V_{major} * t_g$$

Where;

ISD = Intersection Sight Distance

V major = design speed of roadway (km/h)

t_g = assumed time gap for vehicles to turn from stop onto roadway (s)

The calculated and design sight distances are further summarized in Tables 9.9.4, 9.9.6 and 9.9.12 of the TAC GDGCR for vehicles turning left from stop, turning right from stop, or turning left from the major road, respectively. **Table 3** contains a summary of the intersection sight distance requirements for each of the applicable cases.

Table 3: Intersection Sight Distance

Case	Approach	Design Speed	Required Intersection Sight Distance	Available Sight Distance	TAC Reference
B1: Vehicles turning left from stop	West	60 km/h	130 m	+150 m	Table 9.9.4
	East	60 km/h	130 m	85 m ¹	Table 9.9.4
B2: Vehicles turning right from stop	East	60 km/h	110 m	85 m ¹	Table 9.9.6
F: Left turns from the major road	East	60 km/h	95 m	+100 m ²	Table 9.9.12

Note¹: Available sight distance is partially obstructed due to the presence of trees/growth

Note²: Available sight distance is limited by the termination of Little Avenue at Hurst Drive

As illustrated in **Table 3**, there is sufficient sight distance available to the west for vehicles to turn left without being overtaken by another vehicle approaching from the right. Vehicles waiting to turn left

into the site from Little Avenue can see past the T-intersection and will have sufficient sight distance to see vehicles approaching from the north and south legs of the intersection of Little Avenue and Hurst Drive.

Little Avenue terminates at a T-intersection with Hurst Drive approximately 90 metres east of the proposed site entrance. Westbound vehicles approach via turning movements from Hurst Drive. Accordingly, vehicles are not assumed to attain operating speed before reaching the site entrance on Little Avenue.

Although the minimum sight distances for two of the scenarios are not met, sight lines are available to the at-grade rail crossing and into the signalized intersection of Little Avenue and Hurst Drive, which is the termination point of Little Avenue. Furthermore, the signals at Little Avenue and Hurst Drive create metering of upstream traffic and will provide gaps in westbound traffic to permit safe egress from the Little Avenue entrance. Accordingly, the entrance can be supported from a sight distance perspective.

As an additional measure to improve safety, trees and various growth should be limited within the right-of-way limits along Little Avenue between the site access and the intersection to improve sight line availability for vehicles egressing from the subject lands.

7 PROXIMITY TO THE RAIL CORRIDOR

The subject lands are located adjacent to the Metrolinx Rail Corridor. The Government of Canada provides recommendations for minimum sightlines at grade crossings. For grade crossings with a warning system with gates, the warning system must be visible throughout the stopping sight distance.

The site entrance is approximately 70 metres west of the warning system. Vehicles waiting at the entrance to turn left onto Little Avenue will have clear sight lines to the warning system. After turning left, vehicles are not expected to attain an operating speed of 60 km/h due to the close proximity of the signalized intersection. Assuming a design speed of 50 km/h and a downgrade of 4.5 percent, the minimum stopping sight distance would be 68 metres per TAC GDGCR Table 2.5.3. Since the warning system is 70 metres from the entrance, the warning system will be visible throughout the stopping sight distance length for vehicles exiting the subject lands.

Dialog and J.E. Coulter Associates Limited produced the Guidelines for New Development in Proximity to Railway Operations in May 2013. The guidelines note that Transport Canada recommends including a minimum 30-metre distance between the railway right-of-way and any vehicular ingress/egress. Furthermore, trees, utility poles, and other objects should not obstruct sight lines to the crossing warning signs or systems.

Additionally, Metrolinx is undertaking a rail corridor expansion project in Barrie. Hatch and Burnside undertook the "Transit Project Assessment Process" (TPAP), and produced the Environmental Project Report in August 2017. The goal of the project is to bring frequent two-way, all-day train service seven days a week to the Barrie rail corridor. The report assessed the environmental impacts of the Barrie Rail Corridor Expansion Project and identifies the preferred method of improving transit service, which includes twinning the existing track to permit all-day two-way service. The report highlights the current right-of-way and identifies any required expansions.

Drawing SK-C-139, included as **Attachment H**, illustrates the preliminary design at the intersection of Little Avenue and Hurst Drive. The drawing illustrates that the rail expansion can be completed within the existing right-of-way along the property frontage. Using the Simcoe County GIS Mapping portal, the proposed site entrance was measured to be 50 meters west of the railway right-of-way, thereby

adhering to the minimum 30-meter right-of-way spacing requirements outlined by Transport Canada. The acceptability of the entrance location has also been confirmed by Metrolinx staff.

8 CONCLUSIONS

The proposed development is not expected to create a safety hazard due to vehicle ingress or egress at the Little Avenue site entrance. The forecasted trips generated by the proposed development are minor in nature, and are not expected to cause operational issues on the boundary road network. Furthermore, there is sufficient stopping sight distance for vehicles approaching the site entrance on Little Avenue from the east and west.

Vehicles exiting the subject lands have sufficient sight distances to the west on Little Avenue and can see to the rail crossing warning system to the east as well as into the intersection of Little Avenue and Hurst Drive. When considering the expected operating speeds of approaching vehicles in conjunction with the proximity of the signalized intersection, we find the available sight distance sufficient with the reduction of trees and growth within the sight line path. By reducing these obstructions, vehicles egressing to Little Avenue will have improved sight lines to the east.

Transport Canada guidelines were referenced to determine the acceptability of the entrance location given its proximity to the Metrolinx corridor. Transport Canada recommends a minimum distance of 30 metres between the railway right-of-way and any vehicular ingress/egress. The Metrolinx plan to twin the existing rail system is shown to occur within the existing Metrolinx right-of-way for the segment fronting the subject lands. The proposed site entrance is approximately 50 metres west of the Metrolinx property limit and thereby meets the minimum Transport Canada spacing requirements.

We trust that this review satisfies any transportation concerns associated with the proposed development. Should you have any questions or require any further information, please do not hesitate to contact the undersigned.

Respectfully submitted by,

C.F. CROZIER & ASSOCIATES INC.



Ryan MacLaughlan, MEng, P.Eng.
Project Engineer

RM/mf

J:\800\892 - Plaza Corp\4560-428 Little Ave\Letters\2019.07.05_Traffic Opinion Letter.docx

Enc.

Figure 1 – Site Location Plan

Figure 2 – Preliminary Site Plan

Attachment A – City of Barrie Zoning By-law Map

Attachment B – City of Barrie Official Plan "Schedule A – Land Use"

Attachment C – City of Barrie Official Plan "Schedule D – Road Plan"

Attachment D – ITE Trip Generation Manual, 10th Edition – Excerpts

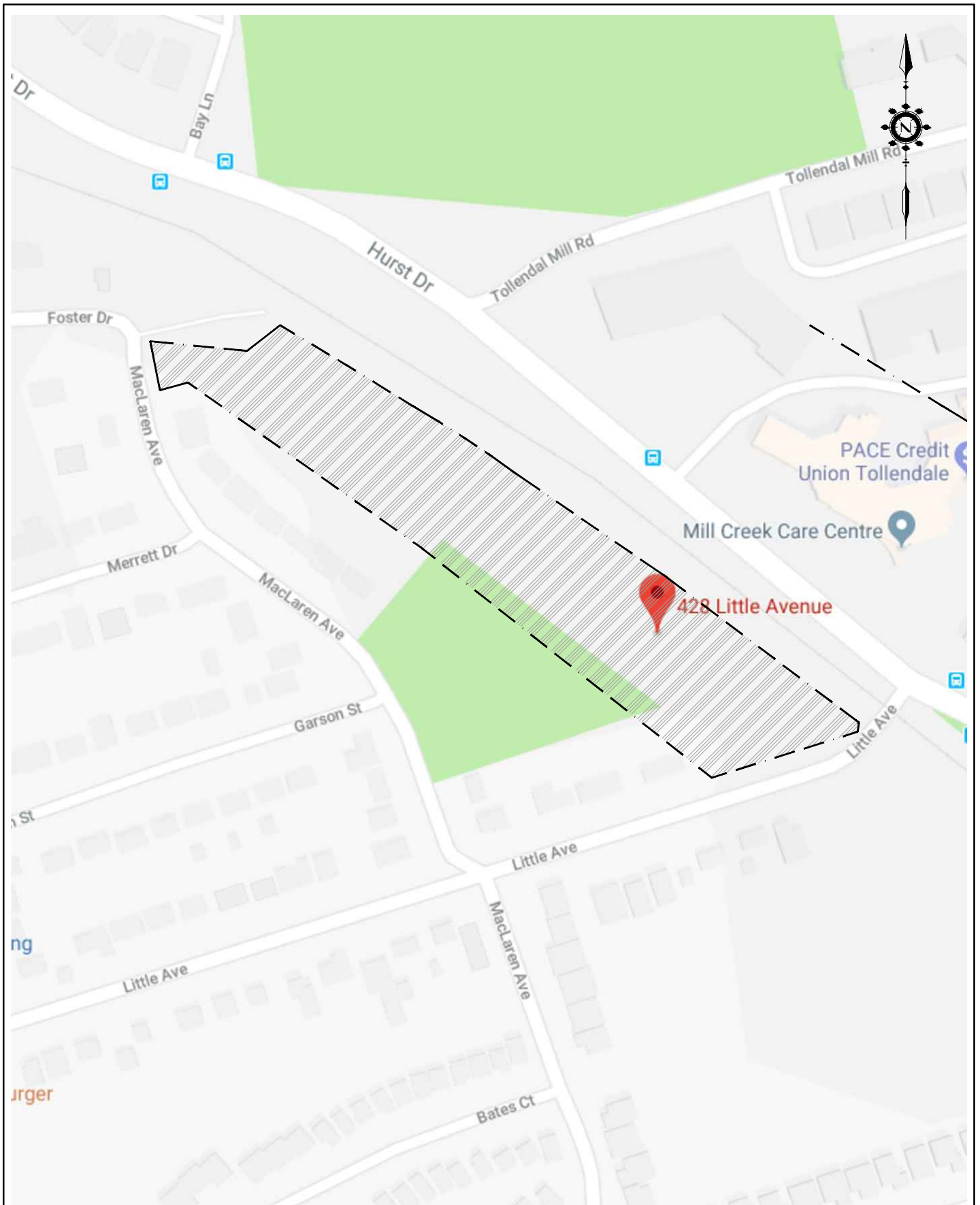
Attachment E – City of Barrie Urban Design Manual – Excerpts

Attachment F – Truck Turning Diagrams

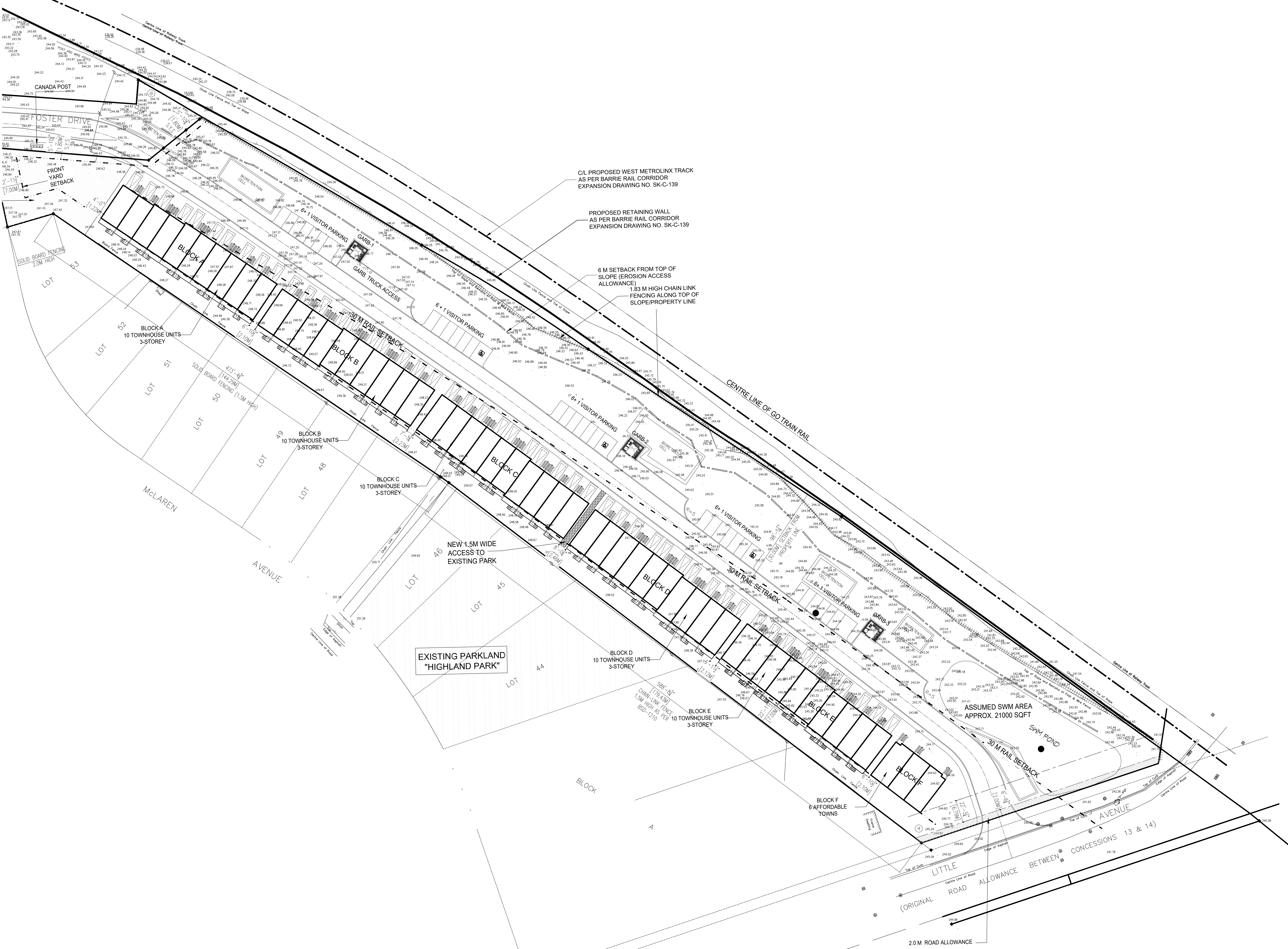
Attachment G – TAC GDGCR – Excerpts

Attachment H – Barrie Rail Corridor Expansion Project – Drawing SK-C-139

FIGURES



Legend  = SUBJECT PROPERTY	Project 428 LITTLE AVENUE, BARRIE	 CROZIER CONSULTING ENGINEERS The HarbourEdge Building, 40 Huron Street, Suite 301, Collingwood, ON L9Y 4R3 705 446-3510 T 705 446-3520 F www.ccrozier.ca info@ccrozier.ca			
	Drawing SITE LOCATION		Drawn By B.K.	Design By M.L.	Project 892-4560
	N.T.S.		Date 09/12/2018	Check By M.L.	Drawing FIG. 1



BUILDERS SHALL VERIFY ALL DIMENSIONS AND ALL JOB SITE CONDITIONS PRIOR TO PROCEEDING WITH CONSTRUCTION AND REPORT ANY DISCREPANCIES IMMEDIATELY TO THE ARCHITECT.

ONLY THE LATEST APPROVED DRAWINGS ARE TO BE USED FOR CONSTRUCTION.

IT IS THE BUILDER'S DUTY TO ENSURE THAT THEY HAVE THE LATEST APPROVED DRAWINGS IN HAND.

PROJECT NORTH

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SEE DRAWING A-1 FOR GENERAL AND CONSTRUCTION NOTES

NO.	DATE	DESCRIPTION
12	JUNE 27, 19	REVISE SITE PLAN
11	APR 22 2019	REVISE SITE PLAN
10	MAR 18 2019	REVISE BLOCK C
9	MAR 15 2019	REVISED FOR CLIENT REVIEW
8	FEB 27 2019	REVISED FOR CLIENT REVIEW
7	JAN 23 2019	REVISED FOSTER DR. FOR CLIENT REVIEW
6	JAN 11 2019	REVISED FOR CLIENT REVIEW
5	MAR 22 2018	REVISED FOR CLIENT REVIEW
4	MAR 5 2018	REVISED FOR CLIENT REVIEW
3	JAN 25 2018	REVISED FOR CLIENT REVIEW
2	JAN 3 2018	REVISED FOR CLIENT REVIEW
1	MAY 4 2017	ISSUED FOR PRE-CONSULTATION REVIEW

NO.	DATE	DESCRIPTION
REVISIONS / ISSUE DATES		

PETER HIGGINS
ARCHITECT INC.
124 MERTON STREET, SUITE 204
TORONTO, ONTARIO, M4S 2Z2
OFFICE: (416) 481-6229
FAX: (416) 481-8084
E-MAIL: phigginsarchitect@rogers.com

PROJECT:

PROJECT TYPE

237 FOSTER DR - 428 LITTLE AVE
BARRIE, ONTARIO

DRAWN BY: L.B.M./S.A	DATE: MAY 2017
CHECKED BY: P.J.H.	
SCALE: 1 : 500	BCIN 4208 3486

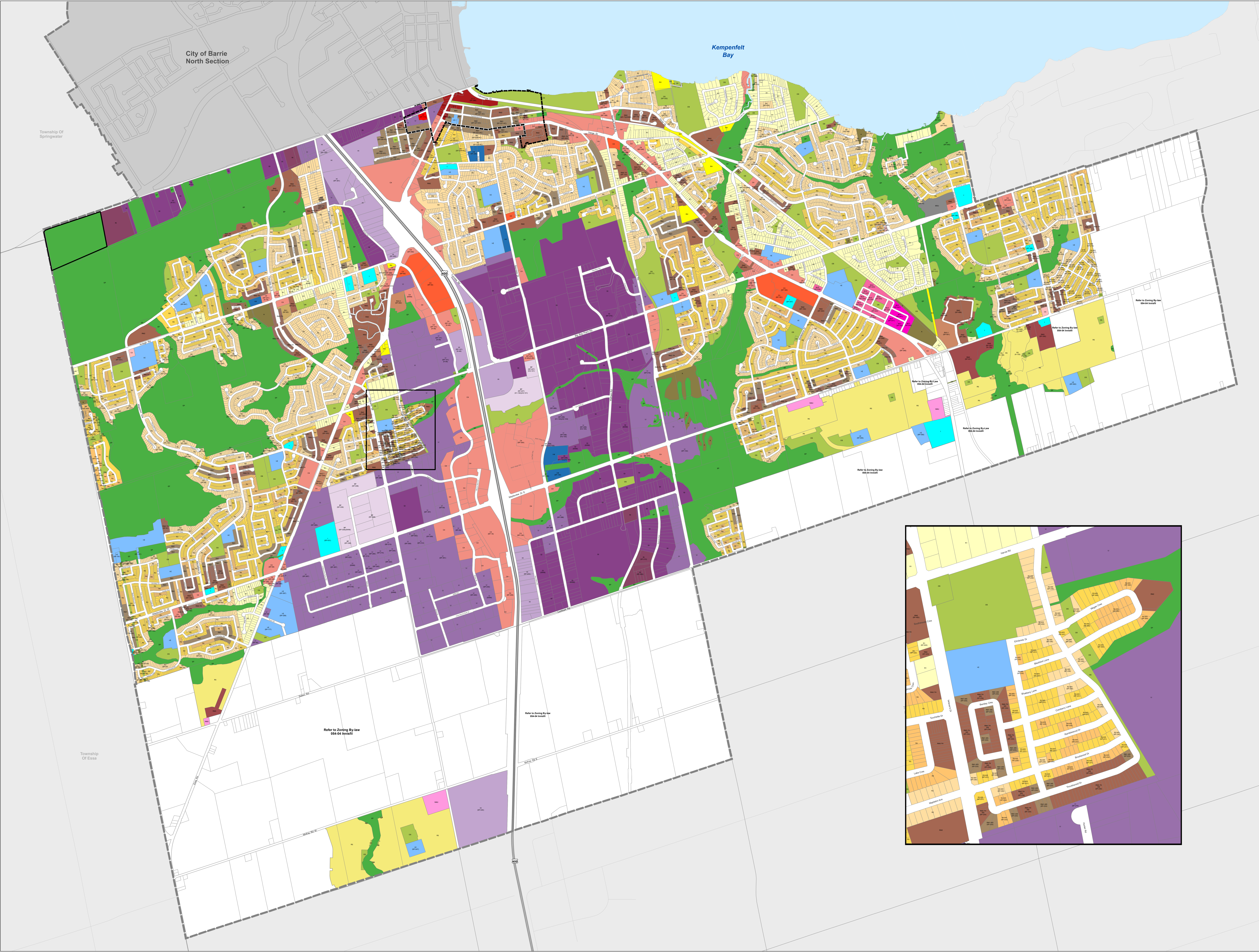
ONTARIO ASSOCIATION
OF
ARCHITECTS
PETER HIGGINS
LICENCE 4208

PROJECT NO: 17-023	DRAWING TITLE: PRELIMINARY SITE PLAN	DRAWING NO: A-1
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Figure 2

ATTACHMENT A

City of Barrie Zoning By-law Map

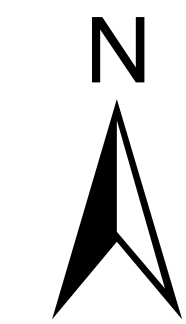
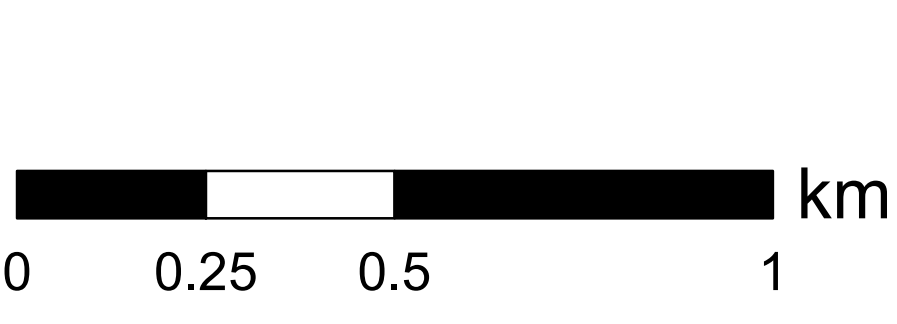


**ZONING BY-LAW 2009-141
SOUTH SECTION**

**Office Consolidation
December 31, 2017**

- Central Area Commercial (C1, C1-1, C1-2)
- Transition Centre Commercial (C2, C2-1, C2-2)
- Shopping Centre Commercial (C3)
- General Commercial (C4)
- Convenience Commercial (C5)
- Mixed Use Node (MU1)
- Mixed Use Corridor (MU2)
- Neighbourhood Mixed Use (NNU)
- Residential Hold (RH)
- Residential Single Detached Dwelling First Density (R1)
- Residential Single Detached Dwelling Second Density (R2, R2-WS)
- Residential Single Detached Dwelling Third Density (R3, R3-WS)
- Residential Single Detached Dwelling Fourth Density (R4, R4-WS)
- Neighbourhood Residential (R5)
- Residential Apartment Dwelling First Density (RA1, RA1-1, RA1-2, RA1-3)
- Residential Apartment Dwelling Second Density (RA2, RA2-1, RA2-2)
- Residential Multiple Dwelling First Density (RM1, RM1-SS, RM1-WS)
- Residential Multiple Dwelling Second Density (RM2, RM2-TH, RM2-TH WS)
- RM3, Neighbourhood Multiple Residential
- Institutional (I)
- Educational Institutional (I-E)
- Major Institutional (I-M, I-M-1)
- Open Space (OS)
- Environmental Protection Area
- Agriculture (A)
- Business Park (BP)
- Highway Industrial (HI)
- Light Industrial (LI)
- General Industrial (GI)
- Restrictive Industrial (RI)
- Municipal Services and Utilities (MSU)
- Refer to Zoning By-law 054-04 Innisfil

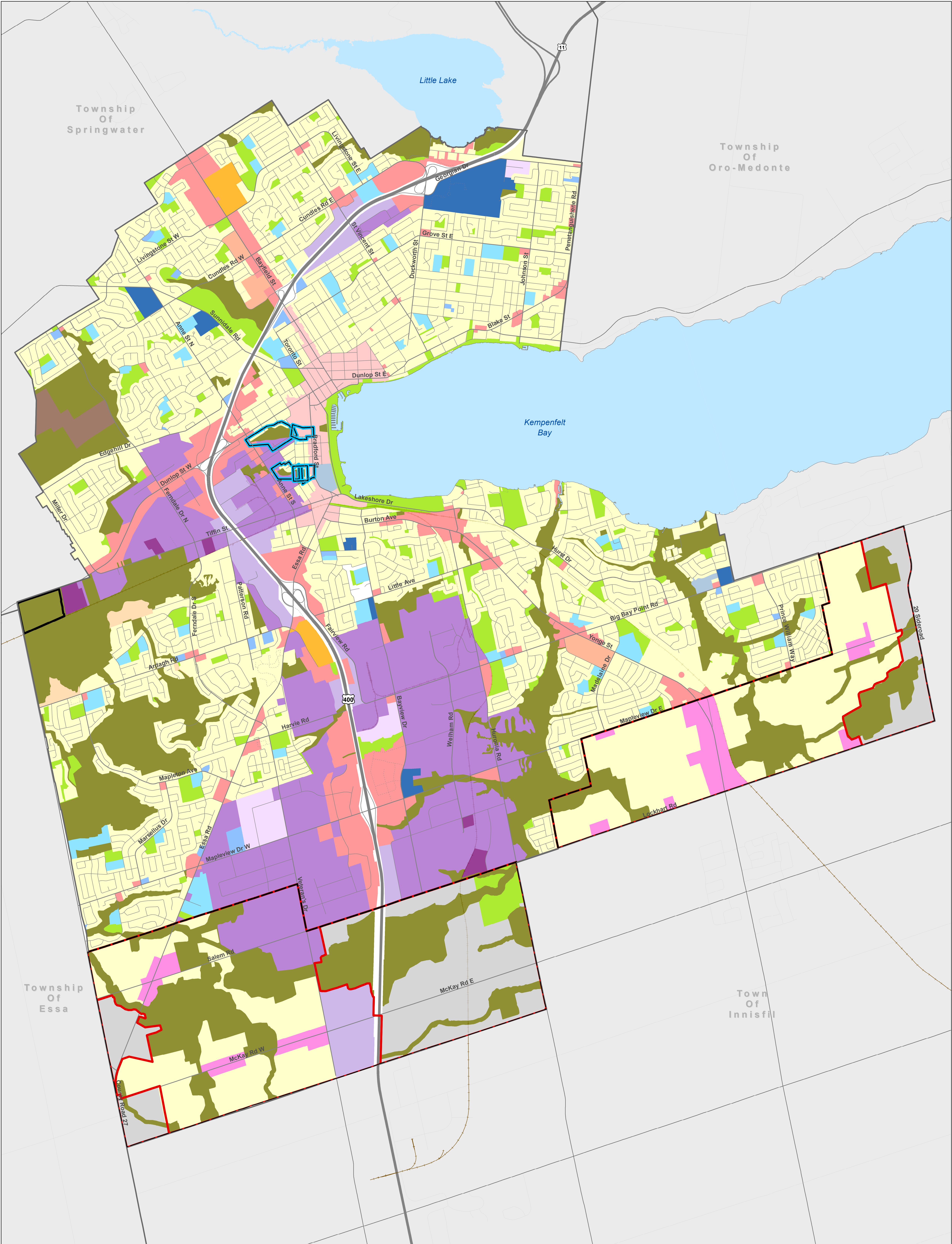
- City Centre Revitalization Area
- Application Currently Before the Ontario Municipal Board
- City Boundary
- Parcels



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For information please contact Service Barrie at 705-725-4242 or ServiceBarrie@barrie.ca

ATTACHMENT B

City of Barrie Official Plan “Schedule A – Land Use”



OFFICIAL PLAN
Schedule A
Land Use
Office Consolidation
January 2018

Residential	Institutional	Waste Disposal Area - Non decision per section 4.7.2.8
City Centre	Educational Institutional	City Boundary
General Commercial	Major Institutional	Application Before the Ontario Municipal Board (OMB)
Community Centre Commercial	Open Space	Secondary Plan Boundary
Regional Centre Commercial	Environmental Protection Area	Settlement Area Boundary
Mixed Use Nodes and Corridors	Special Rural Area	
Business Park	Water Treatment Centre	
Highway 400 Industrial	Waste Management Facility	
General Industrial	Future Urban	
Restricted Industrial		



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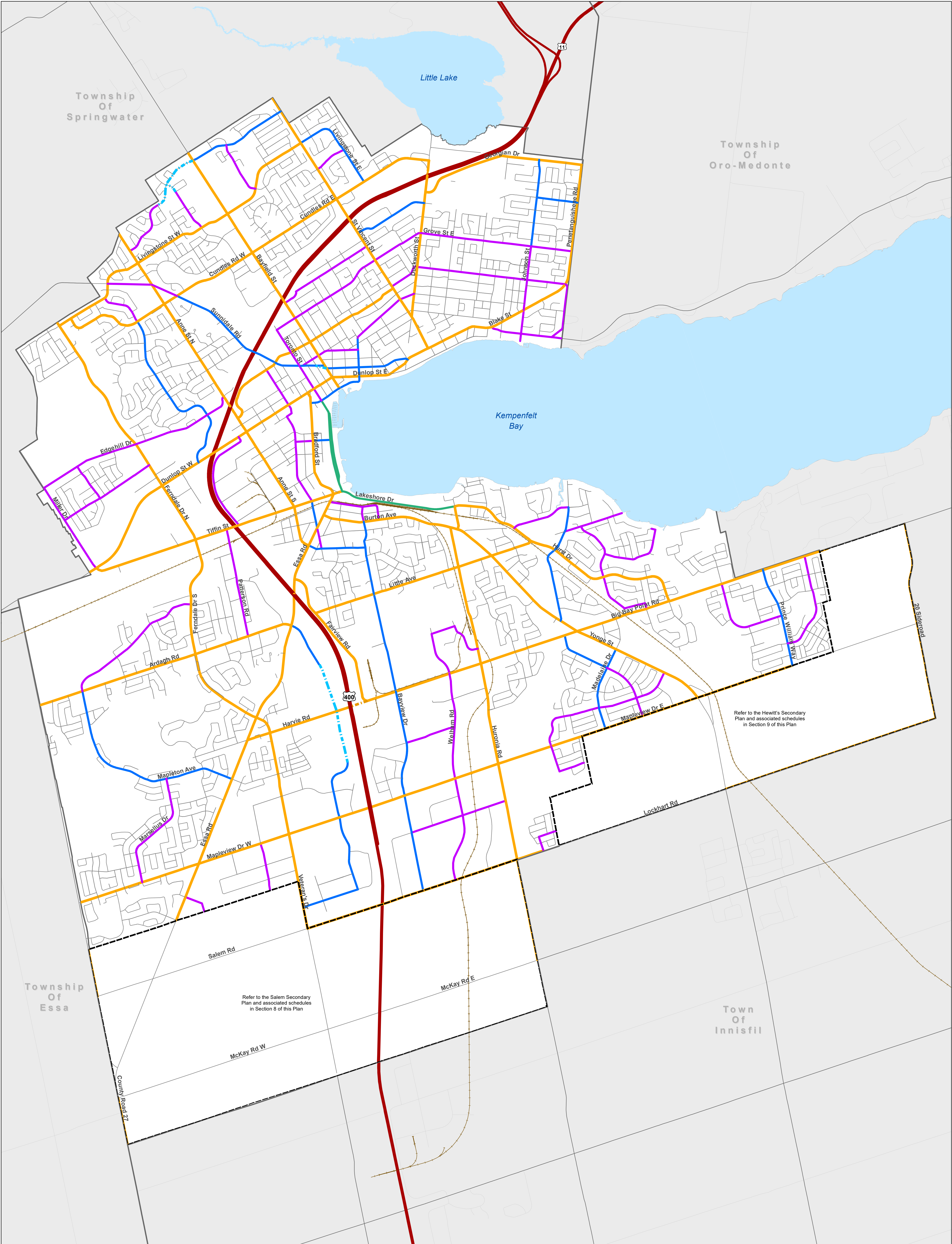


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GIS Branch 4/27/2018

ATTACHMENT C

City of Barrie Official Plan “Schedule D – Road Plan”



OFFICIAL PLAN

Schedule D

Roads Plan

Office Consolidation

January 2018

- | | | |
|--------------------|-----------------|------------------|
| Provincial Highway | Minor Collector | FUTURE ARTERIAL |
| Arterial | Parkway | Future Collector |
| Major Collector | Local | Railway |

1:20,000

0 0.5 1 2 km

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GIS Branch 4/27/2018

ATTACHMENT D

ITE Trip Generation Manual, 10th Edition – Excerpts

Land Use: 220

Multifamily Housing (Low-Rise)

Description

Low-rise multifamily housing includes apartments, townhouses, and condominiums located within the same building with at least three other dwelling units and that have one or two levels (floors). Multifamily housing (mid-rise) (Land Use 221), multifamily housing (high-rise) (Land Use 222), and off-campus student apartment (Land Use 225) are related land uses.

Additional Data

In prior editions of *Trip Generation Manual*, the low-rise multifamily housing sites were further divided into rental and condominium categories. An investigation of vehicle trip data found no clear differences in trip making patterns between the rental and condominium sites within the ITE database. As more data are compiled for future editions, this land use classification can be reinvestigated.

For the three sites for which both the number of residents and the number of occupied dwelling units were available, there were an average of 2.72 residents per occupied dwelling unit.

For the two sites for which the numbers of both total dwelling units and occupied dwelling units were available, an average of 96.2 percent of the total dwelling units were occupied.

This land use included data from a wide variety of units with different sizes, price ranges, locations, and ages. Consequently, there was a wide variation in trips generated within this category. Other factors, such as geographic location and type of adjacent and nearby development, may also have had an effect on the site trip generation.

Time-of-day distribution data for this land use are presented in Appendix A. For the 10 general urban/suburban sites with data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:15 and 8:15 a.m. and 4:45 and 5:45 p.m., respectively. For the one site with Saturday data, the overall highest vehicle volume was counted between 9:45 and 10:45 a.m. For the one site with Sunday data, the overall highest vehicle volume was counted between 11:45 a.m. and 12:45 p.m.

For the one dense multi-use urban site with 24-hour count data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:00 and 8:00 a.m. and 6:15 and 7:15 p.m., respectively.

For the three sites for which data were provided for both occupied dwelling units and residents, there was an average of 2.72 residents per occupied dwelling unit.

The average numbers of person trips per vehicle trip at the five general urban/suburban sites at which both person trip and vehicle trip data were collected were as follows:

- 1.13 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 7 and 9 a.m.
- 1.21 during Weekday, Peak Hour of Adjacent Street Traffic, one hour between 4 and 6 p.m.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in British Columbia (CAN), California, District of Columbia, Florida, Georgia, Illinois, Indiana, Maine, Maryland, Minnesota, New Jersey, New York, Ontario, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Virginia, and Washington.

It is expected that the number of bedrooms and number of residents are likely correlated to the number of trips generated by a residential site. Many of the studies included in this land use did not indicate the total number of bedrooms. To assist in the future analysis of this land use, it is important that this information be collected and included in trip generation data submissions.

Source Numbers

168, 187, 188, 204, 211, 300, 305, 306, 319, 320, 321, 357, 390, 412, 418, 525, 530, 571, 579, 583, 864, 868, 869, 870, 896, 903, 918, 946, 947, 948, 951

Multifamily Housing (Low-Rise) (220)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,

Peak Hour of Adjacent Street Traffic,

One Hour Between 7 and 9 a.m.

Setting/Location: General Urban/Suburban

Number of Studies: 42

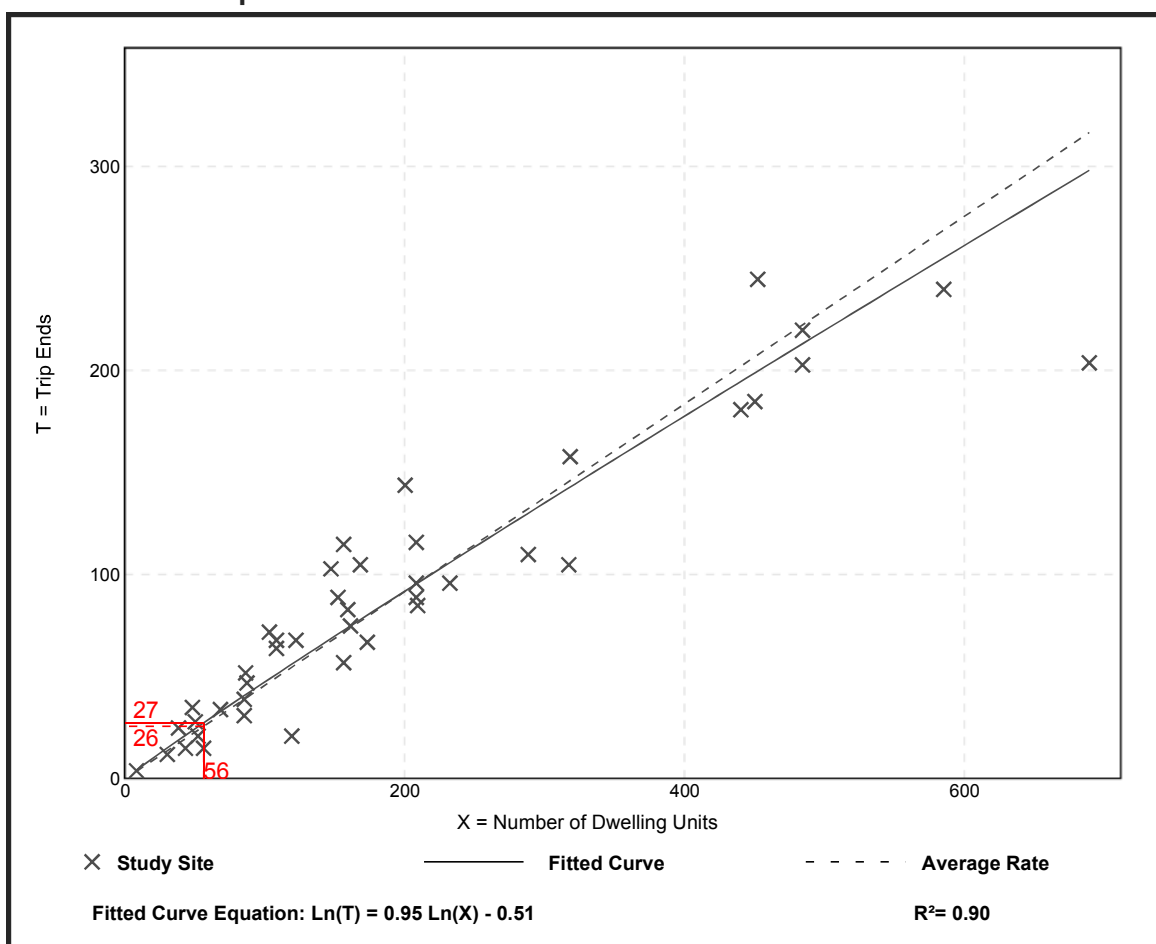
Avg. Num. of Dwelling Units: 199

Directional Distribution: 23% entering, 77% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.46	0.18 - 0.74	0.12

Data Plot and Equation



Trip Generation Manual, Generation Manual, Institute of Transportation Engineers

Multifamily Housing (Low-Rise) (220)

Vehicle Trip Ends vs: Dwelling Units

**On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.**

Setting/Location: General Urban/Suburban

Number of Studies: 50

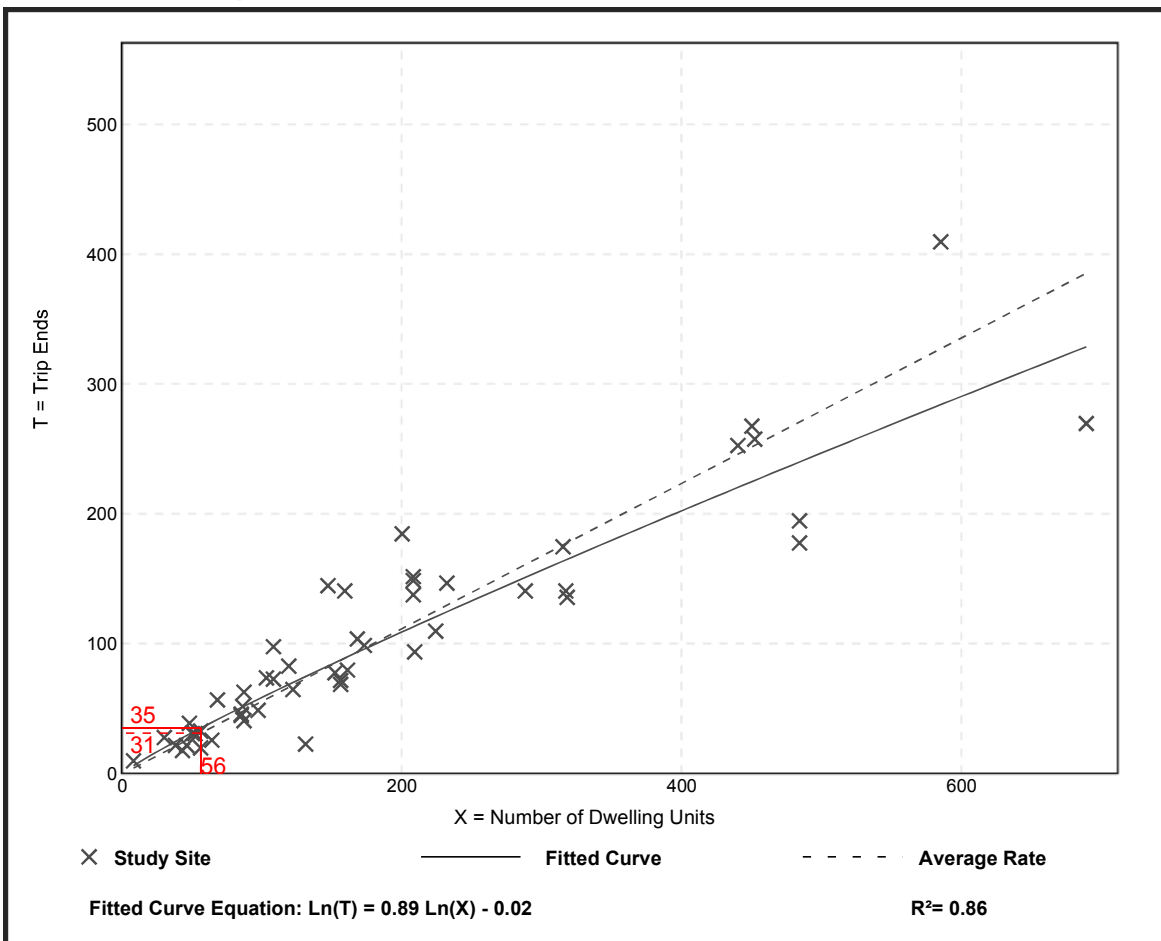
Avg. Num. of Dwelling Units: 187

Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.56	0.18 - 1.25	0.16

Data Plot and Equation



ATTACHMENT E

City of Barrie Urban Design Manual – Excerpts

10. Where the angle of the driveway is between 60° and 75°, paired angled driveways shall not be used on two-way roads nor shall two-way traffic be permitted on the driveways. Two-way traffic is permitted on a driveway with an angle of 75° to 90°.

Angled Driveway Geometry

11. The angle between the road and the driveway shall not be less than 60° for one-way driveways. Two-way driveways shall be 90° but angles of 75° to 90° may be considered in special circumstances.
12. The standard width of the driveway shall be between 7 and 9 metres.
13. The outside return radius shall not be less than 3 metres and the inside return radius shall not be less than 2 metres.
14. At driveways on high volume roads, the use of a taper leading to the outside return radius may be required.

Driveway Design

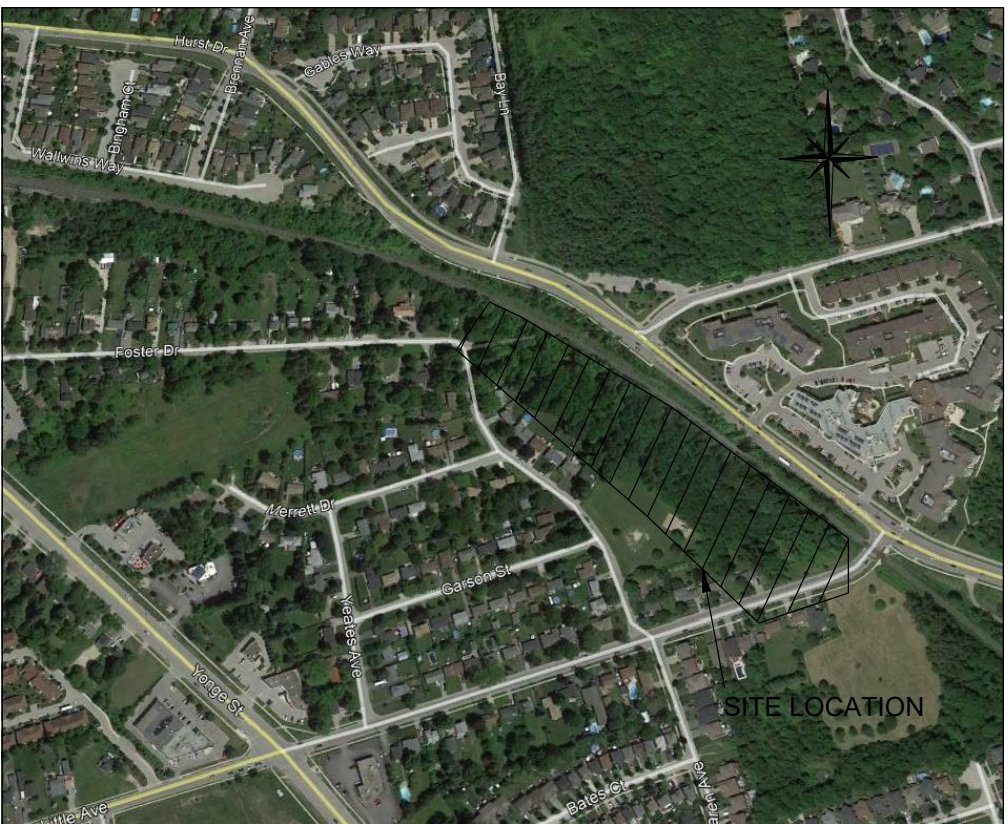
15. Driveways shall be constructed to a quality equivalent to a minimum of 50mm HL3 asphalt on a minimum of 200mm of Granular 'A' for Residential and 250mm of Granular 'A' for Commercial/Industrial or alternative equivalent surface material as approved by the City (i.e. paving stone, concrete).
16. Entrance aprons on municipal boulevards shall be paved and constructed as per City standards as described in Table 7.

Table 7

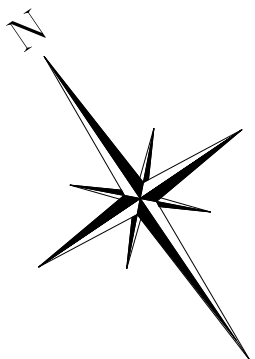
Land Use	Road Type	Entrance Width (m)		Radius (m)
		One-Lane	Two-Lane	
Low Density Residential	Arterial	4	6	5
	Collector	4	6	2
	Local	4	6	0
Multiple Residential	Arterial	6	9	8
	Collector	5	8	6
	Local	5	6	5

ATTACHMENT F

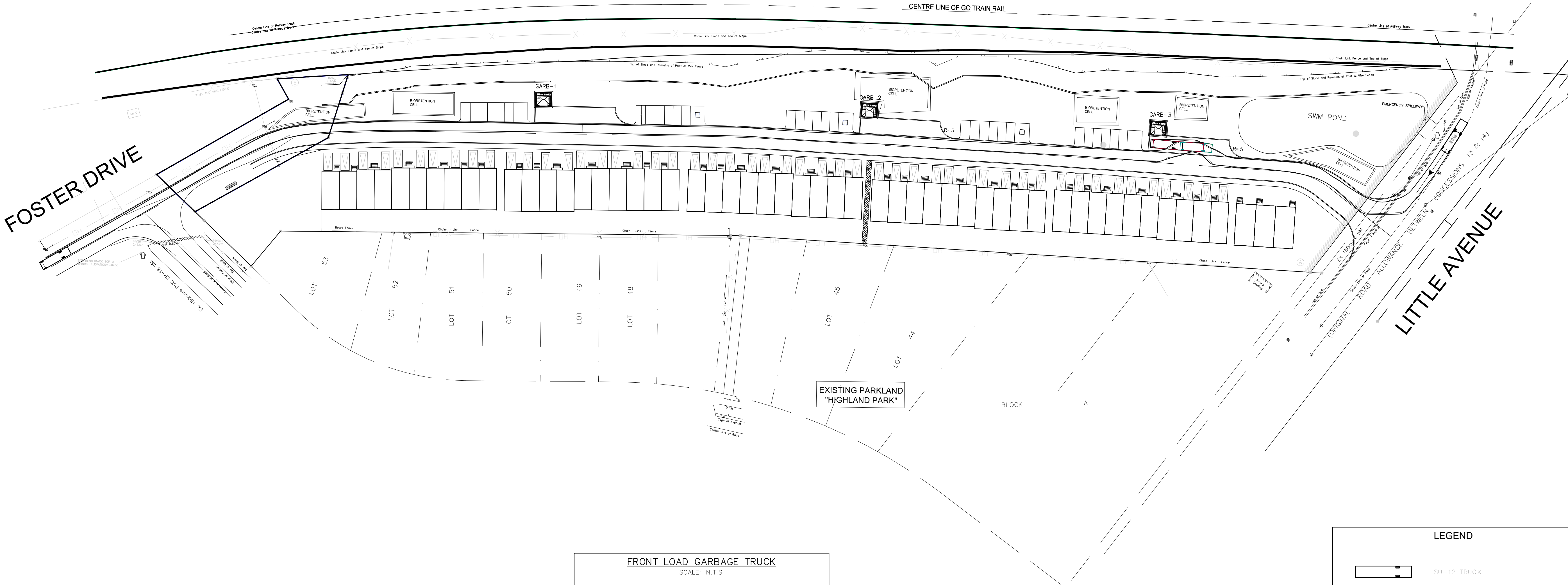
Truck Turning Analysis



KEY PLAN
NTS



SITE ROAD

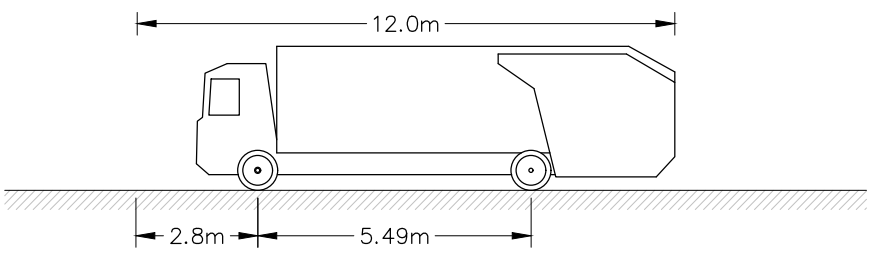


LEGEND

 SU-12 TRUCK

 DIRECTION OF TRUCK MOVEMENT

FRONT LOAD GARBAGE TRUCK
SCALE: N.T.S.



VEHICLE STATISTICS:
OVERALL VEHICLE LENGTH: 12.00 m
OVERALL VEHICLE WIDTH: 2.40 m
OVERALL VEHICLE HEIGHT: 4.10 m
MIN. BODY/GROUND CLEARANCE: 0.30 m
VEHICLE TRACK WIDTH: 2.40 m
LOCK-TO-LOCK TIME: 6.00 sec
CURB TO CURB TURNING RADIUS: 14.00 m

Project		428 LITTLE AVENUE CITY OF BARRIE		 CROZIER CONSULTING ENGINEERS		The HarbourEdge Building, 40 Huron Street, Suite 301, Collingwood, ON L9Y 4R3 705 446-3510 T 705 446-3520 F www.crozier.ca info@crozier.ca			
Drawing		GARBAGE TRUCK MOVEMENT				Drawn By	J.Z.	Design By	
Scale	1:400	Date	07/18/2019	Check By	M.F.	Drawing			

ATTACHMENT G

TAC GDGCR – Excerpts

The Effect of Grade

Braking distances will increase on downgrades and decrease on upgrades. When the roadway is on a grade, formula 2.5.1 for braking distance is modified as follows:

$$d_b = \frac{V^2}{254 [(a/9.81) + G]} \quad (2.5.3)$$

Where:

- d_b = Braking distance (m)
- V = Design speed (km/h)
- a = Deceleration rate (m/s^2)
- G = Grade (m/m) (G is positive if vehicles uphill and negative if downhill)

It has been noted that many drivers, particularly those in automobiles, do not compensate completely (i.e., by acceleration or deceleration) for the changes in speed caused by grade. It should also be noted that in many cases the sight distance available on downgrades is greater than on upgrades, which can help to provide the necessary corrections for grade. The following **Table 2.5.3** summarizes the stopping sight distances on grades for a variety of design speeds.

Table 2.5.3: Stopping Sight Distance on Grades⁵⁵

Design Speed (km/h)	Stopping Sight Distance (m)					
	Downgrades (%)			Upgrades (%)		
	3	6	9	3	6	9
20	20	20	20	19	18	18
30	32	35	35	31	30	29
40	50	50	53	45	44	43
50	66	70	74	61	59	58
60	87	92	97	80	77	75
70	110	116	124	100	97	93
80	136	144	154	123	118	114
90	164	174	187	148	141	136
100	194	207	223	174	167	160
110	227	243	262	203	194	186
120	263	281	304	234	223	214
130	302	323	350	267	254	243

Table 9.9.4: Design Intersection Sight Distance – Case B1, Left Turn From Stop

Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance for Passenger Cars	
		Calculated (m)	Design (m)
20	20	41.7	45
30	35	62.6	65
40	50	83.4	85
50	65	104.3	105
60	85	125.1	130
70	105	146.0	150
80	130	166.8	170
90	160	187.7	190
100	185	208.5	210
110	220	229.4	230
120	250	250.2	255
130	285	271.1	275

Note: Intersection sight distance shown is for a stopped passenger car to turn left onto a two-lane highway with no median and grades 3% or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

Sight distance design for left turns at divided-highway intersections should consider multiple design vehicles and median width. If the design vehicle used to determine sight distance for a divided-highway intersection is larger than a passenger car, then sight distance for left turns will need to be checked for that selected design vehicle and for smaller design vehicles as well. If the divided-highway median is wide enough to store the design vehicle with a clearance to the through lanes of approximately 1 m at both ends of the vehicle, no separate analysis for the departure sight triangle for left turns is needed on the minor-road approach for the near roadway to the left. In most cases, the departure sight triangle for right turns (case B2) will provide sufficient sight distance for a passenger car to cross the near roadway to reach the median. Possible exceptions are addressed in the discussion of case B3.

Table 9.9.6: Design Intersection Sight Distance – Case B2, Right Turn from Stop, and Case B3, Crossing Maneuver

Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance for Passenger Cars	
		Calculated (m)	Design (m)
20	20	36.1	40
30	35	54.2	55
40	50	72.3	75
50	65	90.4	95
60	85	108.4	110
70	105	126.5	130
80	130	144.6	145
90	160	162.6	165
100	185	180.7	185
110	220	198.8	200
120	250	216.8	220
130	285	234.9	235

Note: Intersection sight distance shown is for a stopped passenger car to turn right onto or to cross a two-lane highway with no median and with grades of 3% or less. For other conditions, the time gap should be adjusted and the sight distance recalculated.

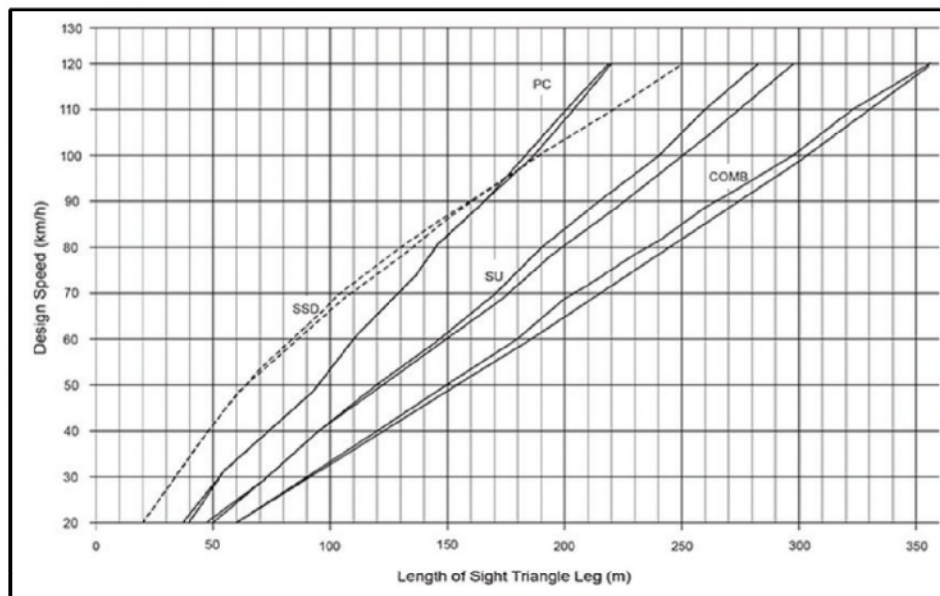


Figure 9.9.5: Intersection Sight Distance – Case B2, Right Turn from Stop, and Case B3, Crossing Maneuver (Calculated and Design Values Plotted)

Table 9.9.12: Intersection Sight Distance – Case F, Left Turn from the Major Road

Design Speed (km/h)	Stopping Sight Distance (m)	Intersection Sight Distance	
		Passenger Cars	
		Calculated (m)	Design (m)
20	20	30.6	35
30	35	45.9	50
40	50	61.2	65
50	65	76.5	80
60	85	91.7	95
70	105	107.0	110
80	130	122.3	125
90	160	137.6	140
100	185	152.9	155
110	220	168.2	170
120	250	183.5	185
130	285	198.8	200

Note: Intersection sight distance shown is for a passenger car making a left turn from an undivided highway. For other conditions and design vehicles, the time gap should be adjusted and the sight distance recalculated.

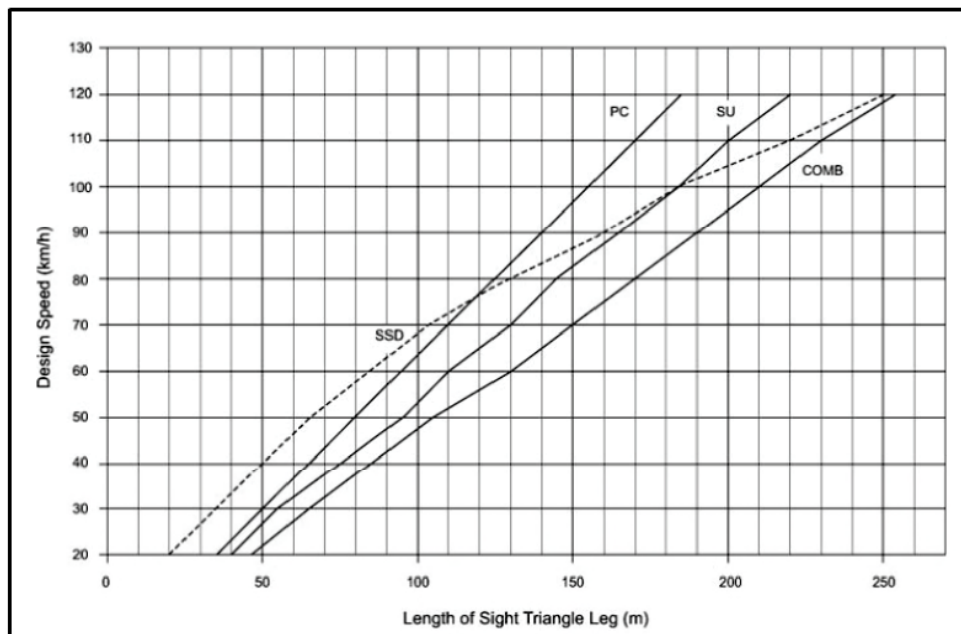
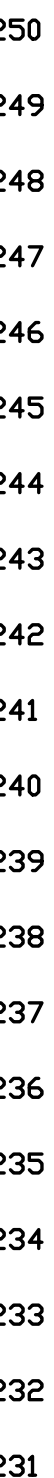
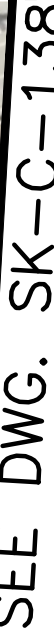


Figure 9.9.8: Intersection Sight Distance – Case F, Left Turn from the Major Road

ATTACHMENT H

Barrie Rail Corridor Expansion Project – Drawing SK-C-139



REFERENCE DRAWINGS		ISSUE		REVISIONS		DRAWN BY: K.D. 15/09/03	DESIGNED BY: K.D. 15/09/02	HATCH	 METROLINX An agency of the Government of Ontario	BARRIE RAIL CORRIDOR EXPANSION PRELIMINARY DESIGN DOUBLE TRACK PLAN AND PROFILE STA 98+500 TO STA 99+200			
						CHECKED BY: M.P. 17/07/25	APPROVED BY: S.D. 17/08/08						
						SCALE: FULL SIZE ONLY							
DWG NO.	TITLE	0	17/08/08	FINAL EPR			1:1000 H 1:100 V			NOT FOR CONSTRUCTION		CONTRACT NO.	DWG. NO. SK-C-139