

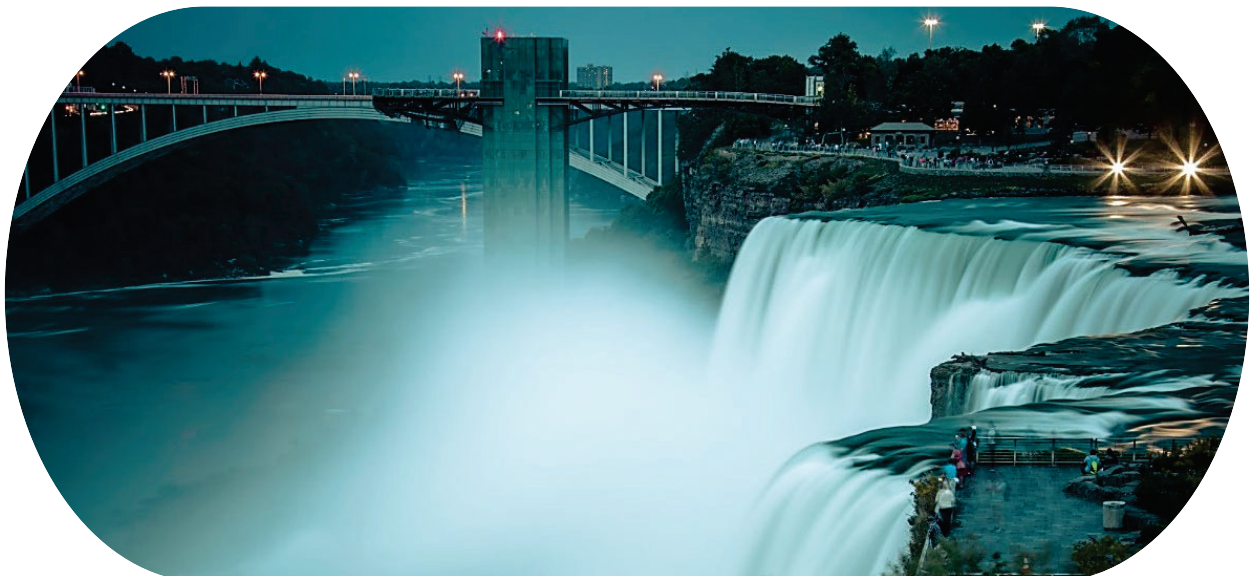
Prepared For:
Residence on Niagara Inc.



TRANSPORTATION IMPACT ASSESSMENT

FINAL REPORT

October 30, 2023



PROPOSED STACKED TOWNHOUSE DEVELOPMENT

5858, 5866, AND 5882 DUNN STREET

NIAGARA FALLS, ONTARIO



Prepared By:
Quinta International Inc.

www.quintainternational.com

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1 PROJECT OVERVIEW

Quinta **International** Inc. (QI) was retained by Residence on Niagara Inc. (RNI) to undertake Transportation Impact Assessment (TIA) and Parking Impact Analysis (PIA) for the proposed stacked townhouse development on 5858, 5866, and 5882 Dunn Street in Niagara Falls, Ontario. The Parking Impact Analysis (PIA) report will be submitted under a different cover.

The current land use on 5858, 5866, and 5882 Dunn Street is two single detached residential dwellings. Based on the latest version of the site plan received from RPD Studio on September 15, 2023, the client is proposing to demolish these two existing dwellings, to construct four (4) 3-storey stacked townhouse developments consisting of 72-units in total. Two (2) 3-storey stacked townhouses will comprise of 15 units and the other two (2) 3-storey stacked townhouses will contain 21 units.

One (1) new site driveway is proposed to service the site with accesses provided from Dunn Street. The abutting property on the west side i.e., Ailanthus Parking Lot, serves as an off-site valet parking lot for numerous hotel establishments in the area. Per an earlier traffic study undertaken in 2018, a westbound left-turn lane of 40 m storage length is warranted for Ailanthus Parking Lot (APL). The TIA will evaluate the need for extension of this left-turn storage bay length, based on the site trips generated from the proposed development.

Per this site plan, 79 parking spaces in total (i.e., 75 regular parking and 4 accessible parking) are proposed for this development, at a parking rate of 1.10 parking spaces/unit.

Below is an excerpt of the site plan in **Figure 1-1**, and the detailed version of the site plan is provided in **Appendix A**.



Figure 1-1: Excerpt of the Site Plan

This report has been prepared based on the scope of work identified in the pre-consultation comments received from Transportation department of the City of Niagara Falls (City), information provided by RPD Studios (RPD), meeting and discussion with the City's Transportation staff related to the Terms of Reference (TOR) that was submitted to the City, and approved methodology from industry approved standards and guidelines.

2 PROJECT SITE

The project site is located on the south side of Dunn Street, east of Orchard Avenue and west of Ailanthus Avenue. The proposed site driveway is located approximately 30 m to the east of the existing site driveway to the APL located on the west side. The location of project site with respect to the site driveway of the APL and Ailanthus Avenue, is shown in **Figure 2-1**.



Figure 2-1: Project Location and Adjacent Road Network

3 PRE-CONSULTATION

At the onset of the study, the following review agencies were contacted for their input on any specific issues or concerns related to this development: The City of Niagara Falls (City), and Regional Municipality of Niagara (Region). As part of the pre-consultation, terms of reference (TOR) were prepared and submitted to the City, and approval was received prior to undertaking the analysis.

The feedback received pertaining to TIA are summarized below:

- Evaluate the need to extend the approved 40 m westbound left turn storage length on Dunn Street at its intersection with Ailanthus Parking Lot, due to the additional trips from the proposed development.

4 TRANSPORTATION IMPACT ASSESSMENT

4.1 LITERATURE REVIEW

Ailanthus Parking Lot (APL) is proposed to provide off-site valet parking spaces for few linked hotels in the downtown area (i.e., Hyatt Centric Hotel, Tower Hotel, Embassy Hotel, Wyndham Hotel, etc.). As part of the Terms of Reference (TOR), the traffic study reports of hotel establishments linked to the APL for off-site valet operations were requested from City staff. Per TOR approved by City staff, we had received a copy of the following TIS reports:

- *Ailanthus Parking Lot – Traffic Study* dated July 6, 2018, including appendix (prepared by RVA)
- *TIS for Redevelopment of Corporate Office Parking Lot* dated October 25, 2021, including appendix (prepared by RVA)

A literature review was undertaken for the above-mentioned reports, to determine the left-turning vehicles accessing the APL during the design hours.

Per *Ailanthus Parking Lot – Traffic Study* dated July 6, 2018, under the Future Total 2028 scenario a westbound left-turn of 40 m storage length was proposed for Dunn Street at its intersections with existing APL East Driveway (shown in **Figure 2**), for a proposed parking supply of 1651 spaces. This storage was forecasted based on a westbound left-turning volume of 185 vehicles and 207 vehicles during the weekday PM peak hour and Saturday MD peak hour traffic conditions, respectively. Off-site valet parking spaces totalling to 771 spaces from three linked hotel establishments were considered in this study i.e., Four Points by Sheraton (368 spaces), Embassy Suites (108 spaces) and Marriot Fallsview (295 spaces). Per that report, out of 1651 spaces, 880 spaces (i.e., $1651 - 771 = 880$) were not linked to hotel facilities.

Subsequent to the submission and approval of the *Ailanthus Parking Lot – Traffic Study* dated July 6, 2018, few changes were proposed to the off-site valet parking operations from the above-mentioned linked hotel establishments to APL, and few are summarized below:

- Hyatt Centric Niagara Falls Hotel was proposed to provide off-site valet parking operations at APL. At the time of writing this report we had not received a copy of the *Hyatt Centric Hotel TIS report* dated 2019 that was requested. Therefore, the summary of information used in the subsequently submitted *TIS for Redevelopment of Corporate Office Parking Lot* dated October 25, 2021, report was used for this analysis.
- The land use intensity for the Hyatt Centric Niagara Falls Hotel development got reduced from 1200 rooms to 1095 rooms, which impacted the number of off-site valet parking spaces that were proposed at APL.

- Other valet parking lots were added in the area including Corporate Office Parking Lot (COPL), which were proposed to accommodate a portion of the off-site valet parking spaces from the above-mentioned four linked hotel establishments that were originally proposed at APL.
- *Ailanthus Parking Lot – Traffic Study* dated July 6, 2018, had considered trip generation rates from *ITE’s Trip Generation Manual* (10th edition) for LUC 310: Hotel, to determine the trip ends. This trip rate is for hotel establishments with regular parking and does not take into consideration the valet parking operations from hotel establishments.
- *Hyatt Centric Hotel Niagara Falls TIS* dated 2019/2020 and *TIS for Redevelopment of Corporate Office Parking Lot* dated October 25, 2021, had used a different methodology for trip generation. For these studies, Trip Generation for hotels with off-site valet parking service was determined during peak period of adjacent street traffic by combining the following two approaches:
 - *ITE’s Trip Generation Manual* (10th edition) methodology for determining the trip ends from Business Hotels (LUC 312) located within city centre core, and
 - Adjusting the trip ends determined from the above step by using observed trip generation values from a representative hotel development (i.e., Embassy Suites in Niagara Falls, located to the southeast quadrant of the intersection of Main Street/Portage Road with Fallsview Boulevard) located within the study area of this project. This Embassy Suites Hotel also provides off-site valet parking service, similar to these linked hotels. The adjustment to the trip ends obtained from the *ITE’s* methodology were made taking into consideration that the *ITE’s* trip generation rates provided in the manual are not for hotels with off-site valet parking service. As the *ITE* data constitute regular hotels with on-site parking spaces, these adjustment to the trip end values were required.
 - The peaking of hotel check-ins and check-outs are different from that of the peak hour of demand for the adjacent road network.

The trips from the following approved developments which would have an influence on the study corridor were already taken into consideration in the Future Total 2027 analysis of *TIS for Redevelopment of Corporate Office Parking Lot* dated October 25, 2021.

- 1) Hyatt Centric Niagara Falls Hotel
- 2) Niagara Falls Hotel by Rudan Holdings Ltd.
- 3) Ailanthus Parking Lot Expansion

As part of the TOR, any additional/updated studies that were undertaken since the submission of the *TIS for Redevelopment of Corporate Office Parking Lot* report dated October 25, 2021 was also requested. At the time of writing this report, per TOR approved by the City’s transportation staff, there were no other updated studies that would have an impact on the left-turning volume at the intersection of Dunn Street with APL East Driveway. Therefore, the left-turning volume from *TIS for Redevelopment of Corporate Office Parking Lot* report dated October 25, 2021 was used in this analysis for determining the left-turn storage requirement under the base condition.

In the absence of any other updated studies, the information available in the *TIS for Redevelopment of Corporate Office Parking Lot* report dated October 25, 2021 for westbound left-turning volumes at the

intersection of Dunn Street with APL East Driveway was used for determining the left-turn storage requirement for the base condition.

4.2 LEFT-TURNING TRIPS FROM THE PROPOSED DEVELOPMENT

The anticipated opening year for the proposed stacked townhouse development is 2024. The analysis period considered for this study is 2029 (5-year planning horizon). In approval from City’s transportation staff, the design hours considered for determining left-turn storage requirement were weekday PM peak hour and Saturday MD peak hour.

The land use code (LUC) considered for the proposed 3-storey stacked townhouse developments is LUC 220: Multifamily Housing (Low Rise). The four (4) stacked townhouses consisting of 72-units is anticipated to generate 37 trips in total (23 entry and 14 exit) during weekday PM peak hour. As sufficient data was not available in *ITE’s Trip Generation Manual* (11th edition) for this LUC 220 under the Saturday MD traffic condition, a comparison of the rates between 11th edition and the 10th edition was undertaken, to determine the adjustment factor. This adjustment factor was applied to determine the projected trips under the Saturday MD traffic condition. Based on this adjustment, four (4) stacked townhouses consisting of 72-units is anticipated to generate 51 trips in total (24 entry and 27 exit) during Saturday MD peak hour. The Trip Generation from the site is summarized in **Table 4-1**.

Table 4-1: Site Trip Generation Summary

TRIP GENERATION SUMMARY				
DESIGN HOUR	DEVELOPMENT TYPE	TOTAL	IN	OUT
Weekday PM Peak	Stacked Townhouse with 72 Units LUC 220: Multifamily Housing (Low Rise)	37	23	14
Saturday MD		51	24	27

Trip Distribution from the subject site were assigned based on traffic pattern along Dunn Street to the west side of APL East Driveway, to prevent the influence of valet parking operations from the linked hotel establishments that are located to the east. Based on this, the summary of Trip Distribution is furnished below:

- Weekday PM
 - West along Dunn Street → 58%
 - East along Dunn Street → 42%
- Saturday MD
 - West along Dunn Street → 50%
 - East along Dunn Street → 50%

Based on this Trip Distribution, there would be 13 and 12 westbound vehicles entering the proposed development during weekday PM peak hour and Saturday MD peak hour, respectively.

4.3 LEFT-TURN STORAGE LENGTH REQUIREMENT

Per information from the *TIS for Redevelopment of Corporate Office Parking Lot* report dated October 25, 2021, the westbound left-turning volumes on Dunn Street at its intersection with APL East Driveway, under Future Total 2027 weekday PM peak hour and Saturday MD peak hour traffic conditions are 83 vehicles and 82 vehicles, respectively. Additionally, per this report, the valet parking service from all the linked hotel developments were anticipated to be in operation by 2027 (i.e., before the horizon year of this study of year 2029).

Taking into consideration the site trips, the total vehicles using the exclusive left-turning storage bay would be 96 vehicles during the weekday PM peak hour and 94 vehicles during the Saturday MD peak hour.

A conservative analysis was undertaken using TMC from pre-pandemic 2018 traffic conditions and applying a traffic growth of 1% per annum, only to the eastbound and westbound through traffic. The Future Total 2029 traffic volumes under weekday PM and Saturday MD peak hours are shown in **Figures 4-1** and **4-2**, respectively.

Left-turn warrant analysis was undertaken to determine the requirement for a left-turn on Dunn Street at its intersection with the site driveway of the proposed development, under the Future Total 2029 design hour traffic conditions. The results showed a left-turn of 15 m storage length is warranted for the proposed site driveway under both the design hours i.e., weekday PM peak hour and Saturday MD peak hour.

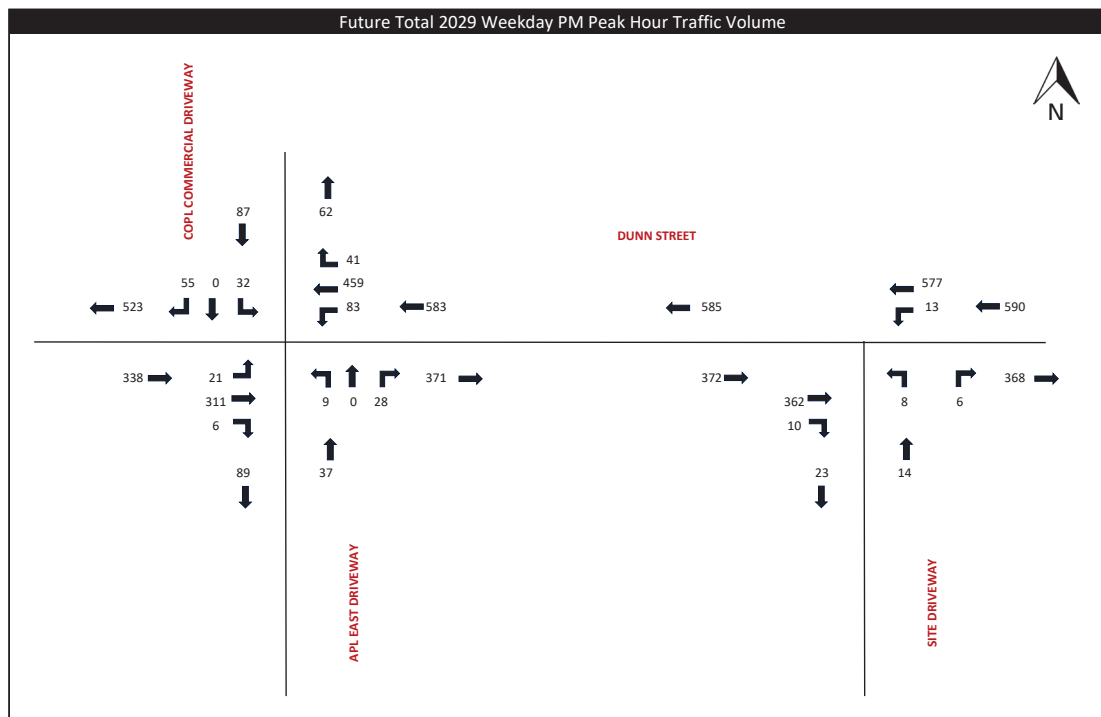


Figure 4-1: Future Total 2029 Weekday PM TMC

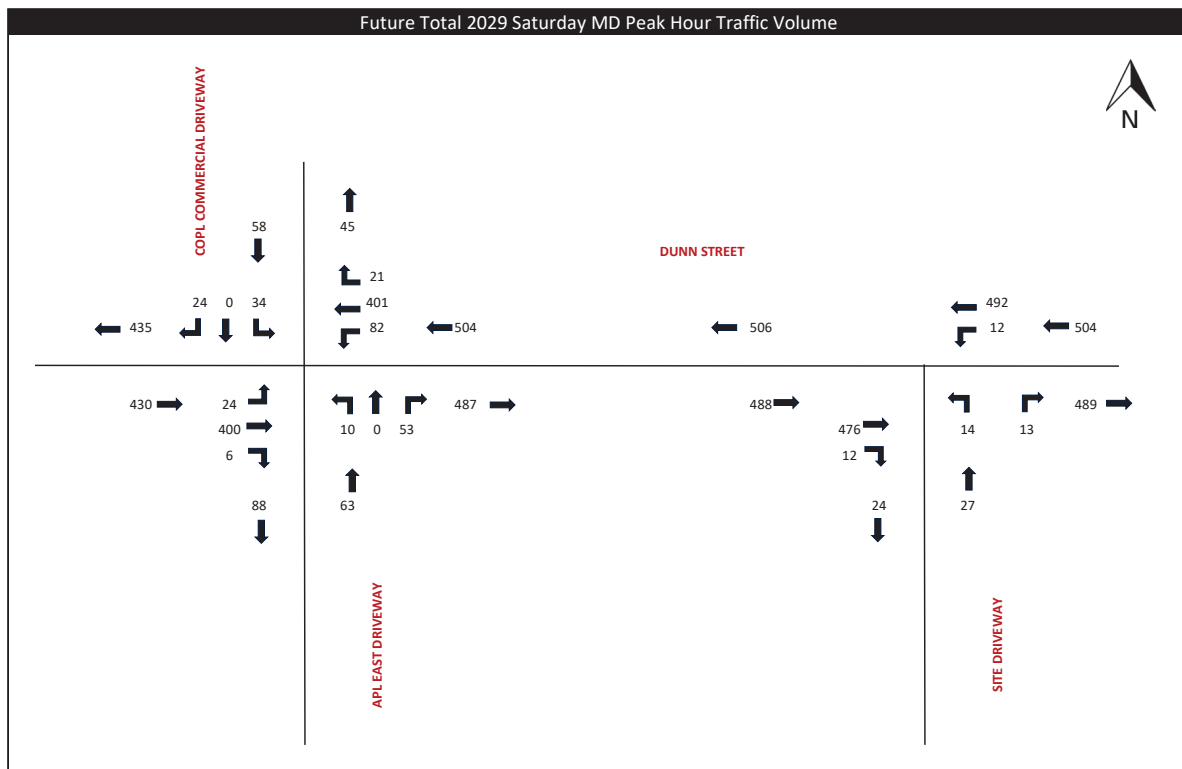


Figure 4-2: Future Total 2029 Saturday MD TMC

SimTraffic simulation was undertaken to determine the 95th percentile queue length for the left-turning vehicles. The results showed 95th percentile queue length of 5.6 m and 6.3 m (i.e., approximately 1 vehicle length), under the Future Total 2029 weekday PM peak hour and Saturday MD peak hour traffic conditions, respectively.

The proposed site driveway is located approximately 31.5 m to the east of the existing APL East Driveway (i.e., centreline to centreline distance). From the stop line, the 40 m storage bay length will extend approximately 18.5 m east of the centreline of the site driveway, thus providing a storage length of approximately 12.5 m east of the proposed site driveway. This storage length of 12.5 m east of the proposed site driveway can accommodate the 95th percentile queue length of 6.8 m (i.e., approximately one (1) vehicle length), for the proposed development under both the design hour traffic conditions.

Additionally, the storage length requirement of left-turning vehicles at APL East Driveway was carried out to determine if there would be a need to accommodate the spill over of left-turning vehicles into the storage area located to the east of the proposed site driveway. Based on the proposed location of the site driveway, a storage length of approximately 18 m is available for left-turning vehicles on Dunn Street between the APL East Driveway and the proposed site driveway. Based on the number of westbound left-turning vehicles, the left-turn warrant nomographs shows that a storage length of 25 m is required for the westbound movement on Dunn Street at the APL East Driveway, under both the design hour traffic conditions. A summary of analysis is shown in **Appendix C**.

The left-turn warrant nomographs showed signalization might be required under urban conditions. Therefore, SimTraffic simulation was undertaken for Two-Way-Stop-Control (TWSC) at APL East Driveway/COPL Driveway and proposed Site Driveway of RNI, to verify the operations at the study intersections. The SimTraffic simulation results showed the 95th percentile queue length is 13.9 m and 14.4 m (i.e., approximately 2 vehicle lengths), under the Future Total 2029 weekday PM peak hour and Saturday MD peak hour traffic conditions, respectively.

The lane configuration considered for this simulation was extension of the westbound left turn lane at APL East Driveway to the proposed intersection of Dunn Street with site driveway, to accommodate the storage of left-turning vehicles entering the APL East Driveway.

The SimTraffic simulation results shows the 95th percentile queue for westbound left-turns at APL East Driveway with Dunn Street, and the proposed site driveway at Dunn Street can be accommodated within the previously recommended storage length of 40 m recommended in the *Ailanthus Parking Lot – Traffic Study* dated July 6, 2018, under both the design hour traffic conditions i.e., weekday PM peak hour and Saturday MD peak hour. It is to be noted that this analysis was based on the left turning traffic volume information from the *TIS for Redevelopment of Corporate Office Parking Lot* report dated October 25. If any information has changed since then which will impact the left turning volumes at the intersection of Dunn Street with APL East Driveway, the analysis will need to be redone. The Synchro and SimTraffic reports are provided in **Appendix B**.

5 SUMMARY OF FINDINGS

Below is a summary of our findings from research, literature review, and analysis:

- The four (4) stacked townhouses consisting of 72-units is anticipated to generate 37 trips in total (23 entry and 14 exit) during weekday PM peak hour, and 51 trips in total (24 entry and 27 exit) during Saturday MD peak hour.
- Based on the Trip Distribution, there would be 13 and 12 westbound vehicles entering the proposed development during weekday PM peak hour and Saturday MD peak hour, respectively.
- A left-turn of 15 m storage length is warranted for the proposed site driveway under both the design hours i.e., weekday PM peak hour and Saturday MD peak hour.
- A storage length of 25 m is required for the westbound movement on Dunn Street at the APL East Driveway, under both the design hour traffic conditions.
- Based on the location of the proposed site driveway, the 40 m storage bay length will extend approximately 18.5 m east of the centreline of the site driveway, thus providing a storage length of approximately 12.5 m east of the proposed site driveway. This storage length of 12.5 m east of the proposed site driveway can accommodate the 95th percentile queue length of 6.8 m (i.e., approximately one (1) vehicle length), for the proposed development under both the design hour traffic conditions.
- SimTraffic simulation shows that the proposed westbound left-turn storage length of 40 m at the intersection of Dunn Street with Ailanthus Parking Lot can accommodate the left-turning site trips from this proposed development. It is to be noted that this analysis was based on the left turning traffic volume information from the *TIS for Redevelopment of Corporate Office Parking Lot* report

dated October 25. If any information has changed since then which will impact the left turning volumes at the intersection of Dunn Street with APL East Driveway, the analysis will need to be redone.

6 DISCLAIMER

This Traffic Impact Assessment report has been submitted to Residence on Niagara Inc. to be submitted to the City of Niagara Falls, as part of the OPA/ZBA and Site Plan application being made by RPD Studios. No changes or modifications should be made to this report or its contents, without written consent of QI. As this document is not directly submitted to the City of Niagara Falls by QI, we do not assume any responsibility for any changes that could be made to this report or its content, without our knowledge or written consent. QI does not assume any responsibility for the reliability of the data and/or information that was provided to us by the client and/or client's representatives. A copy of comments received from the City of Niagara Falls on this report will be required, for our records.

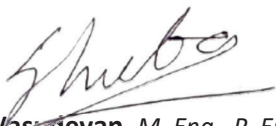
7 IN CLOSING...

This Traffic Impact Assessment report has been prepared based on the approved TOR from the City's Transportation staff. This report is intended solely for the purpose of review of the anticipated impact of the proposed development and is not to be used for detailed design. If the City's Transportation staff needs to verify the operations at the study intersections, a virtual meeting can be scheduled to run the SimTraffic simulation models, to show the operations at the study intersections.

During the review of this report, if you have any questions or need any additional clarification, please feel free to contact Sheeba Vasudevan by email at svasudevan@quintainternational.com or by a phone call at 289-700-8784.

Yours very truly,

QUINTA INTERNATIONAL INC.

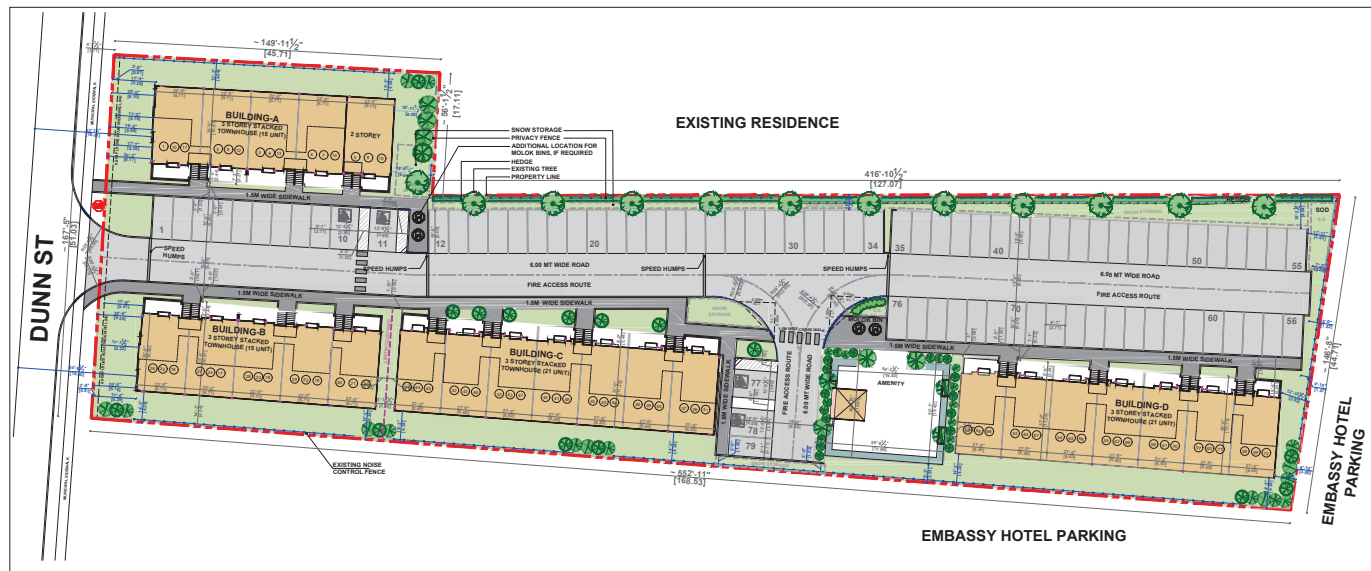


Sheeba Vasudevan, M. Eng., P. Eng.

Principal | Transportation Planning & Engineering

APPENDIX A

Site Plan



BUILDING	UNITS
A	15
B	15
C	21
D	21
TOTAL UNITS	72
REGULAR PARKING	75
BARRIER FREE PARKING	4
TOTAL PROPOSED PARKING	79 (1.10 PARKING / UNIT)

LOT AREA = 78577.72 SQ.FT (7300.11 SQ.MT.) - 100%
 LOT COVERAGE = 21854.26 SQ.FT (2030.33 SQ.MT.) - 27.81%

LEGEND:	
[Symbol]	DOWNSPOUT
[Symbol]	SNOW STORAGE
[Symbol]	S.L.T. SIGHT LIGHT TRIANGLE
[Symbol]	CONCRETE SIDEWALK
[Symbol]	PAINTED LINES
[Symbol]	PROPERTY LINE
[Symbol]	SOD
[Symbol]	ACCESSIBLE PARKING SPACE
[Symbol]	PRIVACY FENCE
[Symbol]	EXISTING NOISE CONTROL FENCE
[Symbol]	CURB CUT/DEPRESSED SIDE WALK

PRIMARY CONSULTANT & PROJECT MANAGER

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Consent to issue must check and verify all dimensions before issuing the work and final report drawings and shall not be used or revised without the approval of the engineer.
 All drawings, specifications and related documents are the copyright of the engineer and shall be returned upon request.
 The engineer shall be responsible for the design and construction of the work shown on these drawings and shall not be responsible for any errors or omissions.
 This drawing is not to be used for construction until signed and stamped by the engineer.

No.	Date	Version	Drawn
1.	03/09/2023	ISSUED FOR BIDDING BY LAW	

PROJECT:
STACKED TOWNHOMES DEVELOPMENT
 5858 DUNN STREET,
 NIAGARA FALLS, ON L2G 2P1
 CANADA

DRAWING TITLE:

DRAWN BY: DATE:




















CHECKED BY: SCALE: 1:250

PROJECT NO.: DRAWING NO.: **A-2.0**

APPENDIX B

Synchro and SimTraffic Report

Lanes, Volumes, Timings
3: APL East Driveway/COPL Driveway & Dunn St

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	24	400	6	82	401	21	10	0	53	34	0	24
Future Volume (vph)	24	400	6	82	401	21	10	0	53	34	0	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	15.0		0.0	40.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	1		0	0		0	0		0	0		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.992			0.887				0.944
Flt Protected	0.950			0.950				0.992				0.971
Satd. Flow (prot)	1789	1880	0	1789	1868	0	0	1657	0	0	1726	0
Flt Permitted	0.950			0.950				0.992				0.971
Satd. Flow (perm)	1789	1880	0	1789	1868	0	0	1657	0	0	1726	0
Link Speed (k/h)		50			50			25				25
Link Distance (m)		309.6			24.2			177.0				36.2
Travel Time (s)		23.2			2.2			13.3				2.7
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	26	435	7	89	436	23	11	0	58	37	0	26
Shared Lane Traffic (%)												
Lane Group Flow (vph)	26	442	0	89	459	0	0	69	0	0	63	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0				0.0
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Free			Free			Stop				Stop

Intersection Summary











Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	45.4%
ICU Level of Service	A
Analysis Period (min)	15

Intersection												
Int Delay, s/veh	3.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗			↕			↕	
Traffic Vol, veh/h	24	400	6	82	401	21	10	0	53	34	0	24
Future Vol, veh/h	24	400	6	82	401	21	10	0	53	34	0	24
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	15	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	26	435	7	89	436	23	11	0	58	37	0	26

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	459	0	0	442	0	0	1130	1128	439	1146	1120	448
Stage 1	-	-	-	-	-	-	491	491	-	626	626	-
Stage 2	-	-	-	-	-	-	639	637	-	520	494	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1102	-	-	1118	-	-	181	204	618	176	206	611
Stage 1	-	-	-	-	-	-	559	548	-	472	477	-
Stage 2	-	-	-	-	-	-	464	471	-	539	546	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1102	-	-	1118	-	-	160	183	618	147	185	611
Mov Cap-2 Maneuver	-	-	-	-	-	-	160	183	-	147	185	-
Stage 1	-	-	-	-	-	-	546	535	-	461	439	-
Stage 2	-	-	-	-	-	-	409	433	-	477	533	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s/v	0.5		1.4		15.1		28.7	
HCM LOS					C		D	

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	425	1102	-	-	1118	-	-	214
HCM Lane V/C Ratio	0.161	0.024	-	-	0.08	-	-	0.295
HCM Control Delay (s/veh)	15.1	8.3	-	-	8.5	-	-	28.7
HCM Lane LOS	C	A	-	-	A	-	-	D
HCM 95th %tile Q(veh)	0.6	0.1	-	-	0.3	-	-	1.2

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	476	12	12	492	14	13
Future Volume (vph)	476	12	12	492	14	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		0.0	10.0		0.0	0.0
Storage Lanes		0	1		0	0
Taper Length (m)			2.5		2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.997				0.935	
Flt Protected			0.950		0.975	
Satd. Flow (prot)	1878	0	1789	1883	1717	0
Flt Permitted			0.950		0.975	
Satd. Flow (perm)	1878	0	1789	1883	1717	0
Link Speed (k/h)	50			50	25	
Link Distance (m)	24.2			233.0	101.8	
Travel Time (s)	2.2			17.5	7.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	517	13	13	535	15	14
Shared Lane Traffic (%)						
Lane Group Flow (vph)	530	0	13	535	29	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 35.9% ICU Level of Service A
 Analysis Period (min) 15

Intersection						
Int Delay, s/veh	0.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑		↑	↑	↑	↑
Traffic Vol, veh/h	476	12	12	492	14	13
Future Vol, veh/h	476	12	12	492	14	13
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	10	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	517	13	13	535	15	14

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	530	0	1085 524
Stage 1	-	-	-	-	524 -
Stage 2	-	-	-	-	561 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1037	-	240 553
Stage 1	-	-	-	-	594 -
Stage 2	-	-	-	-	571 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1037	-	237 553
Mov Cap-2 Maneuver	-	-	-	-	237 -
Stage 1	-	-	-	-	594 -
Stage 2	-	-	-	-	564 -

Approach	EB	WB	NB
HCM Control Delay, s/v	0	0.2	17.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	327	-	-	1037	-
HCM Lane V/C Ratio	0.09	-	-	0.013	-
HCM Control Delay (s/veh)	17.1	-	-	8.5	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.3	-	-	0	-

Intersection: 3: APL East Driveway/COPL Driveway & Dunn St

Movement	EB	WB	NB	SB
Directions Served	L	L	LTR	LTR
Maximum Queue (m)	9.8	14.1	20.0	21.8
Average Queue (m)	2.4	6.1	9.7	9.7
95th Queue (m)	8.9	14.4	17.3	18.2
Link Distance (m)		11.3	169.6	28.8
Upstream Blk Time (%)		1		0
Queuing Penalty (veh)		3		0
Storage Bay Dist (m)	15.0			
Storage Blk Time (%)	0			
Queuing Penalty (veh)	0			



















Intersection: 6: Site Driveway & Dunn St

Movement	EB	WB	WB	NB
Directions Served	TR	L	T	LR
Maximum Queue (m)	3.2	9.2	7.7	15.4
Average Queue (m)	0.2	1.3	0.6	5.7
95th Queue (m)	2.4	6.6	4.8	13.7
Link Distance (m)	11.3		229.3	94.4
Upstream Blk Time (%)	0			
Queuing Penalty (veh)	0			
Storage Bay Dist (m)		10.0		
Storage Blk Time (%)		0	0	
Queuing Penalty (veh)		2	0	

Network Summary

Network wide Queuing Penalty: 6

Lanes, Volumes, Timings
3: APL East Driveway/COPL Driveway & Dunn St

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	21	311	6	83	459	41	9	0	28	32	0	55
Future Volume (vph)	21	311	6	83	459	41	9	0	28	32	0	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	15.0		0.0	40.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	1		0	0		0	0		0	0		0
Taper Length (m)	2.5			2.5			2.5			2.5		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997			0.988			0.899			0.915	
Flt Protected	0.950			0.950				0.988			0.982	
Satd. Flow (prot)	1789	1878	0	1789	1861	0	0	1673	0	0	1692	0
Flt Permitted	0.950			0.950				0.988			0.982	
Satd. Flow (perm)	1789	1878	0	1789	1861	0	0	1673	0	0	1692	0
Link Speed (k/h)		50			50			25			25	
Link Distance (m)		309.6			24.2			75.5			36.2	
Travel Time (s)		23.2			2.2			13.3			2.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	23	338	7	90	499	45	10	0	30	35	0	60
Shared Lane Traffic (%)												
Lane Group Flow (vph)	23	345	0	90	544	0	0	40	0	0	95	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	48.2%
ICU Level of Service	A
Analysis Period (min)	15












Intersection												
Int Delay, s/veh	3.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗			↕			↕	
Traffic Vol, veh/h	21	311	6	83	459	41	9	0	28	32	0	55
Future Vol, veh/h	21	311	6	83	459	41	9	0	28	32	0	55
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	15	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	23	338	7	90	499	45	10	0	30	35	0	60

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	544	0	0	345	0	0	1120	1112	342	1105	1093	522
Stage 1	-	-	-	-	-	-	388	388	-	702	702	-
Stage 2	-	-	-	-	-	-	732	724	-	403	391	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1025	-	-	1214	-	-	184	209	701	188	214	555
Stage 1	-	-	-	-	-	-	636	609	-	429	440	-
Stage 2	-	-	-	-	-	-	413	430	-	624	607	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1025	-	-	1214	-	-	152	189	701	167	194	555
Mov Cap-2 Maneuver	-	-	-	-	-	-	152	189	-	167	194	-
Stage 1	-	-	-	-	-	-	622	596	-	420	407	-
Stage 2	-	-	-	-	-	-	341	398	-	584	594	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s/v	0.5			1.2			15.8			22.5		
HCM LOS							C			C		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	373	1025	-	-	1214	-	-	299
HCM Lane V/C Ratio	0.108	0.022	-	-	0.074	-	-	0.316
HCM Control Delay (s/veh)	15.8	8.6	-	-	8.2	-	-	22.5
HCM Lane LOS	C	A	-	-	A	-	-	C
HCM 95th %tile Q(veh)	0.4	0.1	-	-	0.2	-	-	1.3

Lanes, Volumes, Timings
6: Site Driveway & Dunn St

						
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	362	10	13	577	8	6
Future Volume (vph)	362	10	13	577	8	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		0.0	10.0		0.0	0.0
Storage Lanes		0	1		0	0
Taper Length (m)			2.5		2.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.996				0.941	
Flt Protected			0.950		0.973	
Satd. Flow (prot)	1876	0	1789	1883	1724	0
Flt Permitted			0.950		0.973	
Satd. Flow (perm)	1876	0	1789	1883	1724	0
Link Speed (k/h)	50			50	25	
Link Distance (m)	24.2			233.0	60.3	
Travel Time (s)	2.2			17.5	7.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	393	11	14	627	9	7
Shared Lane Traffic (%)						
Lane Group Flow (vph)	404	0	14	627	16	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	40.4%
ICU Level of Service	A
Analysis Period (min)	15

Intersection						
Int Delay, s/veh	0.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑		↑	↑	↑	↑
Traffic Vol, veh/h	362	10	13	577	8	6
Future Vol, veh/h	362	10	13	577	8	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	10	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	393	11	14	627	9	7

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	404	0	1054 399
Stage 1	-	-	-	-	399 -
Stage 2	-	-	-	-	655 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1155	-	250 651
Stage 1	-	-	-	-	678 -
Stage 2	-	-	-	-	517 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1155	-	247 651
Mov Cap-2 Maneuver	-	-	-	-	247 -
Stage 1	-	-	-	-	678 -
Stage 2	-	-	-	-	511 -

Approach	EB	WB	NB
HCM Control Delay, s/v	0	0.2	16.2
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	336	-	-	1155	-
HCM Lane V/C Ratio	0.045	-	-	0.012	-
HCM Control Delay (s/veh)	16.2	-	-	8.2	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0	-

Intersection: 3: APL East Driveway/COPL Driveway & Dunn St

Movement	EB	EB	WB	WB	NB	SB
Directions Served	L	TR	L	TR	LTR	LTR
Maximum Queue (m)	9.5	0.7	13.2	1.8	19.8	25.3
Average Queue (m)	2.5	0.0	5.1	0.1	7.0	12.0
95th Queue (m)	9.0	0.7	13.2	1.5	15.8	20.9
Link Distance (m)		303.9	11.1	11.1	68.0	28.8
Upstream Blk Time (%)			1	0		0
Queuing Penalty (veh)			4	0		0
Storage Bay Dist (m)	15.0					
Storage Blk Time (%)	0					
Queuing Penalty (veh)	0					

Intersection: 6: Site Driveway & Dunn St

Movement	EB	WB	WB	NB
Directions Served	TR	L	T	LR
Maximum Queue (m)	5.6	9.2	9.7	10.9
Average Queue (m)	0.2	1.4	0.5	3.6
95th Queue (m)	3.5	6.8	5.0	10.8
Link Distance (m)	11.1		229.7	53.1
Upstream Blk Time (%)	0			
Queuing Penalty (veh)	0			
Storage Bay Dist (m)		10.0		
Storage Blk Time (%)		0	0	
Queuing Penalty (veh)		2	0	

Network Summary

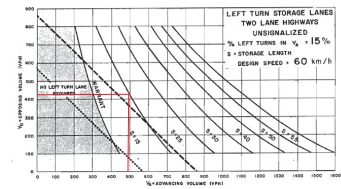
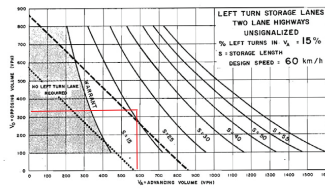
Network wide Queuing Penalty: 6

APPENDIX C

Left-turn Warrant Analysis

FUTURE TOTAL 2029 WEEKDAY PM AND SATURDAY MD PEAK LEFT-TURN WARRANT ANALYSIS - 5858, 5866 and 5882 DUNN STREET, NIAGARA FALLS, ONTARIO

Dunn Street with APL East Driveway		
Movement	WB Dunn St	
Time Period	Weekday PM	Saturday MD
Design Speed (km/h)	60	
Advancing Volume (Va) (veh/h)	574	496
Opposing Volume (Vo) (veh/h)	332	422
LT Volume (veh/h)	83	82
% LT	13%	14%
LT Warranted (Y/N)	Y	Y
Storage Length Required (m)	25	



Dunn Street with RNI Site Driveway		
Movement	WB Dunn St	
Time Period	Weekday PM	Saturday MD
Design Speed (km/h)	60	
Advancing Volume (Va) (veh/h)	579	494
Opposing Volume (Vo) (veh/h)	365	479
LT Volume (veh/h)	13	12
% LT	2%	2%
LT Warranted (Y/N)	Y	Y
Storage Length Required (m)	15	

