Response to Applicant
Form 4A

February 3, 2026

[redacted]

Dear [redacted]

Re: Your request for access to information under Part II of the **Access to Information and Protection of Privacy Act, 2015** [Our File # 2025-19]

On December 4, 2025, the Town of Paradise received your request for access to the following records/ information:

> *1. A copy of all traffic studies completed since 2015 by the Town of Paradise pertaining to the expansion in new residential developments where 5 or more homes were built.*
> *2. A letter from the Town of Paradise outlining the total number of new homes built on vacant lots each year since 2015*
> *3. A copy of The Town of Paradise internal policy regarding notification procedures" to be enacted upon by the town to inform/advise residents of new residential developments.*
> *4. A copy of The Town of Paradise internal policy used when residents have concerns/objections with new residential developments, and how many times since 2015 have this policy been enacted to deal with concerns from residents*
> *5. A copy of the Town of Paradise "residential development plan" and a copy of your "proposed" new residential development plan.*
> *6. A copy of the Town of Paradise internal procedural policy that the town employs during new residential developments to align the developments with the requirements of the Environmental Protection Act, The Wildlife Act, and the Animal Health and Protection Act.*
> *7. A letter outlining the square meters or acres of land given to the Town of Paradise since 2015 from residential developments that fulfilled the required 10% greenspace as per the Act.*
> *8. A letter from the town of Paradise indicating the square acres of land that have been developed for residential and commercial purposes for each year since 2015*

I am pleased to inform you that a decision has been made by the ATIPP Coordinator for the Town of Paradise to provide access to the requested records. Access to some of the information within the requested records has been refused in accordance with the following mandatory exception to disclosure, as specified in the Access to Information and Protection of Privacy Act, 2015 (the Act):

> *40. Disclosure harmful to personal privacy*
> *40.1. The head of a public body shall refuse to disclose personal information to an applicant where the disclosure would be an unreasonable invasion of a third party's personal privacy.*

Please be advised that you may ask the Information and Privacy Commissioner to review the processing of your access request, as set out in section 42 of the Access to Information and Protection of Privacy Act 2015 (the Act). A request to the Commissioner must be made in writing within 15 business days of the date of this letter or within a longer period that may be allowed by the Commissioner.

The address and contact information of the Information and Privacy Commissioner is as follows:

Office of the Information and Privacy Commissioner
2 Canada Drive
P. O. Box 13004, Stn. A
St. John's, NL. A1B 3V8
Telephone: (709) 729-6309 Toll-Free: 1-877-729-6309

You may also appeal directly to the Supreme Court within 15 business days after you receive the decision of the public body, pursuant to section 52 of the Act.

If you have any further questions, please feel free to contact me by telephone or email.

Sincerely,

Terrilynn Smith, CPA, CA
ATIPP Coordinator

ATIPP Response 2025-19

Summary of Requested Information

February 3, 2026

1. ***A copy of all traffic studies completed since 2015 by the Town of Paradise pertaining to the expansion in new residential developments where 5 or more homes were built.***

   Please see attached file "ATIPP Response 2025- – Traffic Studies" for responsive records related to this request.

2. ***A letter from the Town of Paradise outlining the total number of new homes built on vacant lots each year since 2015***

   Please see below for a table outlining the total number of new homes built on vacant lots each year since 2015.

Year	# of New Builds
2015	141
2016	137
2017	113
2018	106
2019	94
2020	95
2021	102
2022	148
2023	103
2024	182
2025	199 *(number as of December 22, 2025)*

3. ***A copy of The Town of Paradise internal policy regarding notification procedures" to be enacted upon by the town to inform/advise residents of new residential developments.***

   Provided the proposed residential development complies with the zoning requirements set out in the Town of Paradise's Development Regulations, there is no policy requiring notification of surrounding residents, as the development is a permitted use. Approval is granted through the public Committee of the Whole and Council meeting process.

4. ***A copy of The Town of Paradise internal policy used when residents have concerns/objections with new residential developments, and how many times since 2015 have this policy been enacted to deal with concerns from residents.***

   Any objections received from the public in relation to a proposed residential development are presented to Council for consideration, consistent with the requirements of the Towns and Local Service Districts Act. There is no formal written Town policy that enacts this process.

5. ***A copy of the Town of Paradise "residential development plan" and a copy of your "proposed" new residential development plan.***

   Please see below for two plans applicable to your request. There is currently no proposed new residential development plan.
   - *Town of Paradise Municipal Plan:* https://www.paradise.ca/en/government-and-engagement/Municipal-Plan.aspx#What-is-the-Municipal-Plan
   - *Town of Paradise's Recreation Master Plan:* https://www.paradise.ca/en/parks-recreation-and-culture/resources/Publications/Paradise-Recreation-Master-Plan-May-2019.pdf

6. ***A copy of the Town of Paradise internal procedural policy that the town employs during new residential developments to align the developments with the requirements of the Environmental Protection Act, The Wildlife Act, and the Animal Health and Protection Act.***

   No records responsive. There is no internal procedural policy governing new residential developments to ensure alignment with the requirements of the Environmental Protection Act, the Wildlife Act, and the Animal Health and Protection Act. The Town complies with applicable requirements or directives issued by the appropriate regulatory authorities under these pieces of legislation.

7. ***A letter outlining the square meters or acres of land given to the Town of Paradise since 2015 from residential developments that fulfilled the required 10% greenspace as per the Act.***

   Since 2015, approximately 33.4 acres of land have been conveyed to the Town of Paradise through residential developments to satisfy the required 10% greenspace provision.

8. **A letter from the Town of Paradise indicating the square acres of land that have been developed for residential and commercial purposes for each year since 2015**

   Due to the duration and overlapping nature of subdivision development and construction phases, it is not feasible to accurately determine land acreage of land developed on a year-by-year basis.

   The estimated total acreage of land developed for residential purposes between 2015 and 2025 is approximately 334 acres, and for commercial purposes is approximately 55.6 acres. Please note that figures are approximate and were not obtained from an existing record. The tables below have been created specifically in response to this request and summarize a breakdown of subdivision, open space, and commercial sizes for the requested timeframe.

2015 - 2025 Subdivision Sizes		
Subdivision Name	**Area**	**Square Meters**
Willowbanks Phase 3A and 3B	26,007.2 sq. m	26007.2
Willowbanks Phase 1	36, 277.8 sq. m	36277.8
Emerald Ridge Phase 1, 2 and 3	8.61 hectares	86100
Fairview Estates Phase 2	9 acres	36421.7
Fairview Estates Phase 3	13.2 acres	53418.5
Fairview Estates Phase 4	7 acres	28328
Fairview Estates Phase 6B	14.6 Acres	59084.1
Fairview Estates Phase 6A	4.0 acres	16187.4
Woodstock Gardens Phase 5A	1.45 hectares	14500
Woodstock Gardens Phase 5B	0.86 hectares	8600
Sunset Gardens Nicholas Quinn Place	1.9 Acres	7689
Marketridge Phase 1A and 1B	9.1 Acres	36826.4
Picco Ridge Phase 1	6.6 hectares	66000
Picco Ridge Phase 2	2.68 Acres	10845.58
Jonathan Park Phase 1 and 2	13 Acres	52609.1
Lake Wynds Phase 1,2 and 3	7.5 hectares	75000
Lakeside Phase 5,6A,6B,7 and 8	114,582.321 sq. m	114582.321
Neils Pond Estates Phase 3	2.9 Acres	11735.9
Elizabeth Park Phase 25A	0.7 acres	2832.8
Elizabeth Park Phase 26	2.6 acres	10521.8
Elizabeth Park Phase 24	13 acres	52609.1
Adams Pond Phase 5C-A and 5C-B	51, 824 sq. m	51824
Adams Pond Phase 7A	7.9 acres	31970.2
Adams Pond Phase 7B	7.8 acres	31565.5
Adams Pond Phase 7C	6.7 acres	27113.9
Adams Pond Phase 8	0.98 Acres	3965.919
Balsomwood Subdivision	27 Acres	109265
Batson Subdivision 5 Lots	30253.5 sq. m	30253.5
Castleview Estates Phase 1	13 acres	52609.1
Grand Meadows Phase 3	6.9 acres	27923.3
Grand Meadows Phase 4	3.8 acres	15378.1
Grand Meadows Phase 5	7.0 acres	28328
Grand Meadows Phase 7	7.6 acres	30756.1
Grand Meadows Phase 8	3.2 acres	12949.9
Corcorans Road Infill 4 lots	4887 sq. m	4887
O'Briens Way Infill 4 lots	4816 sq. m	4816
Paradise Ridge Phase 8	5.47 hectares	54700
Pleasantview Park Phase 4	5.9 acres	23876.5
Christoper Street 6 lot infill	0.5 acres	2023.43
	Total Square Meters	1350382.15
	Total Acres	333.68
	10% of Open Space	33.368

Commercial Location	Size Acres
Civic # 1103 Kenmount Road	0.68
Civic # 1107-1119 Kenmount Road	1.19
Civic # 1121 Kenmount Road	1
Civic # 1127-1131 Kenmount Road	1
Civic # 1155 Kenmount Road	14
Civic # 1108 Kenmount Road	1.2
Civic # 1184 Kenmount Road	1.99
Civic # 1641 Topsail Road	11.3
Civic # 1621 Topsail Road	5.7
Civic # 1570 Topsail Road	0.7
Civic # 1483 Topsail Road	0.9
Civic # 1495 Topsail Road	1.8
Civic # 1448 Topsail Road	0.9
Civic # 1378 Topsail Road	0.9
Civic # 1366 Topsail Road	1.5
Civic # 1324 Topsail Road	0.8
Civic # 4 Elizabeth Drive	0.7
Civic # 1318 Topsail Road	0.6
Civic # 1297 A Topsail Road	2
Civic # 1694 Topsail Road	1.26
Civic # 1923 Topsail Road	5.5
Total Acres	55.62

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February 26, 2021 Project No. 212011

Danny Madden
Dynamic Engineering
62 Campbell Avenue
St. John's, NL A1E 2Z6
DJMadden@dynamicengineering.ca *(sent via e-mail)*

RE: Adams Pond Subdivision, Paradise, NL – Traffic Impact Assessment

Danny,

Harbourside Transportation Consultants has completed a traffic impact assessment relating to the development of a residential subdivision in the Adams Pond area of Paradise, Newfoundland and Labrador.

1 Site Context

The proposed development is located on the south side of Paradise Road between Starlight Drive and Archibald Drive. The site context is illustrated in Figure 1.

Figure 1: Site context Paradise, NL

Paradise Road is a collector roadway that runs from Topsail Road to St. Thomas Line. The majority of Paradise Road has been upgraded to a three-lane urban cross section, with sidewalks on one or both sides (Figure 2). The segment of Paradise Road between Holland Place and Archibald Drive is the only segment that remains as a two-lane roadway with no curb, gutter and /or sidewalk (Figure 3). Upgrades to this segment however are expected to be completed by the end of 2021. Paradise Road has a posted speed limit of 50 km/hr.

Figure 2: Three-lane cross section on Paradise Road

Figure 3: Two-lane cross section on Paradise Road

Starlight Drive is a local roadway with a two-lane cross section. The width of the roadway driving surface is approximately 9.0 metres. There is curb and gutter on one side and curb, gutter and sidewalk on the other side (Figure 4). Starlight Drive has a posted speed limit of 50 km/h.

The intersection of Paradise Road and Starlight Drive is an unsignalized intersection with stop control on the Starlight Drive approach. There is currently no left turn storage lane on Paradise Road at the intersection, however, a left turn lane will be provided once the upgrades on Paradise Road are completed in 2021.

Figure 4: Cross section on Starlight Drive

Archibald Drive is a local cul-de-sac roadway with a two-lane cross section. The width of the roadway driving surface is approximately 6.0 metres. There is no curb, gutter or sidewalk on either side (Figure 5). Archibald Drive has a posted speed limit of 30 km/h.

The intersection of Paradise Road and Archibald Drive is an unsignalized intersection with stop control on the Archibald Drive approach. A left turn lane is provided on Paradise Road at the intersection.

Figure 5: Cross section on Archibald Drive

2 Traffic Volumes

Existing traffic data available through the Town of Paradise was reviewed. Available counts included:

- November 2015 turning movement count at the intersection of St. Thomas Line and Paradise Road
- February 2016 turning movement count at the intersection of Topsail Road and Paradise Road
- November 2019 average daily traffic count on Paradise Road north of Topsail Road

A comparison of the 2016 and 2019 traffic volumes on Paradise Road north of Topsail Road is shown in Table 1. The comparison indicates decreases in traffic volumes both northbound and southbound on Paradise Road during the morning peak hour. During the afternoon peak hour, the comparison indicates a decrease in southbound traffic volumes and an increase in northbound traffic volumes. In order to remain conservative, no adjustments were made to the 2015/2016 turning movement counts to approximate current conditions.

Table 1: Comparison of traffic volumes on Paradise Road north of Topsail Road

Traffic Volumes	Weekday AM			Weekday PM		
	Northbound	Southbound	Total	Northbound	Southbound	Total
February 2016	167	708	875	685	365	1050
November 2019	138	696	834	799	327	1126
Percentage Difference	-17.4%	-1.7 %	-4.7%	16.6%	-10.4%	7.2%

There are no turning movement counts for the intersections of Paradise Road and Starlight Drive and Paradise Road and Archibald Drive. To approximate traffic volumes at these intersections, the turning movement count at the intersection of St. Thomas Line and Paradise Road was used to approximate through traffic volumes on Paradise Road.

Traffic volumes on Archibald Drive and Starlight Drive were estimated using vehicle trip generation rates for the existing houses accessed from each roadway, approximately 25 houses on Archibald Drive and approximately 65 houses on Starlight Drive (include Brisbane Court, Rembrant Boulevard and Lanark Drive).

The vehicle trip generation estimates for the development were quantified using trip generation rates from the 10th edition of the Institute of Transportation Engineers (ITE) *Trip Generation Manual*. The weekday morning (AM) and afternoon (PM) peak hour trip generation estimates for each roadway are summarized in Table 2.

Table 2: Trip generation estimates for Archibald Drive and Starlight Drive

Land Use[1]	Quantity		Trip Generation Rates[2]						Trips Generated[3]					
			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
			Rate	In	Out	Rate	In	Out	Total	In	Out	Total	In	Out
Archibald Drive														
210 - Single-Family Detached Housing	25	Units	0.74	25%	75%	0.99	63%	37%	19	5	14	25	16	9
Starlight Drive														
210 - Single-Family Detached Housing	65	Units	0.74	25%	75%	0.99	63%	37%	48	12	36	64	40	24

1. Land use codes are from the Trip Generation Manual, 10th edition, Institute of Transportation Engineers, 2017.
2. Average rate weekday, peak hour of adjacent street traffic. Trip generation rates are in 'vehicles per hour per unit.'
3. Trips generated are in 'vehicles per hour'.

The trip generation estimates for each roadway were distributed at the intersections using the following trip distribution:

- 10 percent travelling to/from St. Thomas Line (to/from the west)
- 90 percent travelling to/from Topsail Road (to/from the east)

The existing traffic volumes throughout the study are illustrated in Figure 6.

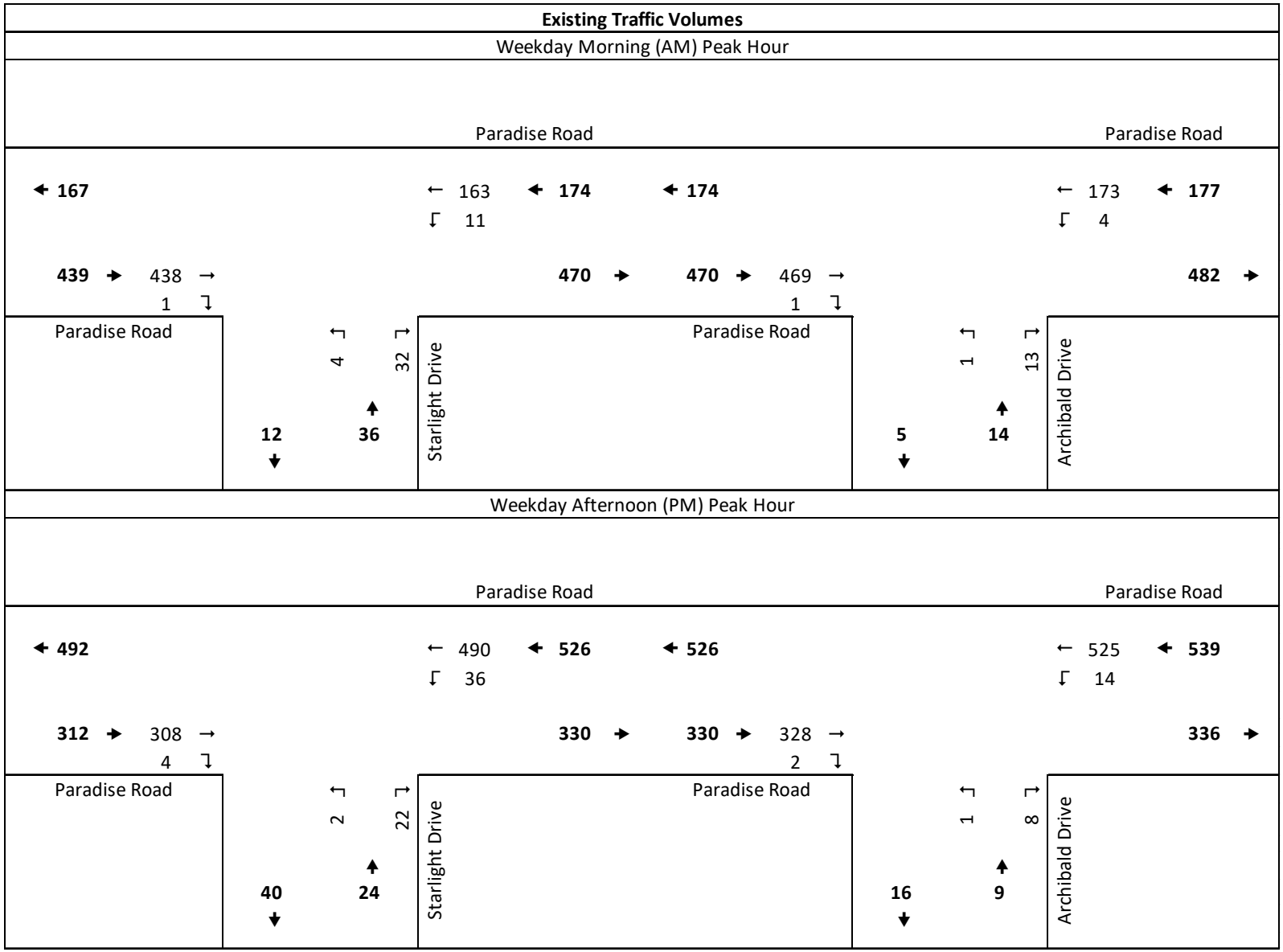

Figure 6: Existing traffic volumes

3 Proposed Development

The proposed subdivision will include 127 residential units in the first two phases of the development and an additional 20 residential units in the future third phase of the development, for a total of 147 residential units. All 147 units will be located along the proposed internal road network. The proposed road network will extend Lanark Drive between Tudor Avenue and Archibald Drive and extend Rembrant Boulevard from Tudor Avenue to a new crescent shaped roadway (currently referred to as Street 'A'). Until Lanark Drive is further extended to the East and/or West, the proposed subdivision will be accessed through Archibald Drive and Starlight Drive. The proposed site development plan is shown in Figure 7.

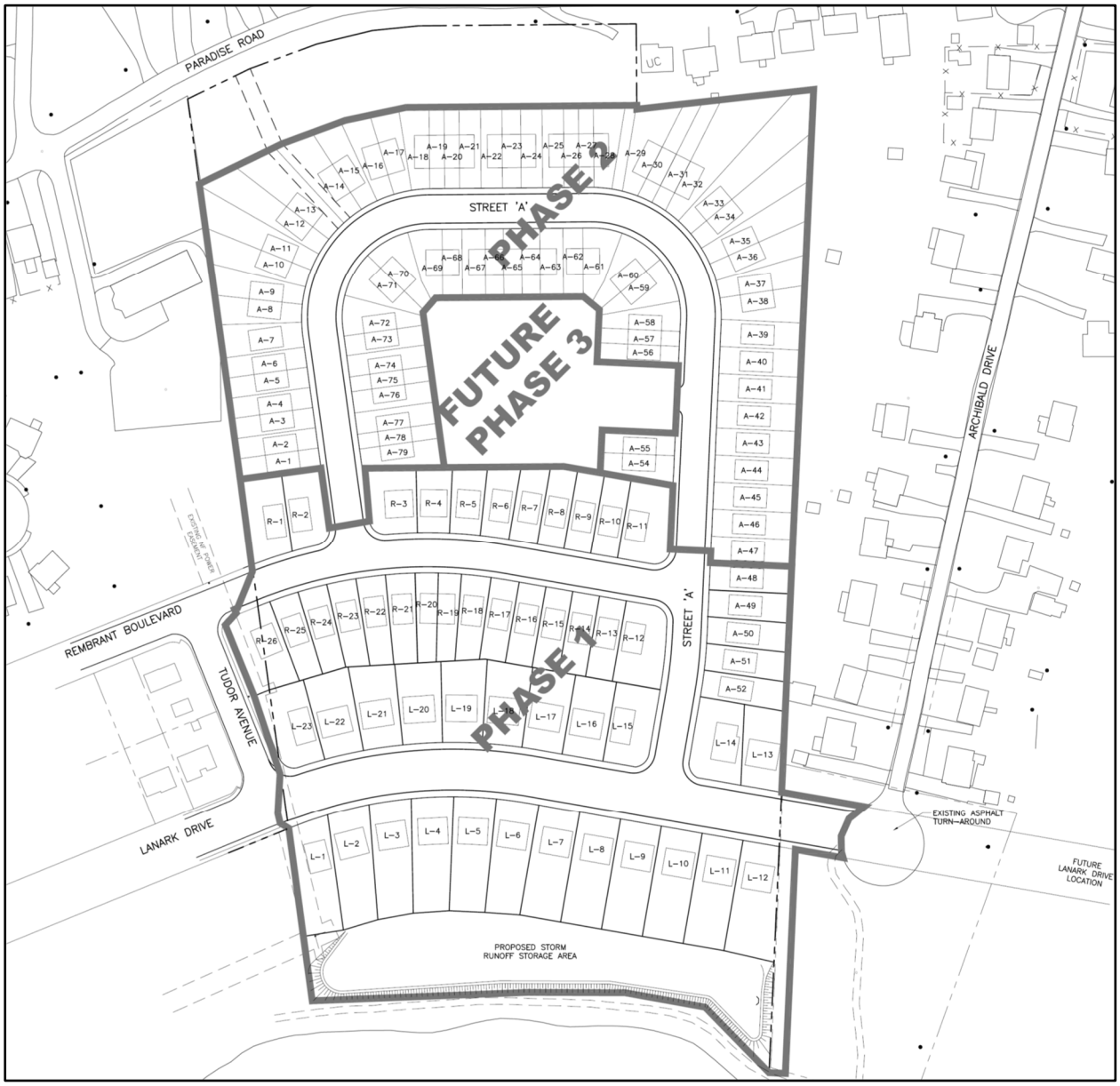

Figure 7: Proposed Site Development Plan

The plans have not been reviewed in detail with respect to adherence to the Town's guidelines for curb radii, street centreline radii, etc. as this is typically completed as part of the Town's review process. For the most part, the proposed street network is the 'natural' extension of both Lanark Drive and Rembrant Boulevard. No issues are noted with respect to the proposed intersections of Rembrant Boulevard at Street 'A' (west), Rembrant Boulevard at Street 'A' (east), or Lanark Drive at Street 'A'. The 'final' layout of the intersection of Lanark Drive at Archibald Drive is not shown on this concept plan and should be addressed on the final development plans.

Sight distance was also reviewed for the proposed access to Future Phase 3 as there is a horizontal curve looking left (to the North) when exiting this proposed access. At the intersection of two low volume local roadways such as this, stopping sight distance is typically considered to be adequate. For a design speed of 50 km/h, minimum stopping sight distance is 65 metres. Stopping sight distance for 40 km/h is 50 metres, Harbourside does not recommend sight distance less than this, regardless of the posted speed. Speed limits within the Town of Paradise are 40km/h unless otherwise posted, and due to the tight centreline radii on the crescent portion of proposed Street 'A', typical operating speeds are likely to be lower than 50km/h for vehicles approaching the proposed access from the North. 50m of sight distance is available within the street ROW looking North from the proposed Phase 3 access. In general terms, it is also noted that the proposed level of development is fairly dense and the close proximity of driveways will limit opportunities for on street parking.

Primary access to the proposed development will be via Archibald Drive and Starlight Drive. Available sight distance at these existing intersections was reviewed with respect to the minimum stopping sight distance and turning sight distance requirements of the Transportation Association of Canada's (TAC) *Geometric Design Guide for Canadian Roads.* As noted above, minimum stopping sight distance for a roadway with a design speed of 50 km/h is 65 metres. Minimum turning sight distance requirements for a two-lane roadway with a design speed of 50 km/h are:

- Minimum turning sight distance – left-turn from stop = 105 metres
- Minimum turning sight distance – right-turn from stop = 95 metres

3.1.1 Paradise Road and Archibald Drive

The intersection of Paradise Road and Archibald Drive is an unsignalized intersection with stop control on the Archibald Drive approach. Minimum stopping sight distance is available in both directions along Paradise Road.

Looking to the east from the Archibald Drive approach there is approximately 75 metres of sight distance along Paradise Road, this sight line is affected by a horizontal curve on Paradise Road and the presence of a utility pole and trees (Figure 8). While the minimum turning sight distance of 105 metres is not satisfied, the following points are noted: minimum stopping sight distance is available, this is an existing intersection that has been in place and operating for a number of years, the volume of 'post-development' left turning traffic is anticipated to remain very low (likely less than 1 per hour in the peak hour periods) as most drivers heading West from this development will be more likely to exit through Starlight Drive. There is more than 95 metres of tuning sight distance available looking to the west from the Archibald Drive approach (Figure 9).

Figure 8: Sight distance at Archibald Drive looking to the right (east)

Figure 9: Sight distance at Archibald Drive looking to the left (west)

3.1.2 Paradise Road and Starlight Drive

The intersection of Paradise Road and Starlight Drive is an unsignalized intersection with stop control on the Starlight Drive approach. There is no left turn lane on Paradise Road at the intersection, however, a left turn lane will be provided once the upgrades on Paradise Road are completed in 2021.

Minimum stopping sight distance is available in both directions along Paradise Road. There is over 105 metres of tuning sight distance available looking to the east (Figure 10) and over 95 metres looking to the west (Figure 11) of the Starlight Drive approach.

Figure 10: Sight distance at Starlight Drive looking to the right (east)

Figure 11: Sight distance at Starlight Drive looking to the left (west)

3.2 Trip Generation, Distribution and Assignment

The vehicle trip generation estimates for the development were quantified using trip generation rates from the 10th edition of the Institute of Transportation Engineers (ITE) *Trip Generation Manual*. The weekday morning (AM) and afternoon (PM) peak hour trip generation estimates for the proposed development are summarized in Table 3. On a typical weekday, the proposed development is expected to generate 104 vehicle trips in the morning peak hour (26 trips entering, 78 trips exiting) and 138 vehicle trips in the afternoon peak hour (87 trips entering, 51 trips exiting). An additional 15 AM peak hour trips and 20 PM peak hour trips along Paradise Road are also reflected in the future volumes to account for possible 'infill' unit development along Paradise Road between Starlight Drive and Archibald Drive that is not specifically related to this proposed development.

The trip generation estimates for the development were distributed at the intersections using the following trip distribution:

- 10 percent travelling to/from St. Thomas Line (to/from the west)
- 90 percent travelling to/from Topsail Road (to/from the east)

Trips from the internal road network travelling to/from St. Thomas Line were assigned to the Starlight Drive intersection. For trips from the internal road network travelling to/from Topsail Road, 80 percent were assigned to the Archibald Drive intersection and 20 percent to the Starlight Drive intersection.

The development traffic volumes distributed throughout the study area are illustrated in Figure 12. The development traffic volumes were added to the existing traffic volumes to develop estimates for future traffic volumes with the full build out of the development. The future traffic volumes throughout the study area are illustrated in Figure 13.

Table 3: Trip generation estimates

Land Use[1]	Quantity		Trip Generation Rates[2]						Trips Generated[3]					
			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
			Rate	In	Out	Rate	In	Out	Total	In	Out	Total	In	Out
Phase 1														
210 - Single-Family Detached Housing	54	Units	0.74	25%	75%	0.99	63%	37%	40	10	30	53	33	20
Phase 2														
210 - Single-Family Detached Housing	56	Units	0.74	25%	75%	0.99	63%	37%	41	10	31	55	35	20
220 - Multifamily Housing (Low-Rise)	17	Units	0.46	23%	77%	0.56	63%	37%	8	2	6	10	6	4
Future Phase 3														
210 - Single-Family Detached Housing	20	Units	0.74	25%	75%	0.99	63%	37%	15	4	11	20	13	7
Total Trips Generated									**104**	**26**	**78**	**138**	**87**	**51**

1. Land use codes are from the Trip Generation Manual, 10th edition, Institute of Transportation Engineers, 2017.
2. Average rate weekday, peak hour of adjacent street traffic. Trip generation rates are in 'vehicles per hour per unit.'
3. Trips generated are in 'vehicles per hour'.

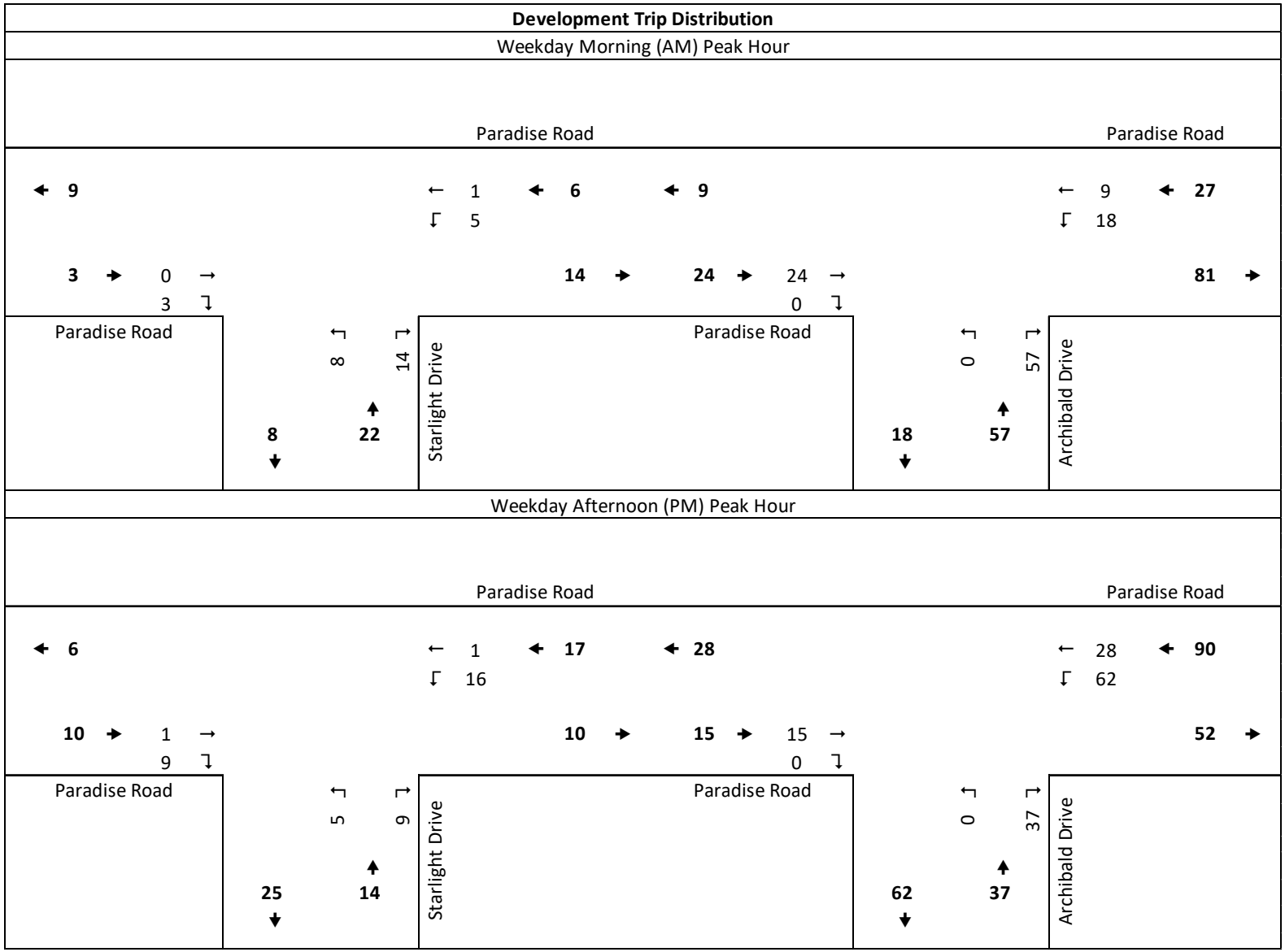

Figure 12: Distribution of development traffic volumes

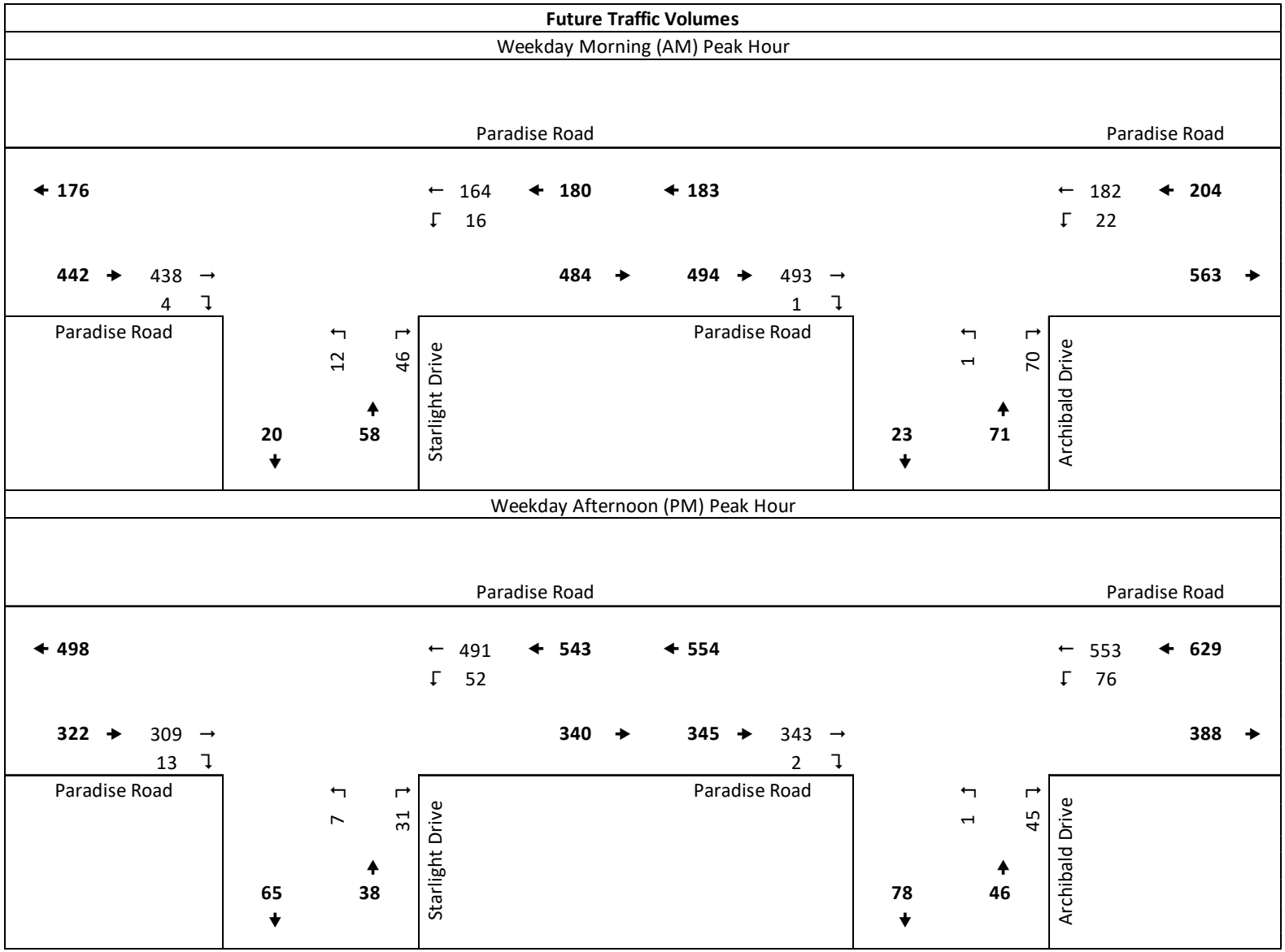

Figure 13: Future traffic volumes

4 Traffic Analysis

Synchro Studio 11 software was used to evaluate the existing and future performance at the unsignalized intersections of Paradise Road and Archibald Drive and Paradise Road and Starlight Drive. The performance of an intersection can be evaluated using a number of measures of effectiveness (MOEs), including level of service (LOS), delay, volume-to-capacity ratio (v/c) and vehicle queuing.

Level of service is a qualitative measure used to describe the level of performance of an intersection in terms of traffic movement. Level of service is a measure of driver discomfort, frustration and increased travel time. The quality of traffic movement is divided into six levels ranging from A to F, where level of service A represents the best quality of traffic where the driver has the freedom to drive with free flow speed and level of service F represents the worst quality of traffic where the level of congestion is considered unacceptable to most drivers. The level of service criteria for intersections are stated in Table 4 in terms of average control delay per vehicle.

Table 4: Level of Service Criteria

Level of Service	Description	Signalized Control Delay	Unsignalized Control Delay
A	No congestion; most vehicles do not stop. (Excellent)	≤ 10 sec/veh	≤ 10 sec/veh
B	Very light congestion; some vehicles stop. (Very Good)	10-20 sec/veh	10-15 sec/veh
C	Light congestion; most vehicles stop. (Good)	20-35 sec/veh	15-25 sec/veh
D	Noticeable congestion; vehicles must sometimes wait through more than one red light. No long-standing queues. (Satisfactory)	35-55 sec/veh	25-35 sec/veh
E	Congestion; vehicles must often wait through more than one red light. Long-standing queues are formed. (Unsatisfactory)	55-80 sec/veh	35-50 sec/veh
F	Severe congestion; demand exceeds the capacity of the intersection. (Unacceptable)	≥ 80 sec/veh	≥ 50 sec/veh

Volume-to-capacity (v/c) ratio is a measure of how the peak hour traffic volume on an approach to an intersection compares to the theoretical maximum volume that could be accommodated on that intersection approach. As the v/c ratio approaches 1.0, the movement has reduced ability to accommodate any additional volume of traffic.

The 95th percentile queue (95th% queue) is the estimated length in metres of a queue of vehicles stopped on an intersection approach which is only exceeded five percent of the time. Since a stopped vehicle occupies approximately seven metres of queue length, a 95th% queue of 14 metres indicates that less than five times of out 100 the queue may exceed two vehicles on the approach. The 95th% queue is typically used to determine if sufficient vehicle storage is available to maintain efficient traffic flow.

4.1 Existing Conditions

The performance of the unsignalized intersections during the morning and afternoon peak hours of traffic was evaluated under existing conditions. The MOE results including delay, level of service, volume-to-capacity ratio, average queue lengths and 95th percentile queue lengths for each intersection are summarized in Table 5. The detailed Synchro reports detailing the results of the analysis can be found in Appendix A.

The analysis indicates that both intersections operate at acceptable levels of service with minimal delay and queuing during the peak hours.

Table 5: Existing intersection performance

Intersection Performance - Existing Conditions, AM Peak Hour								
Paradise Road & Archibald Drive		Paradise Road				Archibald Drive		Overall Intersection
		EB-T	EB-R	WB-L	WB-T	NB-L	NB-R	
Delay (sec/veh)		0.0	0.0	8.4	0.0	11.8		0.3
LOS		A	A	A	A	B		A
v/c		-	-	0.00	-	0.03		
Queue	95th%ile (m)	-	-	0.0	-	0.8		
Paradise Road & Starlight Drive		Paradise Road				Starlight Drive		Overall Intersection
		EB-T	EB-R	WB-L	WB-T	NB-L	NB-R	
Delay (sec/veh)		0.0	0.0	8.4	0.0	11.9		0.8
LOS		A	A	A	A	B		A
v/c		-	-	0.01	-	0.07		
Queue	95th%ile (m)	-	-	0.0	-	1.5		
Intersection Performance - Existing Conditions, PM Peak Hour								
Paradise Road & Archibald Drive		Paradise Road				Archibald Drive		Overall Intersection
		EB-T	EB-R	WB-L	WB-T	NB-L	NB-R	
Delay (sec/veh)		0.0	0.0	8.0	0.0	11.2		0.2
LOS		A	A	A	A	B		A
v/c		-	-	0.01	-	0.02		
Queue	95th%ile (m)	-	-	0.0	-	0.7		
Paradise Road & Starlight Drive		Paradise Road				Starlight Drive		Overall Intersection
		EB-T	EB-R	WB-L	WB-T	NB-L	NB-R	
Delay (sec/veh)		0.0	0.0	8.0	0.0	11.0		0.7
LOS		A	A	A	A	B		A
v/c		-	-	0.03	-	0.04		
Queue	95th%ile (m)	-	-	0.8	-	0.8		

4.2 Future Conditions with Development

The performance of the unsignalized intersections during the morning and afternoon peak hours of traffic was evaluated under future conditions with the full build out of the development. The MOE results including delay, level of service, volume-to-capacity ratio, average queue lengths and 95th percentile queue lengths for each intersection are summarized in Table 6. The detailed Synchro reports detailing the results of the analysis can be found in Appendix A.

The analysis indicates that with the full build out of the development, both intersections will continue to operate at acceptable levels of service with minimal delay and queuing during the peak hours. The additional traffic volumes generated by the development will result in negligible increases in delay (approximately 1.0 seconds per vehicle or less) at the two intersection during the peak hours.

Table 6: Future intersection performance

Intersection Performance - Future Conditions, AM Peak Hour								
Paradise Road & Archibald Drive		Paradise Road				Archibald Drive		Overall Intersection
		EB-T	EB-R	WB-L	WB-T	NB-L	NB-R	
Delay (sec/veh)		0.0	0.0	8.6	0.0	12.8		1.4
LOS		A	A	A	A	B		A
v/c		-	-	0.02	-	0.14		
Queue	95th%ile (m)	-	-	0.8	-	3.8		
Paradise Road & Starlight Drive		Paradise Road				Starlight Drive		Overall Intersection
		EB-T	EB-R	WB-L	WB-T	NB-L	NB-R	
Delay (sec/veh)		0.0	0.0	8.4	0.0	12.6		1.3
LOS		A	A	A	A	B		A
v/c		-	-	0.02	-	0.12		
Queue	95th%ile (m)	-	-	0.0	-	3.0		
Intersection Performance - Existing Conditions, PM Peak Hour								
Paradise Road & Archibald Drive		Paradise Road				Archibald Drive		Overall Intersection
		EB-T	EB-R	WB-L	WB-T	NB-L	NB-R	
Delay (sec/veh)		0.0	0.0	8.3	0.0	11.1		1.1
LOS		A	A	A	A	B		A
v/c		-	-	0.07	-	0.08		
Queue	95th%ile (m)	-	-	1.5	-	2.3		
Paradise Road & Starlight Drive		Paradise Road				Starlight Drive		Overall Intersection
		EB-T	EB-R	WB-L	WB-T	NB-L	NB-R	
Delay (sec/veh)		0.0	0.0	8.1	0.0	12.3		1.0
LOS		A	A	A	A	B		A
v/c		-	-	0.05	-	0.08		
Queue	95th%ile (m)	-	-	0.8	-	1.5		

5 Conclusions

Until Lanark Drive is extended to the East and/or West, all traffic to/from this proposed development will be via Paradise Road and along Starlight Drive or Archibald Drive. The analysis indicates that the full buildout of the development could result in an additional 99 vehicle trips along Archibald Drive and an additional 39 vehicle trips along Starlight Drive in the PM peak period (worst case scenario). While residents of these streets will undoubtedly notice the increase in traffic, no operational concerns are expected to result. The proposed development will have a negligible impact on traffic operations along Paradise Road and both the unsignalized intersections of Starlight Drive at Paradise Road and Archibald Drive at Paradise Road will continue to operate at acceptable levels of service with minimal delay and queuing during the peak hours.

The proposed development plan was not reviewed in detail with respect to adherence to the Town's guidelines for curb radii, street centreline radii, etc. as this is typically completed as part of the Town's review process. A high-level review indicates no issues of note with respect to the proposed intersections of Rembrant Boulevard at Street 'A' (west), Rembrant Boulevard at Street 'A' (east), or Lanark Drive at

Street ‘A’. A preliminary check of available sight distance for the Future Phase 3 access point was also conducted, this should be reviewed/confirmed at the time that the final location and configuration of this access point is confirmed and constructed. It is noted that the proposed ‘final’ layout of the intersection of Lanark Drive at Archibald Drive is not shown on the current concept plan, this should be addressed on the final development plans.

If you have any questions or would like to further discuss any aspects of the above, please do not hesitate to contact me at your convenience.

Best Regards,

[redacted]

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Appendix A: Synchro Reports

Intersection	
Int Delay, s/veh	0.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	469	1	4	173	1	13
Future Vol, veh/h	469	1	4	173	1	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	-	-	150	-	0	-
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	510	1	4	188	1	14

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	511	0	707	511
Stage 1	-	-	-	-	511	-
Stage 2	-	-	-	-	196	-
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	-	-	1054	-	402	563
Stage 1	-	-	-	-	602	-
Stage 2	-	-	-	-	837	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1054	-	400	563
Mov Cap-2 Maneuver	-	-	-	-	400	-
Stage 1	-	-	-	-	602	-
Stage 2	-	-	-	-	834	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	11.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	547	-	-	1054	-
HCM Lane V/C Ratio	0.028	-	-	0.004	-
HCM Control Delay (s)	11.8	-	-	8.4	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0	-

Intersection	
Int Delay, s/veh	0.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	438	1	11	163	4	32
Future Vol, veh/h	438	1	11	163	4	32
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
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	476	1	12	177	4	35

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	477	0	678	477
Stage 1	-	-	-	-	477	-
Stage 2	-	-	-	-	201	-
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	-	-	1085	-	418	588
Stage 1	-	-	-	-	624	-
Stage 2	-	-	-	-	833	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1085	-	413	588
Mov Cap-2 Maneuver	-	-	-	-	413	-
Stage 1	-	-	-	-	624	-
Stage 2	-	-	-	-	823	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	11.9
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	562	-	-	1085	-
HCM Lane V/C Ratio	0.07	-	-	0.011	-
HCM Control Delay (s)	11.9	-	-	8.4	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Intersection	
Int Delay, s/veh	0.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	328	2	14	525	1	8
Future Vol, veh/h	328	2	14	525	1	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
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	357	2	15	571	1	9

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	359	0	959	358
Stage 1	-	-	-	-	358	-
Stage 2	-	-	-	-	601	-
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	-	-	1200	-	285	686
Stage 1	-	-	-	-	707	-
Stage 2	-	-	-	-	547	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1200	-	282	686
Mov Cap-2 Maneuver	-	-	-	-	282	-
Stage 1	-	-	-	-	707	-
Stage 2	-	-	-	-	540	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	11.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	592	-	-	1200	-
HCM Lane V/C Ratio	0.017	-	-	0.013	-
HCM Control Delay (s)	11.2	-	-	8	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0	-

Intersection	
Int Delay, s/veh	0.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	308	4	36	490	2	22
Future Vol, veh/h	308	4	36	490	2	22
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
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	335	4	39	533	2	24

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	339	0	948	337
Stage 1	-	-	-	-	337	-
Stage 2	-	-	-	-	611	-
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	-	-	1220	-	289	705
Stage 1	-	-	-	-	723	-
Stage 2	-	-	-	-	542	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1220	-	276	705
Mov Cap-2 Maneuver	-	-	-	-	276	-
Stage 1	-	-	-	-	723	-
Stage 2	-	-	-	-	518	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.6	11
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	624	-	-	1220	-
HCM Lane V/C Ratio	0.042	-	-	0.032	-
HCM Control Delay (s)	11	-	-	8	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0.1	-

Intersection	
Int Delay, s/veh	1.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	493	1	22	182	1	70
Future Vol, veh/h	493	1	22	182	1	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
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	536	1	24	198	1	76

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	537	0	783	537
Stage 1	-	-	-	-	537	-
Stage 2	-	-	-	-	246	-
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	-	-	1031	-	362	544
Stage 1	-	-	-	-	586	-
Stage 2	-	-	-	-	795	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1031	-	354	544
Mov Cap-2 Maneuver	-	-	-	-	354	-
Stage 1	-	-	-	-	586	-
Stage 2	-	-	-	-	777	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	12.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	540	-	-	1031	-
HCM Lane V/C Ratio	0.143	-	-	0.023	-
HCM Control Delay (s)	12.8	-	-	8.6	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.5	-	-	0.1	-

Intersection	
Int Delay, s/veh	1.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	438	4	16	164	12	46
Future Vol, veh/h	438	4	16	164	12	46
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
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	476	4	17	178	13	50

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	480	0	690	478
Stage 1	-	-	-	-	478	-
Stage 2	-	-	-	-	212	-
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	-	-	1082	-	411	587
Stage 1	-	-	-	-	624	-
Stage 2	-	-	-	-	823	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1082	-	404	587
Mov Cap-2 Maneuver	-	-	-	-	404	-
Stage 1	-	-	-	-	624	-
Stage 2	-	-	-	-	810	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	12.6
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	537	-	-	1082	-
HCM Lane V/C Ratio	0.117	-	-	0.016	-
HCM Control Delay (s)	12.6	-	-	8.4	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	343	2	76	553	1	45
Future Vol, veh/h	343	2	76	553	1	45
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
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	373	2	83	601	1	49

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	375	0	1141	374
Stage 1	-	-	-	-	374	-
Stage 2	-	-	-	-	767	-
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	-	-	1183	-	222	672
Stage 1	-	-	-	-	696	-
Stage 2	-	-	-	-	458	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1183	-	206	672
Mov Cap-2 Maneuver	-	-	-	-	206	-
Stage 1	-	-	-	-	696	-
Stage 2	-	-	-	-	426	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1	11.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	641	-	-	1183	-
HCM Lane V/C Ratio	0.078	-	-	0.07	-
HCM Control Delay (s)	11.1	-	-	8.3	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.3	-	-	0.2	-

Intersection	
Int Delay, s/veh	1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	309	13	52	491	7	31
Future Vol, veh/h	309	13	52	491	7	31
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	-
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	336	14	57	534	8	34

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	350	0	991	343
Stage 1	-	-	-	-	343	-
Stage 2	-	-	-	-	648	-
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	-	-	1209	-	273	700
Stage 1	-	-	-	-	719	-
Stage 2	-	-	-	-	521	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1209	-	260	700
Mov Cap-2 Maneuver	-	-	-	-	260	-
Stage 1	-	-	-	-	719	-
Stage 2	-	-	-	-	497	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	12.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	534	-	-	1209	-
HCM Lane V/C Ratio	0.077	-	-	0.047	-
HCM Control Delay (s)	12.3	-	-	8.1	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.1	-

McCarthy Subdivision, Paradise, NL

Traffic Impact Assessment

Status: Draft Report

Date: July 11, 2022

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Project Name: McCarthy Subdivision Traffic Impact Assessment

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Status: Draft Report

Date: July 11, 2022

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Table of Contents

List of Appendices

List of Figures

List of Tables

1 Introduction

Pinnacle Engineering retained Harbourside Transportation Consultants to conduct a Traffic Impact Assessment for a residential development referred to as the McCarthy Subdivision located on Lanark Drive in Paradise, NL. Figure 1 illustrates the site location.

The study assesses current and future background traffic conditions within the study area, estimates the traffic generated by the development site, assesses the impacts of the site-generated traffic on the surrounding road network and identifies improvements required to accommodate the site generated traffic.

Figure 1: Site Location

2 Study Area

2.1 Road Network

The roadways of interest within the study area include:

- **Paradise Road:** a collector roadway[1] that runs from Topsail Road to St. Thomas Line. Paradise Road has a three-lane urban cross section with sidewalks on one or both sides of the roadway. Paradise Road has a posted speed limit of 50 km/hr.
- **St. Thomas Line**: a collector roadway that runs from Paradise Road north to the adjacent community of Portugal Cove-St. Philip's. St. Thomas Line has a three-lane urban cross section with sidewalks on one side of the roadway between Paradise Road and Ridgewood Drive. North of Ridgewood Drive Paradise Road has a two-lane rural cross section. St. Thomas Line has a posted speed limit of 50 km/hr.
- **Lanark Drive:** a collector roadway that runs from St. Thomas Line along Adams Pond. Segments of Lanark Drive are constructed as development occurs, when completed the roadway will form a loop around Adams Pond. Lanark Drive has a two-lane cross section with sidewalks on both sides of the roadway. Lanark Drive has a speed limit of 40 km/h.
- **Starlight Drive:** a local roadway that runs from Paradise Road to Rembrant Boulevard. Starlight Drive has a two-lane cross section with sidewalks on one side of the roadway. Starlight Drive has a speed limit of 40 km/h.
- **Rembrant Boulevard:** a local roadway that runs from Starlight Drive to Archibald Drive. Rembrant Boulevard has a two-lane cross section with sidewalks on one side of the roadway. Rembrant Boulevard has a speed limit of 40 km/h.

2.2 Intersections

The intersections assessed in this study include:

- **St. Thomas Line and Lanark Drive:** unsignalized three-leg intersection with stop control on the Lanark Drive approach; and
- **Paradise Road and Starlight Drive:** unsignalized three-leg intersection with stop control on the Starlight Drive approach. There is a westbound left turn lane on Paradise Road at the intersection.

[1] Development Regulations – Appendix F: Street Classification, Town of Paradise, September 2020.

3 Existing Traffic Operations

3.1 Traffic Volumes

Turning movement counts were collected at the study area intersections using Miovision 'Scout' video data collection devices. The turning movement counts recorded traffic data during the morning (AM) peak period (7:00 and 9:00 AM), mid-day peak period (11:00 AM and 1:00 PM) and afternoon (PM) peak period (4:00 and 6:00 PM) in June 2022. Motor vehicle and pedestrian volumes were reported in 15-minute intervals.

Figure 2 illustrates the existing base year weekday AM and PM peak hour traffic volumes at the study area intersections. Appendix A contains the traffic count data.

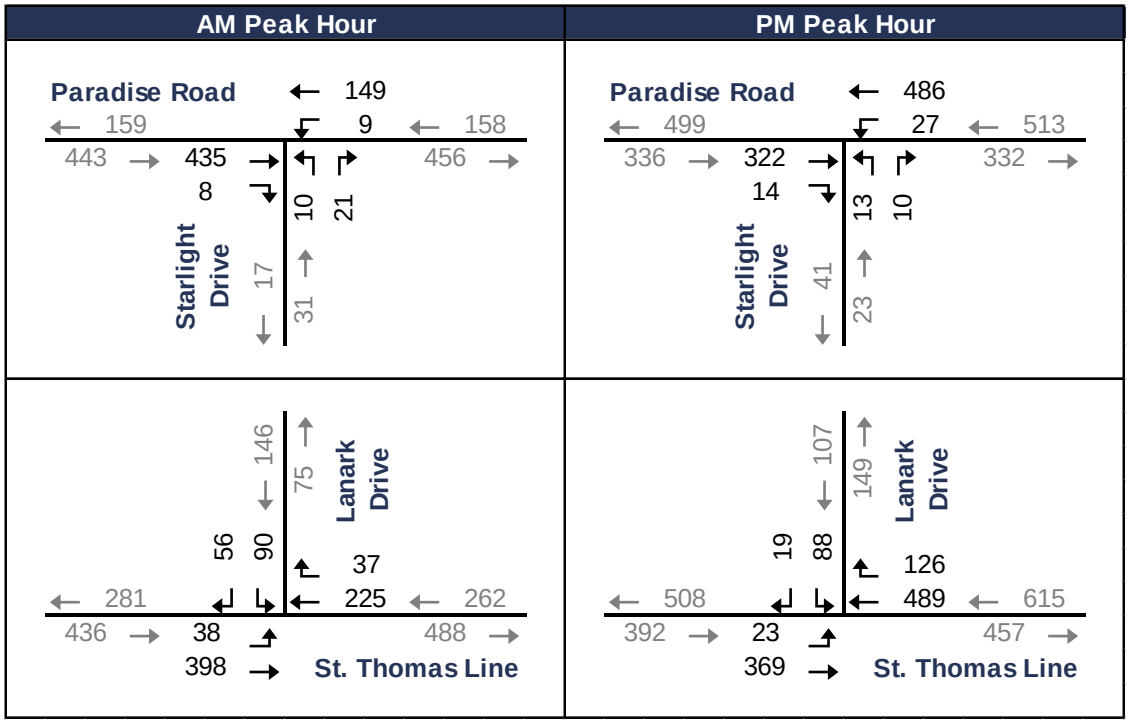


Figure 2: Existing Traffic Volumes

3.2 Existing Operations

Traffic operations at the study area intersections were evaluated using Synchro 11 and Highway Capacity Manual (HCM) 6th edition procedures. The intersection analysis considered the following measures of performance:

- Level of service (LOS) for each turning movement. LOS is a measure that describes the performance or efficiency of traffic flow based on the average control delay per vehicle. Control delay is delay attributable to the presence of traffic

control and conflicting traffic. LOS is reported on a scale of A to F, where A represent the highest possible rating and LOS F represents the worst rating where the level of congestion is considered unacceptable and remedial measures are typically implemented where feasible. Table 1 summarizes the delay criteria for LOS ratings at signalized and unsignalized intersections.

- The volume-to-capacity (v/c) ratio for each turning movement; and
- The 95th percentile queue lengths for each turning movement.

Table 1: Level of Service Criteria

LOS	Description	Signalized Delay	Unsignalized Delay
A	No congestion; most vehicles do not stop.	≤ 10 s/veh	≤ 10 s/veh
B	Very light congestion; some vehicles stop.	10-20 s/veh	10-15 s/veh
C	Light congestion; most vehicles stop.	20-35 s/veh	15-25 s/veh
D	Minor congestion; no long-standing queues.	35-55 s/veh	25-35 s/veh
E	Congestion; long-standing queues are formed.	55-80 s/veh	35-50 s/veh
F	Severe congestion; demand exceeds capacity.	≥ 80 s/veh	≥ 50 s/veh

The following criteria indicate critical conditions:

- LOS for an individual or shared movement exceeds LOS “D”;
- The v/c ratio for an individual or shared movement exceeds 0.85; or
- The 95th percentile length for an individual movement exceeds the available queue storage.

Mitigation measures may need to be considered for movements in critical conditions.

Existing operations at the study intersections were evaluated using the existing lane configuration, traffic control and traffic volumes (Figure 2). Table 2 and Table 3 summarize the results of the analysis for the AM and PM peak hours. No critical movements are identified; operations at both study intersections are considered acceptable. Appendix B contains the supporting detailed Synchro reports.

The Paradise Road & Starlight Drive intersection operates with minimal delay and queuing, and v/c ratios well within capacity during the AM and PM peak hours.

The St. Thomas Line & Lanark Drive intersection operates with minimal delay and queuing, and v/c ratios well within capacity during the AM peak hour. During the PM peak hour, LOS D or minor congestion is observed on the Lanark Drive approach (stop-controlled). No significant or long-standing queues are formed and the v/c ratios well within capacity during the PM peak hours.

Table 2: Existing Operations, AM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	435	8	443	9	149	158	10	21	31	632
	Delay	0.0	0.0	0.0	8.5	0.0	0.5	12.2		12.2	0.7
	LOS	A	A	A	A	A	A	B		B	A
	v/c	0.00	0.00		0.01	0.00		0.06			
	95th% Q	0.0	0.0		0.0	0.0		1.5			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	38	398	436	225	37	262	90	56	146	844
	Delay	8.1	0.0	0.7	0.0	0.0	0.0	22.4		22.4	4.2
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.04	0.00		0.00	0.00		0.47			
	95th% Q	0.8	0.0		0.0	0.0		18.2			

Table 3: Existing Operations, PM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	322	14	336	27	486	513	13	10	23	872
	Delay	0.0	0.0	0.0	8.1	0.0	0.4	15.1		15.1	0.6
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.00	0.00		0.02	0.00		0.06			
	95th% Q	0.0	0.0		0.8	0.0		1.5			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	23	369	392	489	126	615	88	19	107	1114
	Delay	9.0	0.0	0.5	0.0	0.0	0.0	26.4		26.4	2.7
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.03	0.00		0.00	0.00		0.40			
	95th% Q	0.8	0.0		0.0	0.0		14.4			

4 Development Concept

4.1 Development Description

The development site is located in the Lanark Drive area between Quantum Drive and Starlight Drive. The development proposal for the McCarthy Subdivision includes 70 single-family detached units.

The subdivision's road network will:

- Extend Lanark Drive to the north, from Quantum Drive and connecting to the existing segment of Lanark Drive near Tudor Avenue;
- Extend Rembrant Boulevard between Quantum Drive and Starlight Drive;
- Include one new cul-de-sac local roadway accessed from Lanark Drive (currently referred to as Street 'A');
- Include one new cul-de-sac local roadway accessed from Rembrant Boulevard (currently referred to as Street 'B'); and
- Include one new local roadway which will form a crescent shape between Rembrant Boulevard and Street 'B' (currently referred to as Street 'C').

Figure 3 illustrates the concept plan.

Figure 3: Site Concept Plan

4.2 Access Review

Until Lanark Drive is further extended to complete a loop around Adams Pond, it is anticipated that the proposed subdivision will be accessed primarily from St. Thomas Line via Lanark Drive and from Paradise Road via Starlight Drive. While access to Paradise Road will also be available via Archibald Drive and Acharya Drive, these are less direct routes and for the purposes of this study, the primary access points are considered to be existing intersections of Paradise Road & Starlight Drive and St. Thomas Line & Lanark Drive.

Available sight distance at these intersections was reviewed to confirm that the minimum stopping sight distance and turning sight distance requirements of the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads[2] are met. The minimum sight distance requirements for a two-lane roadway with a design speed of 50 km/h are:

- Minimum stopping sight distance = 65 metres
- Minimum turning sight distance – left-turn from stop = 105 metres
- Minimum turning sight distance – right-turn from stop = 95 metres

Minimum stopping and turning sight distance requirements are met in both directions at the intersections of Paradise Road & Starlight Drive and St. Thomas Line & Lanark Drive.

4.3 Site Plan Review

The site plan has not been reviewed in detail with respect to adherence to the Town of Paradise guidelines for curb radii, street centreline radii, etc. as this is typically completed as part of the Town's review process. For the most part, the proposed road network is the 'natural' extension of both Lanark Drive and Rembrant Boulevard. No issues are noted with the four internal intersections.

- Lanark Drive & Street 'A';
- Rembrant Boulevard & Street 'B';
- Rembrant Boulevard & Street 'C'; and
- Street 'B' & Street 'C'.

The sight distance at internal intersections between two low-volume local roadways should meet the TAC minimum stopping sight distance requirement of 65 metres for a design speed of 50 km/h.

[2] Geometric Design Guide for Canadian Roads, Transportation Association of Canada, June 2017.

4.4 Trip Generation

The Institute of Transportation Engineers (ITE) Trip Generation Manual[3] was used to estimate the site's vehicle trip generation. Land use code 210 Single-Family Detached Housing, General Urban/Suburban was used. Table 4 summarizes the trip generation rates for the land use code.

Table 4: Trip Generation Rates

Land Use	AM Peak Hour			PM Peak Hour		
	Rate	Entering	Exiting	Rate	Entering	Exiting
210 Single-Family Detached Housing	0.70	26%	74%	0.94	63%	37%
Note: Rates are in vehicles per hour (vph)/unit						

Table 5 summarizes the estimated trip generation for the subdivision. The development is forecast to generate approximate 49 vehicle trips during the AM peak hour (41 trips entering and 25 trips exiting) and approximately 66 vehicle trips during the PM peak hour (41 trips entering and 25 trips exiting).

Table 5: Estimated Trip Generation

Land Use	Units	AM Peak Hour			PM Peak Hour		
		Total	Entering	Exiting	Total	Entering	Exiting
210 Single-Family Detached	70	49	13	36	66	41	25
Note: Trips generated are in vehicles per hour (vph).							

4.5 Trip Distribution and Assignment

The site generated vehicle trips were distributed to the road network based on existing travel patterns observed in the turning movement counts.

The site generated vehicle trips were assigned to the two access points based on the following assumptions:

- 60 percent of site-generated traffic will access the site via Lanark Drive; and
- 40 percent of site-generated traffic will access the site via Starlight Drive.

Table 6 summarizes the trip distribution assumptions.

[3] Trip Generation Manual, 11th Edition, Institute of Transportation Engineers, September 2021

Table 6: Trip Distribution

Origin/ Destination	Route	Trip Distribution			
		AM		PM	
East	Paradise Road via Starlight Drive	60%	25%	70%	25%
	St. Thomas Line via Lanark Drive		35%		45%
West	Paradise Road via Starlight Drive	40%	15%	30%	15%
	St. Thomas Line via Lanark Drive		25%		15%
Total		100%	100%	100%	100%

Figure 4 illustrates the site generated traffic volumes for the weekday AM and PM peak hours. Appendix C contains the detailed traffic forecasts for the development application.

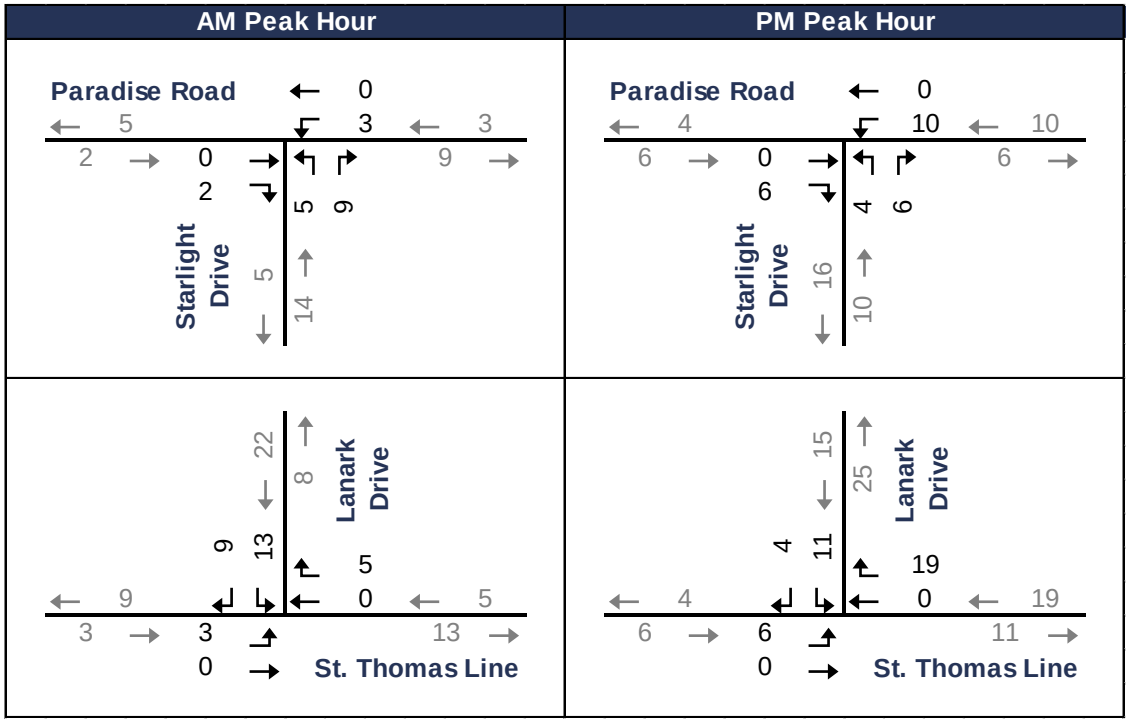


Figure 4: Site-Generated Traffic Volumes

5 Future Traffic Operations

One horizon year, five-years from the date of the study for the full build-out (Year 2027) has been assessed to estimate the impact of background traffic growth and the development.

5.1 Background Operations

The forecast background traffic volumes will consist of:

- Background traffic growth: the increase in non-site traffic is estimated to be 1.0% percent per year; and
- Traffic generated by adjacent developments:
  - Adams Pond Subdivision[4]: A 147-unit subdivision extending Lanark Drive and Rembrant Boulevard between Starlight Drive and Archibald Drive. The development is expected to generate 104 vehicle trips in the AM peak hour (26 trips entering, 78 trips exiting) and 138 vehicle trips in the PM peak hour (87 trips entering, 51 trips exiting). Primary access to the development will be from Paradise Road at Starlight Drive and Archibald Drive.

Figure 5 illustrates the future background traffic volumes for the weekday AM and PM peak hours.

[4] Adams Pond Subdivision Traffic Impact Assessment, Harbourside Transportation Consultants, February 2021.

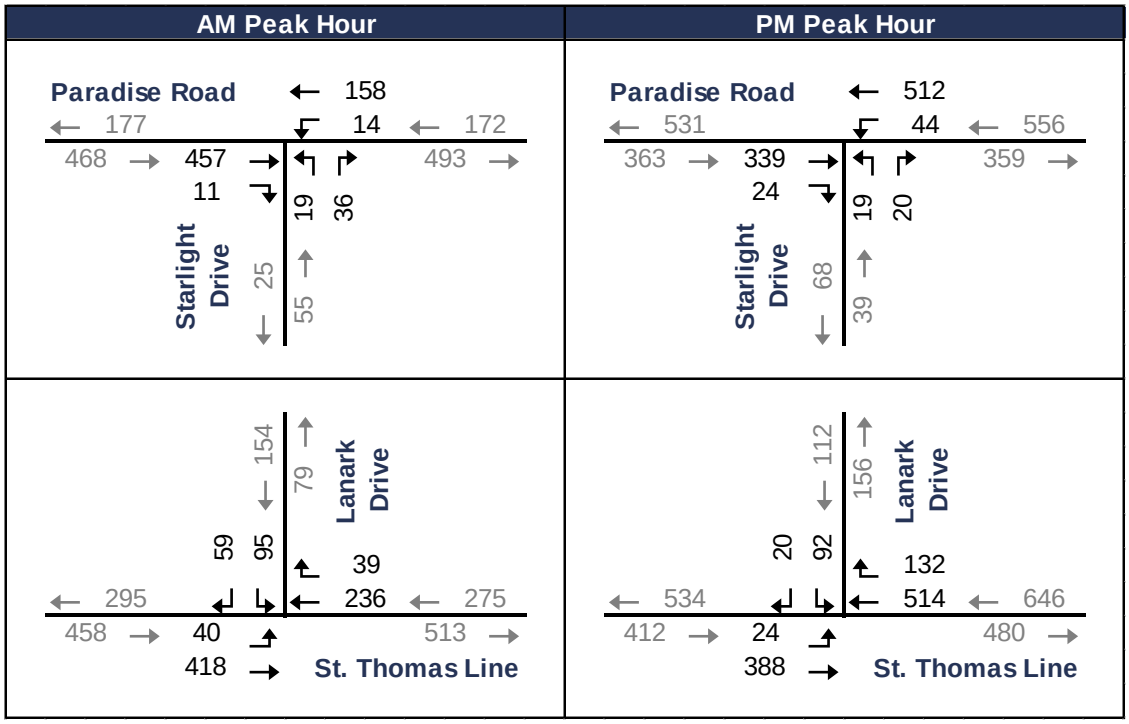


Figure 5: Background Traffic Volumes

Future background operations at the study intersections were evaluated using the same methodology used for existing conditions. No changes to existing traffic control and lane configurations are assumed.

Table 7 and Table 8 summarize the results of the analysis for the AM and PM peak hours. No critical movements are identified; operations at both study intersections are considered acceptable. The impacts of background traffic growth and adjacent developments are:

- Negligible increases in delay (approximately 1.0 second/vehicle or less) and queueing (less than 1 vehicle) are expected at Paradise Road & Starlight Drive; and
- Minor increases in delay (approximately 3.5 seconds/vehicle or less) and queueing (less than 1 vehicle) are expected at St. Thomas Line & Lanark Drive.

Appendix C contains the supporting detailed Synchro reports.

Table 7: Background Operations, AM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	457	11	468	14	158	172	19	36	55	695
	Delay	0.0	0.0	0.0	8.5	0.0	0.7	13.1		13.1	1.2
	LOS	A	A	A	A	A	A	B		B	A
	v/c	0.00	0.00		0.01	0.00		0.11			
	95th% Q	0.0	0.0		0.0	0.0		3.0			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	40	418	458	236	39	275	95	59	154	887
	Delay	8.2	0.0	0.7	0.0	0.0	0.0	25.4		25.4	4.8
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.04	0.00		0.00	0.00		0.52			
	95th% Q	0.8	0.0		0.0	0.0		22.0			

Table 8: Background Operations, PM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	339	24	363	44	512	556	19	20	39	958
	Delay	0.0	0.0	0.0	8.2	0.0	0.7	16.2		16.2	1.1
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.00	0.00		0.04	0.00		0.12			
	95th% Q	0.0	0.0		0.8	0.0		3.0			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	24	388	412	514	132	646	92	20	112	1170
	Delay	9.1	0.0	0.5	0.0	0.0	0.0	29.8		29.8	3.0
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.03	0.00		0.00	0.00		0.45			
	95th% Q	0.8	0.0		0.0	0.0		16.7			

5.2 Total Operations

The forecast total traffic volumes will consist of:

- The future background traffic volumes (background traffic growth and adjacent developments); and
- Traffic generated by the McCarthy Subdivision.

Figure 6 illustrates the future total traffic volumes for the weekday AM and PM peak hours.

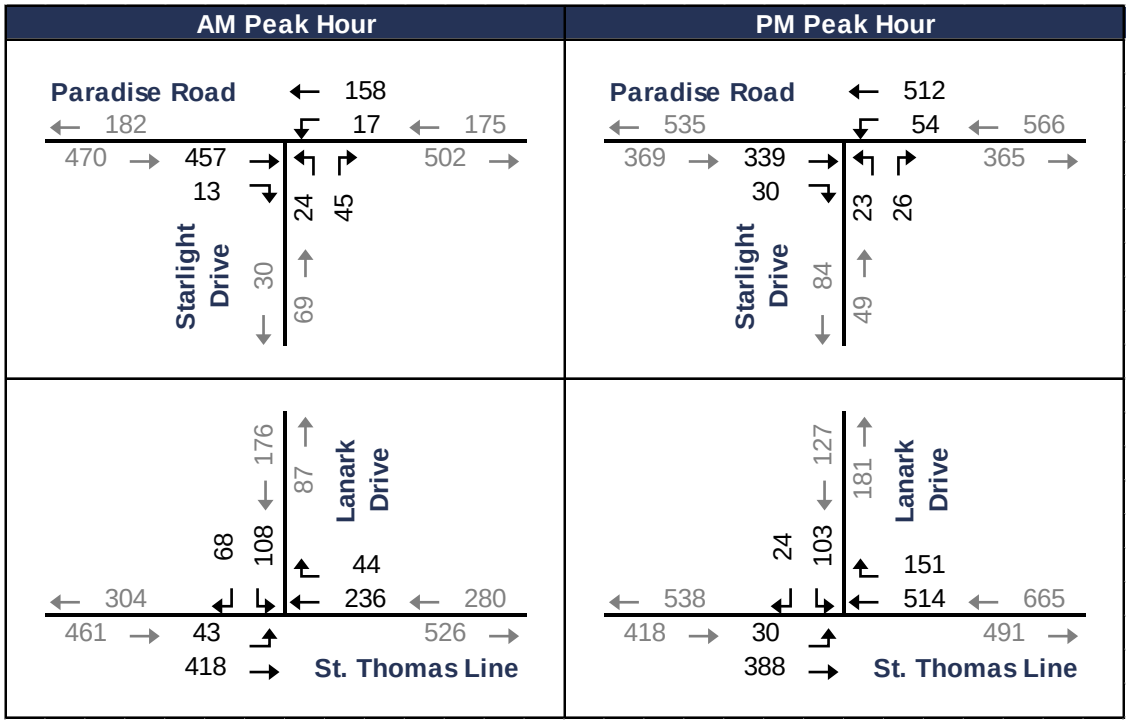


Figure 6: Total Traffic Volumes

Future total operations at the study intersections were evaluated using the same methodology used for existing and future background conditions. No changes to existing traffic control and lane configurations are assumed.

Table 9 and Table 10 summarize the results of the analysis for the AM and PM peak hours. No critical movements are identified; operations at both study intersections are considered acceptable. The impacts of site-generated traffic are:

- Negligible increases in delay (less than 1.0 second/vehicle) and queueing (less than 1 vehicle) are expected at Paradise Road & Starlight Drive; and
- Minor increases in delay (approximately 5.0 seconds/vehicle or less) and queueing (approximately 1 vehicle) are expected at St. Thomas Line & Lanark Drive.

Appendix D contains the supporting detailed Synchro reports.

Table 9: Total Operations, AM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	457	13	470	17	158	175	24	45	69	714
	Delay	0.0	0.0	0.0	8.6	0.0	0.8	13.4		13.4	1.5
	LOS	A	A	A	A	A	A	B		B	A
	v/c	0.00	0.00		0.02	0.00		0.14			
	95th% Q	0.0	0.0		0.8	0.0		3.8			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	43	418	461	236	44	280	108	68	176	917
	Delay	8.2	0.0	0.8	0.0	0.0	0.0	29.5		29.5	6.1
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.04	0.00		0.00	0.00		0.61			
	95th% Q	0.8	0.0		0.0	0.0		28.9			

Table 10: Total Operations, PM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	339	30	369	54	512	566	23	26	49	984
	Delay	0.0	0.0	0.0	8.3	0.0	0.8	16.8		16.8	1.3
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.00	0.00		0.05	0.00		0.15			
	95th% Q	0.0	0.0		1.5	0.0		3.8			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	30	388	418	514	151	665	103	24	127	1210
	Delay	9.2	0.0	0.7	0.0	0.0	0.0	34.8		34.8	3.9
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.04	0.00		0.00	0.00		0.54			
	95th% Q	0.8	0.0		0.0	0.0		22.0			

6 Remedial Measures

6.1 Traffic Signal Warrant

The Transportation Association of Canada (TAC) Traffic Signal and Pedestrian Head Warrant Handbook[5] provides guidance on the assessment of the need for traffic control signals at intersections. The procedure uses a "cumulative factors methodology" to identify if traffic control signals are warranted based on factors such as geometry, operating parameters, local demographics and pedestrian and vehicular volumes and conflicts. To warrant the installation of a traffic control signal, an intersection must score a minimum of 100 cumulative warrant points.

The traffic signal warrant analysis was completed for the intersection of St. Thomas Line & Lanark Drive using existing traffic volumes. The signal warrant is not satisfied (36 cumulative warrant points); no improvements to the existing form of stop control are recommended. Appendix E contains the warrant analysis.

6.2 Left Turn Lane Warrant

The Ministry of Transportation of Ontario (MTO) Supplement for the TAC Geometric Design Guide for Canadian Roads[6] provides guidance on the assessment of the need for left turn lanes at unsignalized intersections. The methodology uses a series of nomographs to identify if a left turn lane is warranted based on factors such as design speed, advancing volumes, left turn volume as a percentage of advancing volumes and opposing volumes.

The left turn lane warrant analysis was completed for the eastbound direction on St. Thomas Line using the future total traffic volumes.

Figure 2 illustrates the left turn warrant analysis for the AM peak hour, where the left turning volume represents approximately 10% of advancing volumes. A left turn lane with a minimum storage length of 15 metres is warranted; it should be noted that the result falls approximately on the warrant line indicating that the threshold is narrowly met.

Figure 8 illustrates the left turn warrant analysis for the PM peak hour, where the left turning volume represents approximately 7% of advancing volumes. A left turn lane with a minimum storage length of 15 metres is warranted.

[5] TAC Traffic Signal and Pedestrian Head Warrant Handbook, June 2014.
[6] MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads, Appendix 9 for Chapter 9 Intersections, June 2017.

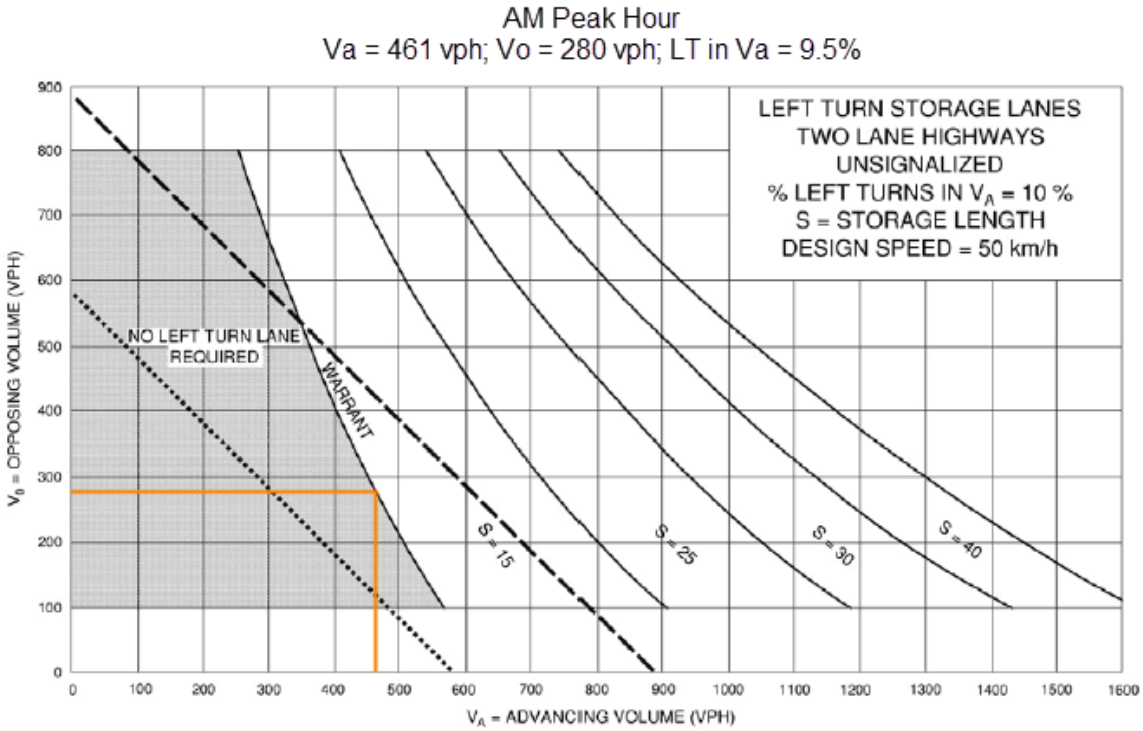


Figure 7: Left Turn Lane Warrant, St. Thomas Line AM Peak Hour

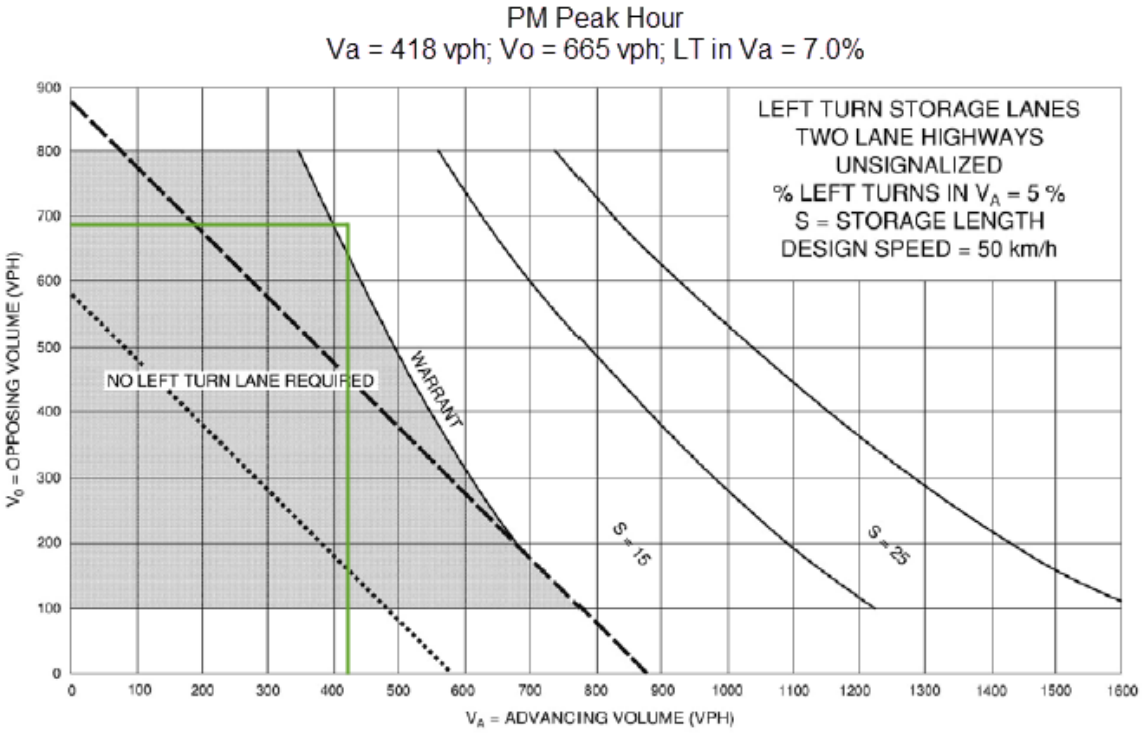


Figure 8: Left Turn Lane Warrant, St. Thomas Line PM Peak Hour

A storage lane could be accommodated within the existing pavement width on St. Thomas Line. Due to the close proximity of Sullivans Road on the opposing side of St. Thomas Line, however, the storage lane would extend across the Sullivans Road approach and vehicles queued in the lane would temporarily block left turns into and out of Sullivans Road. There is also an existing crosswalk in this area. Figure 9 illustrates the existing configuration of the Lanark Drive and Sullivans Road intersections on St. Thomas Line.

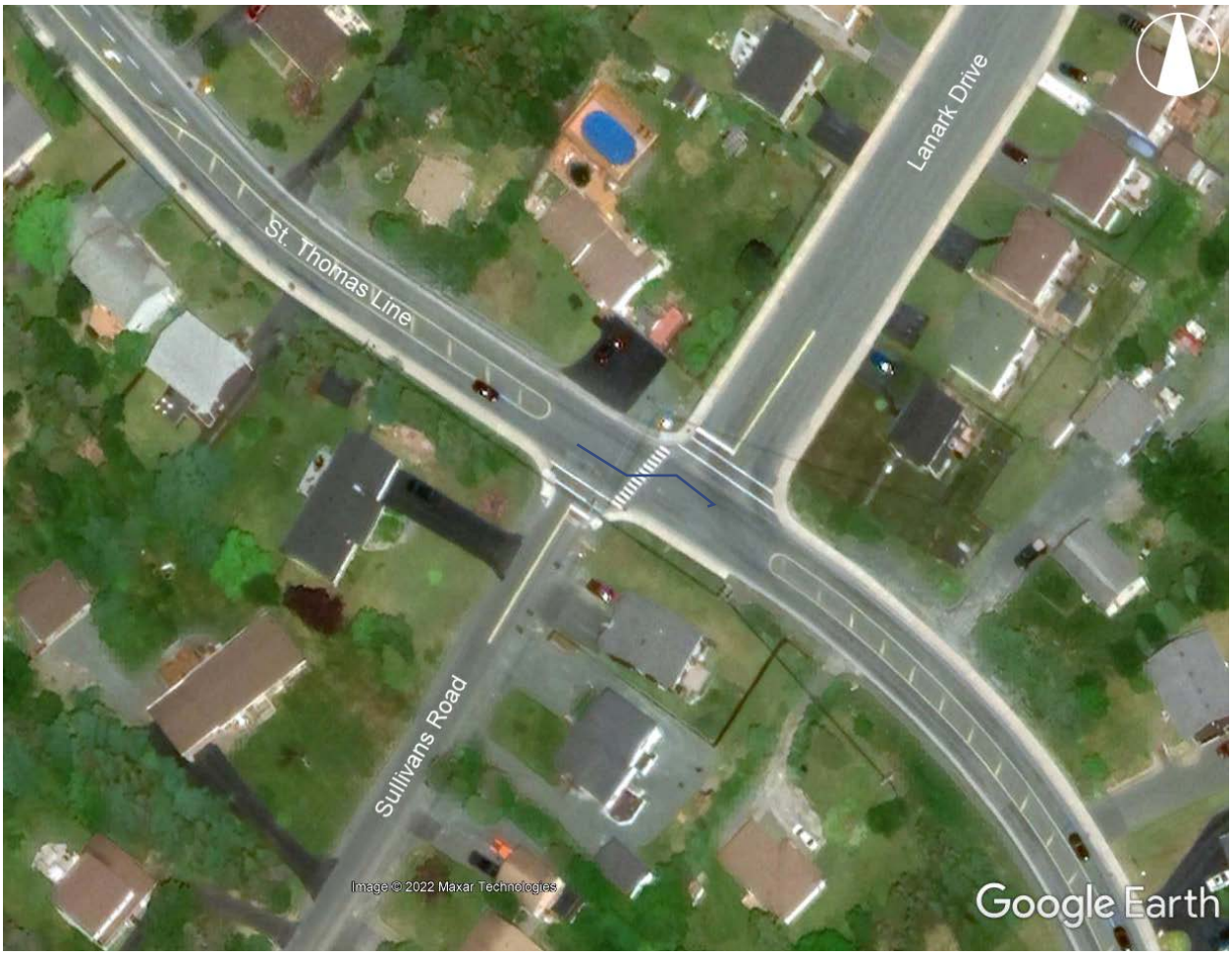


Figure 9: St. Thomas Line & Lanark Drive

While the crosswalk could be relocated either to the west side of Sullivans Road, or to the east side of Lanark Drive, neither of these scenarios is ideal. The left turn volume from Lanark Drive to St. Thomas Line is significantly higher than the right turn volume and moving the crosswalk to the east of Lanark would unnecessarily introduce more vehicle-pedestrian conflicts. There is an existing driveway directly across from the existing pedestrian lowback on the west side of Sullivans Road which would require pushing the crossing point even further to the west. Because the pedestrian ‘desire line’ is anticipated

to be between the north and south sides of St. Thomas Line at Lanark Drive, pedestrians are more likely to continue crossing at the established crossing point.

Furthermore, it is likely that vehicles are already queuing in the available space in the median area on St. Thomas Line to turn left to either Lanark Drive of Sullivan's Road. The traffic analysis indicates that future left turn queues at Lanark Drive are not expected to exceed a couple of vehicles with average delay of less than 10 seconds, and given the low volumes anticipated to be generated by less than 15 single-family homes on Sullivans Road, no operational or safety concerns are expected to arise from this configuration.

Considering these factors, it is recommended that the existing intersection configuration be maintained unless the Town is aware, or becomes aware, of operational issues at this location.

7 Conclusion

Pinnacle Engineering retained Harbourside Transportation Consultants to conduct a Traffic Impact Assessment for a residential development referred to as the McCarthy Subdivision located in Paradise, NL.

The study assesses current and future background traffic conditions within the study area, estimates the traffic generated by the development site, assesses the impacts of the site-generated traffic on the surrounding road network and identifies improvements required to accommodate the site generated traffic.

The development site is located in the Lanark Drive area between Quantum Drive and Starlight Drive. The development proposal for the McCarthy Subdivision includes 70 single-family detached units.

The subdivision's road network will:

- Extend Lanark Drive from Quantum Drive to the north connecting to the existing segment of Lanark Drive near Tudor Avenue;
- Extend Rembrant Boulevard between Quantum Drive and Starlight Drive;
- Include one new cul-de-sac local roadway accessed from Lanark Drive (currently referred to as Street 'A');
- Include one new cul-de-sac local roadway accessed from Rembrant Boulevard (currently referred to as Street 'B'); and
- Include on new local roadway which will form a crescent shape between Rembrant Boulevard and Street 'B' (currently referred to as Street 'C').

Until Lanark Drive is further extended to complete a loop around Adams Pond, it is anticipated that the proposed subdivision will be accessed primarily from St. Thomas Line via Lanark Drive and from Paradise Road via Starlight Drive. While access to Paradise Road will also be available via Archibald Drive and Acharya Drive, these are less direct routes and for the purposes of this study, the primary access points are considered to be existing intersections of Paradise Road & Starlight Drive and St. Thomas Line & Lanark Drive. Minimum stopping and turning sight distance requirements are met in both directions at these intersections.

Based on the investigations carried out, it is concluded that:

- **Existing Traffic Operations:** No capacity issues are identified at the two intersections; traffic operations are considered acceptable.
- **Site-Generated Traffic:** The development is forecast to generate approximate 49 vehicle trips during the AM peak hour (41 trips entering and 25 trips exiting) and approximately 66 vehicle trips during the PM peak hour (41 trips entering and 25 trips exiting).
- **5-year Background Traffic Operations:** No capacity issues are forecast at the intersections with the addition of generalized traffic growth and the adjacent Adams Pond Subdivision.
- **5-year Total Traffic Operations:** No capacity issues of concern result from the addition of site-generated traffic. The existing and 5-year background horizon intersection delays are only slightly exacerbated.
- **Remedial Measures:** The forecast future traffic volumes at the intersection of St. Thomas Line & Lanark Drive do not warrant traffic signals; no improvements to the existing form of stop control are recommended. An eastbound left turn lane with a minimum storage length of 15 metres was found to be warranted on St. Thomas Line. This issue is discussed in detail in Section 6.2 and, considering a number of factors, it is recommended that the existing configuration at the intersection of St. Thomas Line and Lanark Drive/Sullivans Road be maintained unless the Town is aware, or becomes aware, of any operational issues at this location.

Appendix A: Traffic Data

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

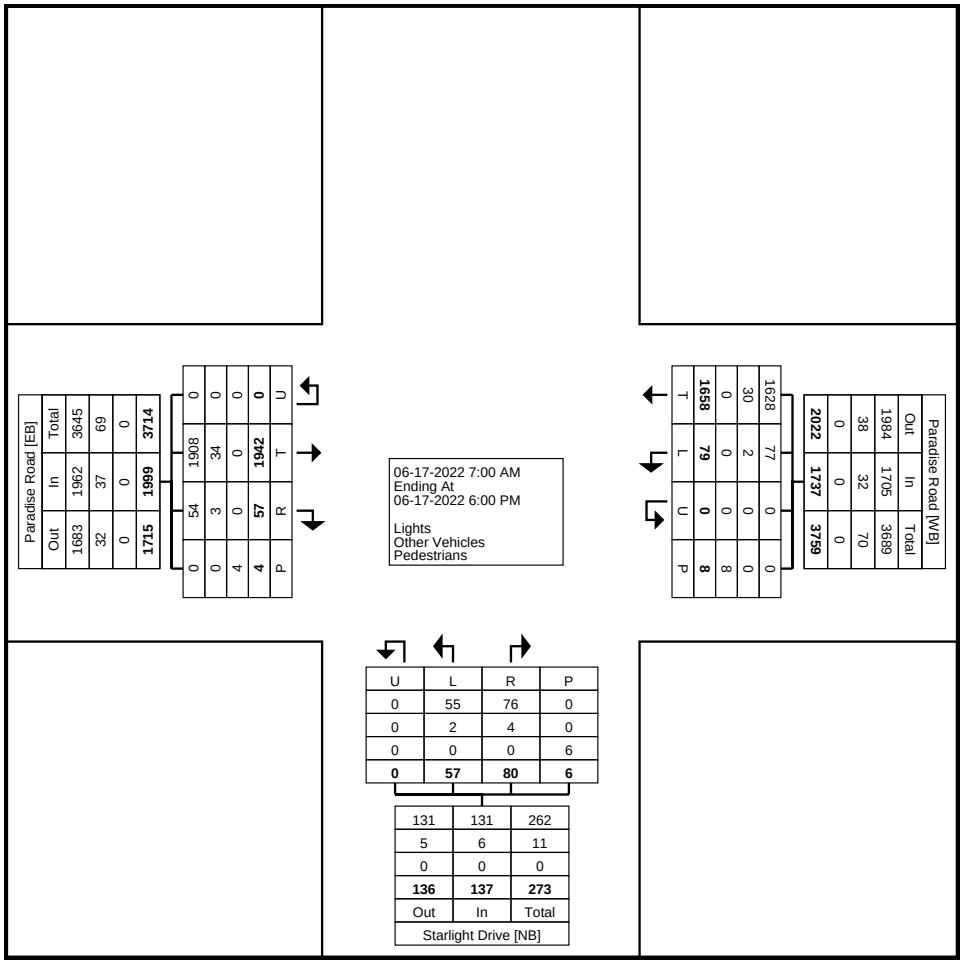
Turning Movement Data

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
7:00 AM	70	0	0	0	70	0	19	0	0	19	1	5	0	0	6	95
7:15 AM	102	1	0	0	103	1	23	0	2	24	2	3	0	0	5	132
7:30 AM	133	1	0	0	134	2	25	0	1	27	2	2	0	1	4	165
7:45 AM	83	2	0	0	85	5	44	0	0	49	3	7	0	0	10	144
Hourly Total	388	4	0	0	392	8	111	0	3	119	8	17	0	1	25	536
8:00 AM	117	2	0	0	119	2	35	0	0	37	1	3	0	0	4	160
8:15 AM	102	3	0	0	105	0	45	0	5	45	4	9	0	0	13	163
8:30 AM	87	1	0	0	88	1	41	0	0	42	4	3	0	0	7	137
8:45 AM	89	2	0	0	91	0	47	0	0	47	2	1	0	0	3	141
Hourly Total	395	8	0	0	403	3	168	0	5	171	11	16	0	0	27	601
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11:00 AM	68	2	0	0	70	2	44	0	0	46	1	5	0	0	6	122
11:15 AM	56	2	0	0	58	3	62	0	0	65	0	5	0	1	5	128
11:30 AM	77	1	0	0	78	0	66	0	0	66	2	1	0	0	3	147
11:45 AM	82	3	0	1	85	2	61	0	0	63	4	2	0	1	6	154
Hourly Total	283	8	0	1	291	7	233	0	0	240	7	13	0	2	20	551
12:00 PM	72	3	0	0	75	3	55	0	0	58	2	3	0	0	5	138
12:15 PM	73	5	0	0	78	3	47	0	0	50	0	4	0	0	4	132
12:30 PM	56	0	0	1	56	3	65	0	0	68	6	5	0	1	11	135
12:45 PM	70	4	0	0	74	2	60	0	0	62	1	1	0	0	2	138
Hourly Total	271	12	0	1	283	11	227	0	0	238	9	13	0	1	22	543
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	72	5	0	0	77	3	102	0	0	105	5	2	0	0	7	189
4:15 PM	67	3	0	0	70	8	119	0	0	127	4	4	0	0	8	205
4:30 PM	79	3	0	0	82	7	117	0	0	124	2	2	0	0	4	210
4:45 PM	79	3	0	0	82	8	117	0	0	125	3	0	0	0	3	210
Hourly Total	297	14	0	0	311	26	455	0	0	481	14	8	0	0	22	814
5:00 PM	77	6	0	0	83	3	123	0	0	126	4	7	0	0	11	220
5:15 PM	87	2	0	2	89	9	129	0	0	138	4	1	0	2	5	232
5:30 PM	77	3	0	0	80	6	113	0	0	119	0	3	0	0	3	202
5:45 PM	67	0	0	0	67	6	99	0	0	105	0	2	0	0	2	174
Hourly Total	308	11	0	2	319	24	464	0	0	488	8	13	0	2	21	828
Grand Total	1942	57	0	4	1999	79	1658	0	8	1737	57	80	0	6	137	3873
Approach %	97.1	2.9	0.0	-	-	4.5	95.5	0.0	-	-	41.6	58.4	0.0	-	-	-
Total %	50.1	1.5	0.0	-	51.6	2.0	42.8	0.0	-	44.8	1.5	2.1	0.0	-	3.5	-
Lights	1908	54	0	-	1962	77	1628	0	-	1705	55	76	0	-	131	3798

% Lights	98.2	94.7	-	-	98.1	97.5	98.2	-	-	98.2	96.5	95.0	-	-	95.6	98.1
Other Vehicles	34	3	0	-	37	2	30	0	-	32	2	4	0	-	6	75
% Other Vehicles	1.8	5.3	-	-	1.9	2.5	1.8	-	-	1.8	3.5	5.0	-	-	4.4	1.9
Pedestrians	-	-	-	4	-	-	-	-	8	-	-	-	-	6	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	100.0	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Data Plot

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

Turning Movement Peak Hour Data (7:30 AM)

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
7:30 AM	133	1	0	0	134	2	25	0	1	27	2	2	0	1	4	165
7:45 AM	83	2	0	0	85	5	44	0	0	49	3	7	0	0	10	144
8:00 AM	117	2	0	0	119	2	35	0	0	37	1	3	0	0	4	160
8:15 AM	102	3	0	0	105	0	45	0	5	45	4	9	0	0	13	163
Total	435	8	0	0	443	9	149	0	6	158	10	21	0	1	31	632
Approach %	98.2	1.8	0.0	-	-	5.7	94.3	0.0	-	-	32.3	67.7	0.0	-	-	-
Total %	68.8	1.3	0.0	-	70.1	1.4	23.6	0.0	-	25.0	1.6	3.3	0.0	-	4.9	-
PHF	0.818	0.667	0.000	-	0.826	0.450	0.828	0.000	-	0.806	0.625	0.583	0.000	-	0.596	0.958
Lights	428	8	0	-	436	8	140	0	-	148	10	20	0	-	30	614
% Lights	98.4	100.0	-	-	98.4	88.9	94.0	-	-	93.7	100.0	95.2	-	-	96.8	97.2
Other Vehicles	7	0	0	-	7	1	9	0	-	10	0	1	0	-	1	18
% Other Vehicles	1.6	0.0	-	-	1.6	11.1	6.0	-	-	6.3	0.0	4.8	-	-	3.2	2.8
Pedestrians	-	-	-	0	-	-	-	-	6	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	100.0	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
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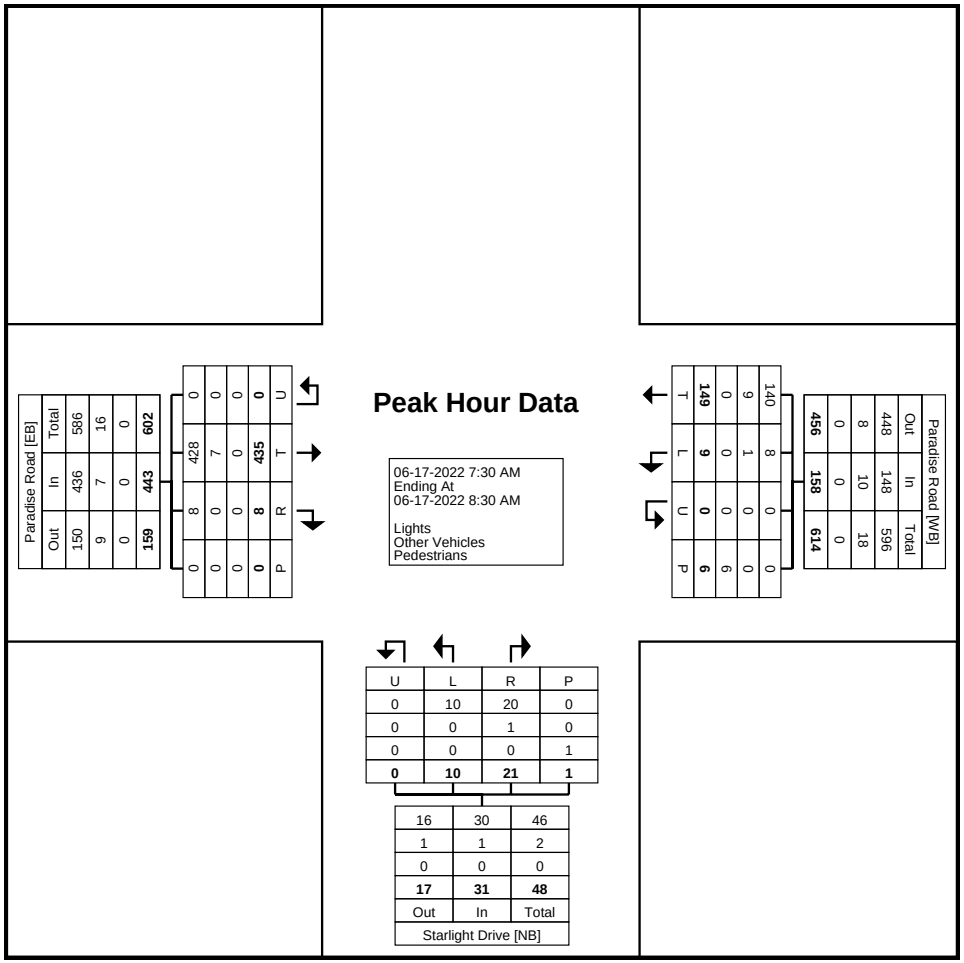
Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Peak Hour Data Plot (7:30 AM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

Turning Movement Peak Hour Data (11:30 AM)

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
11:30 AM	77	1	0	0	78	0	66	0	0	66	2	1	0	0	3	147
11:45 AM	82	3	0	1	85	2	61	0	0	63	4	2	0	1	6	154
12:00 PM	72	3	0	0	75	3	55	0	0	58	2	3	0	0	5	138
12:15 PM	73	5	0	0	78	3	47	0	0	50	0	4	0	0	4	132
Total	304	12	0	1	316	8	229	0	0	237	8	10	0	1	18	571
Approach %	96.2	3.8	0.0	-	-	3.4	96.6	0.0	-	-	44.4	55.6	0.0	-	-	-
Total %	53.2	2.1	0.0	-	55.3	1.4	40.1	0.0	-	41.5	1.4	1.8	0.0	-	3.2	-
PHF	0.927	0.600	0.000	-	0.929	0.667	0.867	0.000	-	0.898	0.500	0.625	0.000	-	0.750	0.927
Lights	298	11	0	-	309	8	225	0	-	233	7	9	0	-	16	558
% Lights	98.0	91.7	-	-	97.8	100.0	98.3	-	-	98.3	87.5	90.0	-	-	88.9	97.7
Other Vehicles	6	1	0	-	7	0	4	0	-	4	1	1	0	-	2	13
% Other Vehicles	2.0	8.3	-	-	2.2	0.0	1.7	-	-	1.7	12.5	10.0	-	-	11.1	2.3
Pedestrians	-	-	-	1	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
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Suite 200
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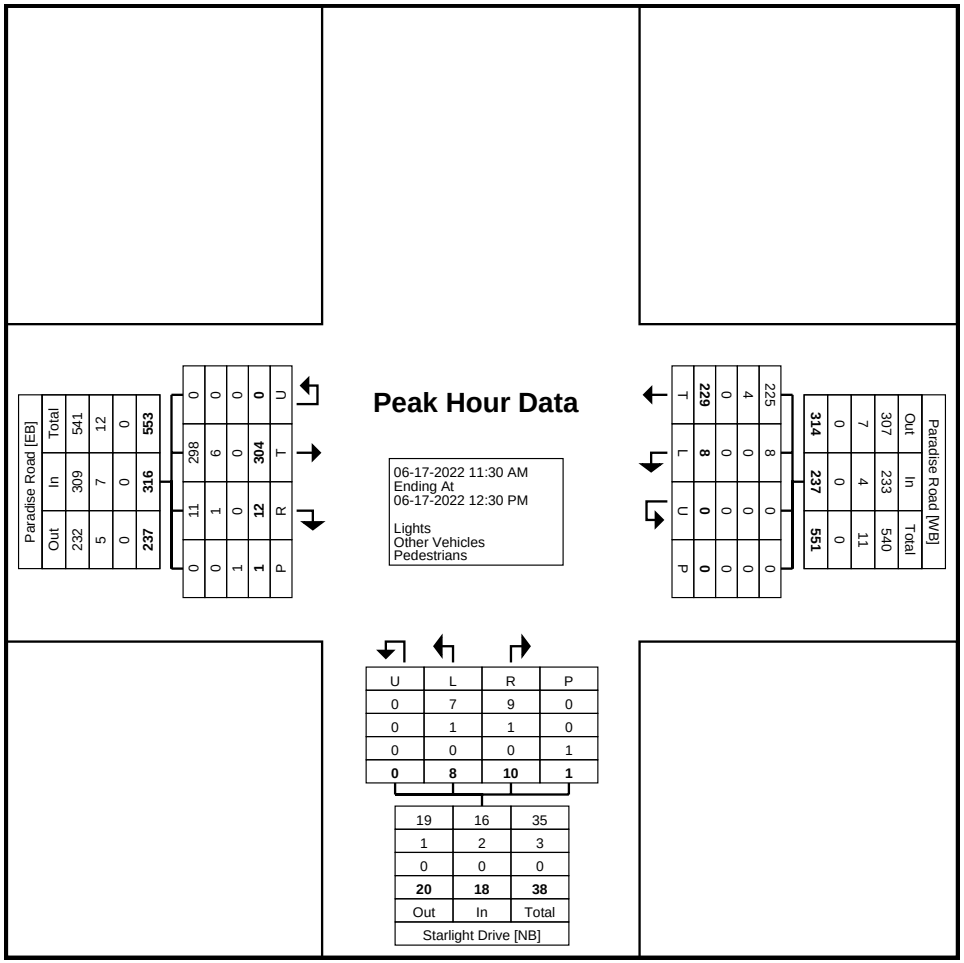
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Peak Hour Data Plot (11:30 AM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

Turning Movement Peak Hour Data (4:30 PM)

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
4:30 PM	79	3	0	0	82	7	117	0	0	124	2	2	0	0	4	210
4:45 PM	79	3	0	0	82	8	117	0	0	125	3	0	0	0	3	210
5:00 PM	77	6	0	0	83	3	123	0	0	126	4	7	0	0	11	220
5:15 PM	87	2	0	2	89	9	129	0	0	138	4	1	0	2	5	232
Total	322	14	0	2	336	27	486	0	0	513	13	10	0	2	23	872
Approach %	95.8	4.2	0.0	-	-	5.3	94.7	0.0	-	-	56.5	43.5	0.0	-	-	-
Total %	36.9	1.6	0.0	-	38.5	3.1	55.7	0.0	-	58.8	1.5	1.1	0.0	-	2.6	-
PHF	0.925	0.583	0.000	-	0.944	0.750	0.942	0.000	-	0.929	0.813	0.357	0.000	-	0.523	0.940
Lights	318	13	0	-	331	27	484	0	-	511	13	9	0	-	22	864
% Lights	98.8	92.9	-	-	98.5	100.0	99.6	-	-	99.6	100.0	90.0	-	-	95.7	99.1
Other Vehicles	4	1	0	-	5	0	2	0	-	2	0	1	0	-	1	8
% Other Vehicles	1.2	7.1	-	-	1.5	0.0	0.4	-	-	0.4	0.0	10.0	-	-	4.3	0.9
Pedestrians	-	-	-	2	-	-	-	-	0	-	-	-	-	2	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
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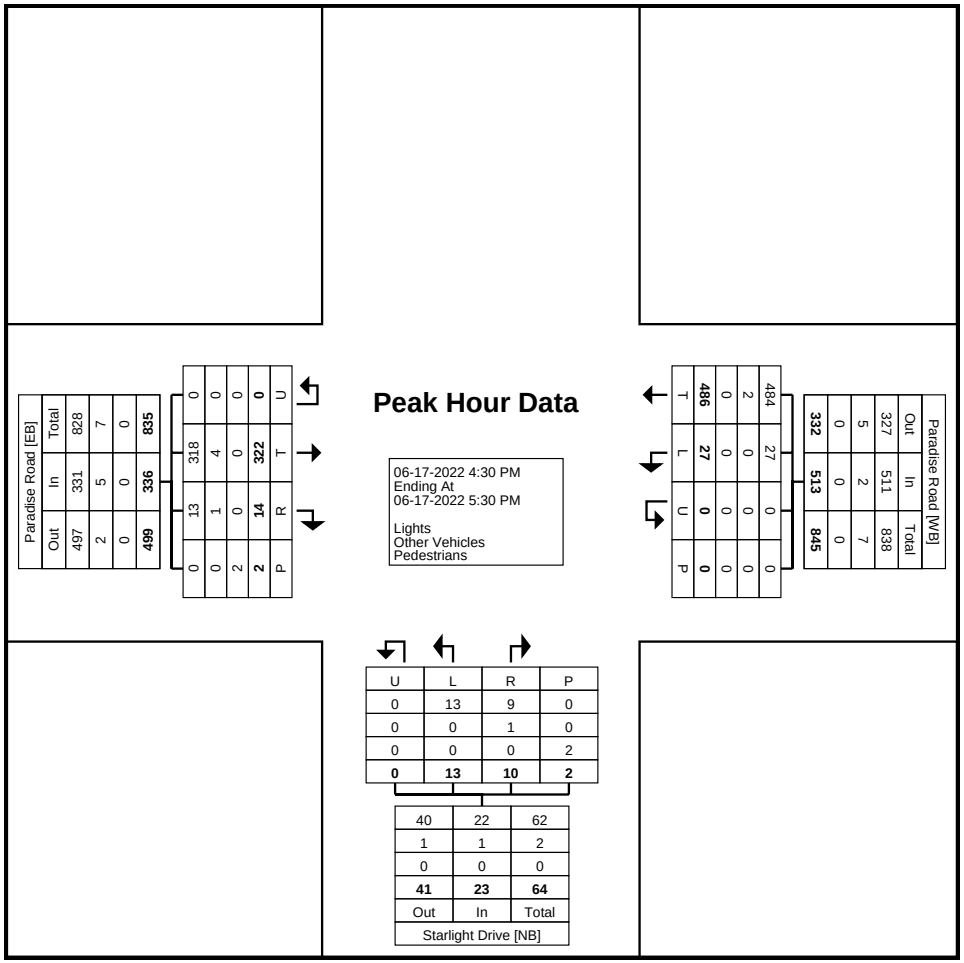
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Peak Hour Data Plot (4:30 PM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

Turning Movement Data

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
7:00 AM	0	35	0	0	35	20	7	0	0	27	15	1	0	0	16	78
7:15 AM	1	77	0	0	78	27	8	0	0	35	28	0	0	0	28	141
7:30 AM	0	106	0	0	106	42	8	0	0	50	21	7	0	0	28	184
7:45 AM	0	89	0	0	89	41	10	0	0	51	35	4	0	0	39	179
Hourly Total	1	307	0	0	308	130	33	0	0	163	99	12	0	0	111	582
8:00 AM	4	91	0	0	95	39	11	0	0	50	26	5	0	0	31	176
8:15 AM	5	106	0	1	111	63	6	0	0	69	26	13	0	2	39	219
8:30 AM	11	120	0	2	131	70	8	0	0	78	25	22	0	0	47	256
8:45 AM	18	81	0	0	99	53	12	0	0	65	13	16	0	0	29	193
Hourly Total	38	398	0	3	436	225	37	0	0	262	90	56	0	2	146	844
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11:00 AM	1	49	0	0	50	49	15	0	0	64	13	1	0	0	14	128
11:15 AM	3	42	0	0	45	30	9	0	0	39	17	1	0	0	18	102
11:30 AM	1	45	0	0	46	32	15	0	0	47	14	2	0	0	16	109
11:45 AM	4	68	0	0	72	62	15	0	0	77	15	0	0	0	15	164
Hourly Total	9	204	0	0	213	173	54	0	0	227	59	4	0	0	63	503
12:00 PM	1	56	0	0	57	52	17	0	0	69	11	1	0	0	12	138
12:15 PM	2	52	0	0	54	68	8	0	0	76	19	0	0	0	19	149
12:30 PM	1	69	0	0	70	72	27	0	0	99	24	3	0	0	27	196
12:45 PM	3	56	0	0	59	63	14	0	0	77	23	6	0	1	29	165
Hourly Total	7	233	0	0	240	255	66	0	0	321	77	10	0	1	87	648
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	2	88	0	1	90	91	26	0	0	117	18	5	0	1	23	230
4:15 PM	6	94	0	3	100	98	30	0	0	128	16	6	0	2	22	250
4:30 PM	7	90	0	1	97	122	30	0	0	152	21	5	0	0	26	275
4:45 PM	4	90	0	1	94	131	39	0	0	170	17	4	0	0	21	285
Hourly Total	19	362	0	6	381	442	125	0	0	567	72	20	0	3	92	1040
5:00 PM	8	90	0	1	98	148	26	0	0	174	16	5	0	0	21	293
5:15 PM	4	79	0	1	83	109	31	0	0	140	30	4	0	1	34	257
5:30 PM	7	110	0	0	117	101	30	0	0	131	25	6	0	0	31	279
5:45 PM	6	108	0	1	114	88	20	0	0	108	21	7	0	0	28	250
Hourly Total	25	387	0	3	412	446	107	0	0	553	92	22	0	1	114	1079
Grand Total	99	1891	0	12	1990	1671	422	0	0	2093	489	124	0	7	613	4696
Approach %	5.0	95.0	0.0	-	-	79.8	20.2	0.0	-	-	79.8	20.2	0.0	-	-	-
Total %	2.1	40.3	0.0	-	42.4	35.6	9.0	0.0	-	44.6	10.4	2.6	0.0	-	13.1	-
Lights	92	1836	0	-	1928	1617	409	0	-	2026	477	117	0	-	594	4548

% Lights	92.9	97.1	-	-	96.9	96.8	96.9	-	-	96.8	97.5	94.4	-	-	96.9	96.8
Other Vehicles	7	55	0	-	62	54	13	0	-	67	12	7	0	-	19	148
% Other Vehicles	7.1	2.9	-	-	3.1	3.2	3.1	-	-	3.2	2.5	5.6	-	-	3.1	3.2
Pedestrians	-	-	-	12	-	-	-	-	0	-	-	-	-	7	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
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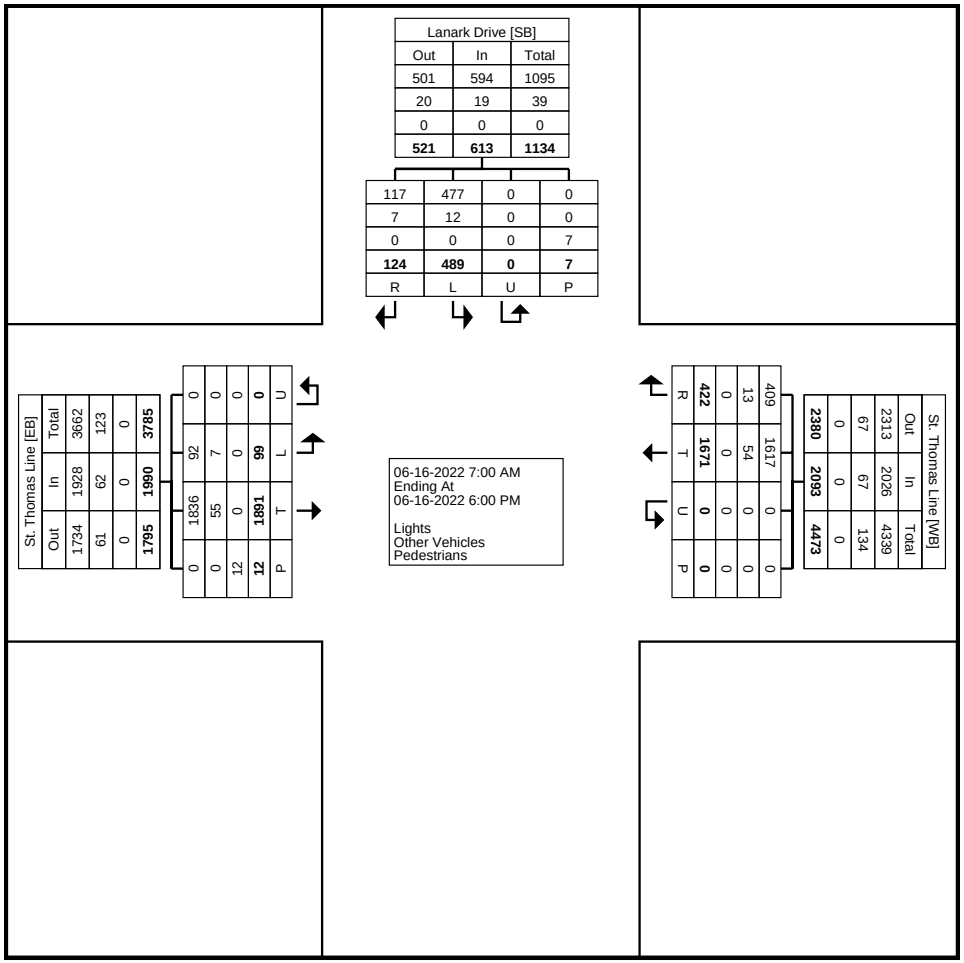
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Data Plot

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

Turning Movement Peak Hour Data (8:00 AM)

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
8:00 AM	4	91	0	0	95	39	11	0	0	50	26	5	0	0	31	176
8:15 AM	5	106	0	1	111	63	6	0	0	69	26	13	0	2	39	219
8:30 AM	11	120	0	2	131	70	8	0	0	78	25	22	0	0	47	256
8:45 AM	18	81	0	0	99	53	12	0	0	65	13	16	0	0	29	193
Total	38	398	0	3	436	225	37	0	0	262	90	56	0	2	146	844
Approach %	8.7	91.3	0.0	-	-	85.9	14.1	0.0	-	-	61.6	38.4	0.0	-	-	-
Total %	4.5	47.2	0.0	-	51.7	26.7	4.4	0.0	-	31.0	10.7	6.6	0.0	-	17.3	-
PHF	0.528	0.829	0.000	-	0.832	0.804	0.771	0.000	-	0.840	0.865	0.636	0.000	-	0.777	0.824
Lights	35	376	0	-	411	203	35	0	-	238	83	53	0	-	136	785
% Lights	92.1	94.5	-	-	94.3	90.2	94.6	-	-	90.8	92.2	94.6	-	-	93.2	93.0
Other Vehicles	3	22	0	-	25	22	2	0	-	24	7	3	0	-	10	59
% Other Vehicles	7.9	5.5	-	-	5.7	9.8	5.4	-	-	9.2	7.8	5.4	-	-	6.8	7.0
Pedestrians	-	-	-	3	-	-	-	-	0	-	-	-	-	2	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

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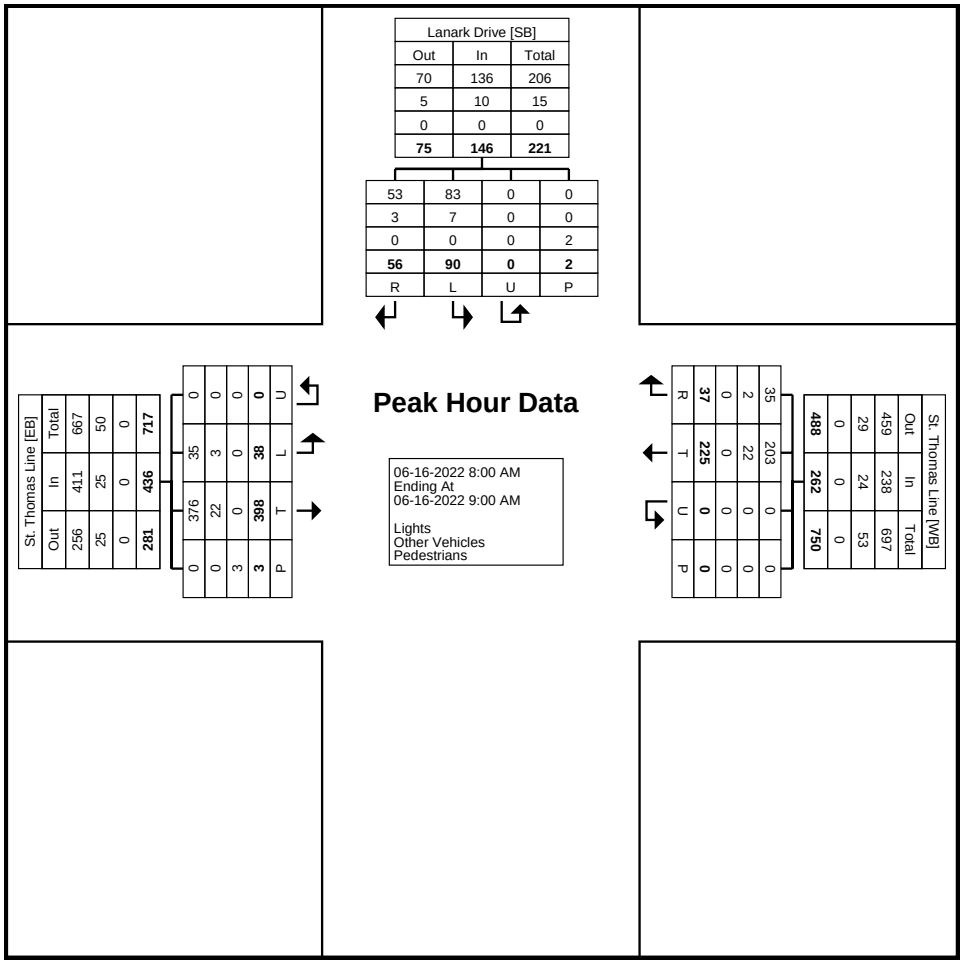
Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Peak Hour Data Plot (8:00 AM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

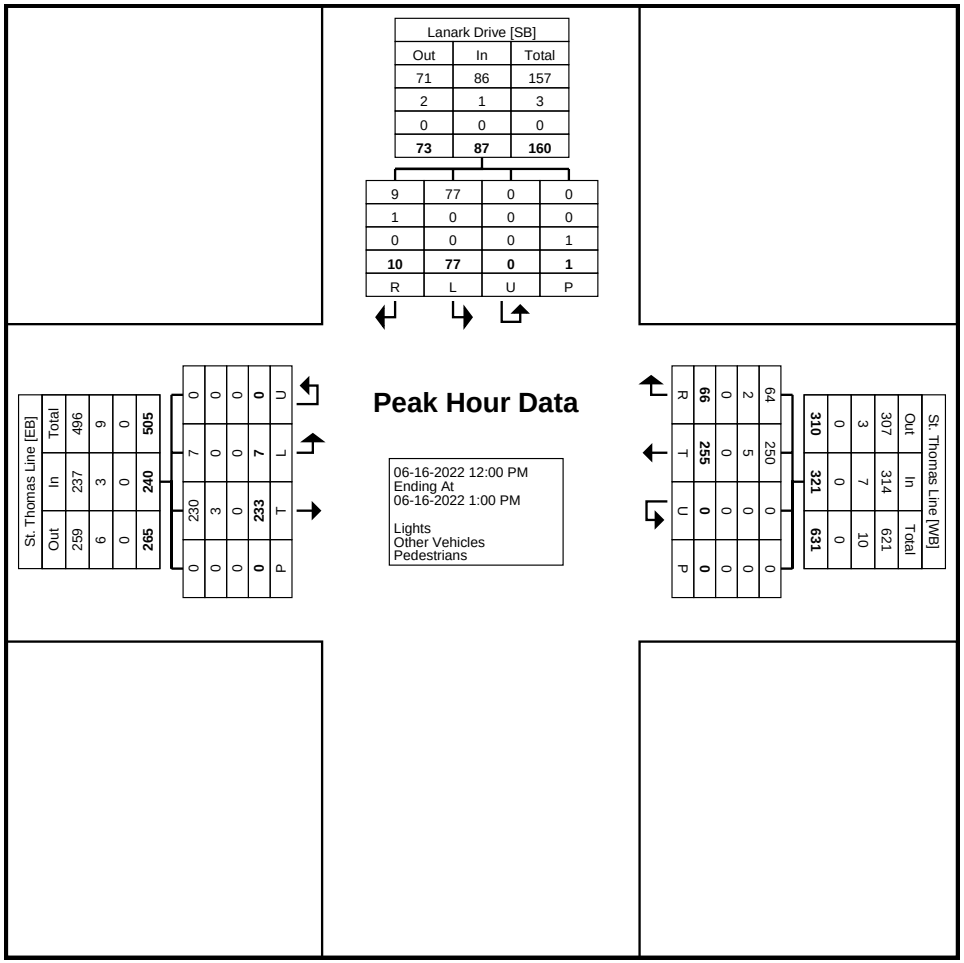
Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

Turning Movement Peak Hour Data (12:00 PM)

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
12:00 PM	1	56	0	0	57	52	17	0	0	69	11	1	0	0	12	138
12:15 PM	2	52	0	0	54	68	8	0	0	76	19	0	0	0	19	149
12:30 PM	1	69	0	0	70	72	27	0	0	99	24	3	0	0	27	196
12:45 PM	3	56	0	0	59	63	14	0	0	77	23	6	0	1	29	165
Total	7	233	0	0	240	255	66	0	0	321	77	10	0	1	87	648
Approach %	2.9	97.1	0.0	-	-	79.4	20.6	0.0	-	-	88.5	11.5	0.0	-	-	-
Total %	1.1	36.0	0.0	-	37.0	39.4	10.2	0.0	-	49.5	11.9	1.5	0.0	-	13.4	-
PHF	0.583	0.844	0.000	-	0.857	0.885	0.611	0.000	-	0.811	0.802	0.417	0.000	-	0.750	0.827
Lights	7	230	0	-	237	250	64	0	-	314	77	9	0	-	86	637
% Lights	100.0	98.7	-	-	98.8	98.0	97.0	-	-	97.8	100.0	90.0	-	-	98.9	98.3
Other Vehicles	0	3	0	-	3	5	2	0	-	7	0	1	0	-	1	11
% Other Vehicles	0.0	1.3	-	-	1.3	2.0	3.0	-	-	2.2	0.0	10.0	-	-	1.1	1.7
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Peak Hour Data Plot (12:00 PM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

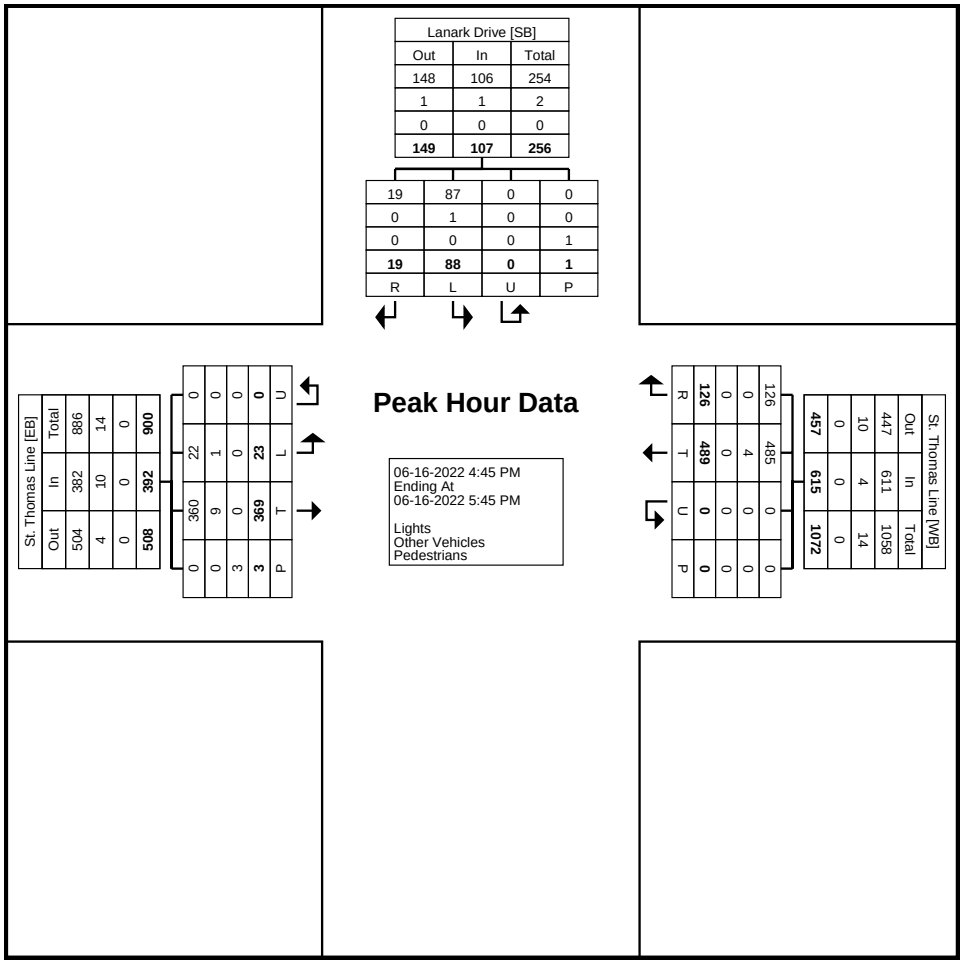
Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

Turning Movement Peak Hour Data (4:45 PM)

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
4:45 PM	4	90	0	1	94	131	39	0	0	170	17	4	0	0	21	285
5:00 PM	8	90	0	1	98	148	26	0	0	174	16	5	0	0	21	293
5:15 PM	4	79	0	1	83	109	31	0	0	140	30	4	0	1	34	257
5:30 PM	7	110	0	0	117	101	30	0	0	131	25	6	0	0	31	279
Total	23	369	0	3	392	489	126	0	0	615	88	19	0	1	107	1114
Approach %	5.9	94.1	0.0	-	-	79.5	20.5	0.0	-	-	82.2	17.8	0.0	-	-	-
Total %	2.1	33.1	0.0	-	35.2	43.9	11.3	0.0	-	55.2	7.9	1.7	0.0	-	9.6	-
PHF	0.719	0.839	0.000	-	0.838	0.826	0.808	0.000	-	0.884	0.733	0.792	0.000	-	0.787	0.951
Lights	22	360	0	-	382	485	126	0	-	611	87	19	0	-	106	1099
% Lights	95.7	97.6	-	-	97.4	99.2	100.0	-	-	99.3	98.9	100.0	-	-	99.1	98.7
Other Vehicles	1	9	0	-	10	4	0	0	-	4	1	0	0	-	1	15
% Other Vehicles	4.3	2.4	-	-	2.6	0.8	0.0	-	-	0.7	1.1	0.0	-	-	0.9	1.3
Pedestrians	-	-	-	3	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Peak Hour Data Plot (4:45 PM)

Appendix B: Existing Operations Synchro Reports

Intersection	
Int Delay, s/veh	0.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	435	8	9	149	10	21
Future Vol, veh/h	435	8	9	149	10	21
Conflicting Peds, #/hr	0	1	1	0	0	6
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	11	6	2	5
Mvmt Flow	453	8	9	155	10	22

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	462	0	631	464
Stage 1	-	-	-	-	458	-
Stage 2	-	-	-	-	173	-
Critical Hdwy	-	-	4.21	-	6.42	6.25
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.299	-	3.518	3.345
Pot Cap-1 Maneuver	-	-	1053	-	445	592
Stage 1	-	-	-	-	637	-
Stage 2	-	-	-	-	857	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1052	-	441	588
Mov Cap-2 Maneuver	-	-	-	-	441	-
Stage 1	-	-	-	-	636	-
Stage 2	-	-	-	-	849	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	12.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	531	-	-	1052	-
HCM Lane V/C Ratio	0.061	-	-	0.009	-
HCM Control Delay (s)	12.2	-	-	8.5	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Intersection	
Int Delay, s/veh	4.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	38	398	225	37	90	56
Future Vol, veh/h	38	398	225	37	90	56
Conflicting Peds, #/hr	2	0	0	2	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	8	6	10	5	8	5
Mvmt Flow	46	485	274	45	110	68

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	321	0	-	0	876	302
Stage 1	-	-	-	-	299	-
Stage 2	-	-	-	-	577	-
Critical Hdwy	4.18	-	-	-	6.48	6.25
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	2.272	-	-	-	3.572	3.345
Pot Cap-1 Maneuver	1206	-	-	-	312	731
Stage 1	-	-	-	-	739	-
Stage 2	-	-	-	-	550	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1203	-	-	-	295	727
Mov Cap-2 Maneuver	-	-	-	-	295	-
Stage 1	-	-	-	-	699	-
Stage 2	-	-	-	-	549	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	22.4
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1203	-	-	-	382
HCM Lane V/C Ratio	0.039	-	-	-	0.466
HCM Control Delay (s)	8.1	0	-	-	22.4
HCM Lane LOS	A	A	-	-	C
HCM 95th %tile Q(veh)	0.1	-	-	-	2.4

Intersection	
Int Delay, s/veh	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	322	14	27	486	13	10
Future Vol, veh/h	322	14	27	486	13	10
Conflicting Peds, #/hr	0	2	2	0	2	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	7	2	2	2	10
Mvmt Flow	343	15	29	517	14	11

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	360	0	930	353
Stage 1	-	-	-	-	353	-
Stage 2	-	-	-	-	577	-
Critical Hdwy	-	-	4.12	-	6.42	6.3
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.39
Pot Cap-1 Maneuver	-	-	1199	-	297	673
Stage 1	-	-	-	-	711	-
Stage 2	-	-	-	-	562	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1196	-	289	671
Mov Cap-2 Maneuver	-	-	-	-	289	-
Stage 1	-	-	-	-	710	-
Stage 2	-	-	-	-	547	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	15
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	384	-	-	1196	-
HCM Lane V/C Ratio	0.064	-	-	0.024	-
HCM Control Delay (s)	15	-	-	8.1	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.1	-

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	23	369	489	126	88	19
Future Vol, veh/h	23	369	489	126	88	19
Conflicting Peds, #/hr	1	0	0	1	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	2	2	2	2	2
Mvmt Flow	24	388	515	133	93	20

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	649	0	-	0	1019	586
Stage 1	-	-	-	-	583	-
Stage 2	-	-	-	-	436	-
Critical Hdwy	4.14	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.236	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	927	-	-	-	263	510
Stage 1	-	-	-	-	558	-
Stage 2	-	-	-	-	652	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	926	-	-	-	254	508
Mov Cap-2 Maneuver	-	-	-	-	254	-
Stage 1	-	-	-	-	539	-
Stage 2	-	-	-	-	651	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	26.4
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	926	-	-	-	279
HCM Lane V/C Ratio	0.026	-	-	-	0.404
HCM Control Delay (s)	9	0	-	-	26.4
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	1.9

Appendix C: 5-Year Background Operations Synchro Reports

Intersection	
Int Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	457	11	14	158	19	36
Future Vol, veh/h	457	11	14	158	19	36
Conflicting Peds, #/hr	0	1	1	0	0	6
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	11	6	2	5
Mvmt Flow	476	11	15	165	20	38

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	488	0	678	489
Stage 1	-	-	-	-	483	-
Stage 2	-	-	-	-	195	-
Critical Hdwy	-	-	4.21	-	6.42	6.25
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.299	-	3.518	3.345
Pot Cap-1 Maneuver	-	-	1030	-	418	573
Stage 1	-	-	-	-	620	-
Stage 2	-	-	-	-	838	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1029	-	411	569
Mov Cap-2 Maneuver	-	-	-	-	411	-
Stage 1	-	-	-	-	619	-
Stage 2	-	-	-	-	825	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	13.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	502	-	-	1029	-
HCM Lane V/C Ratio	0.114	-	-	0.014	-
HCM Control Delay (s)	13.1	-	-	8.5	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	40	418	236	39	95	59
Future Vol, veh/h	40	418	236	39	95	59
Conflicting Peds, #/hr	2	0	0	2	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	8	6	10	5	8	5
Mvmt Flow	49	510	288	48	116	72

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	338	0	-	0	922	317
Stage 1	-	-	-	-	314	-
Stage 2	-	-	-	-	608	-
Critical Hdwy	4.18	-	-	-	6.48	6.25
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	2.272	-	-	-	3.572	3.345
Pot Cap-1 Maneuver	1188	-	-	-	293	717
Stage 1	-	-	-	-	727	-
Stage 2	-	-	-	-	532	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1185	-	-	-	275	713
Mov Cap-2 Maneuver	-	-	-	-	275	-
Stage 1	-	-	-	-	683	-
Stage 2	-	-	-	-	531	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	25.4
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1185	-	-	-	360
HCM Lane V/C Ratio	0.041	-	-	-	0.522
HCM Control Delay (s)	8.2	0	-	-	25.4
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	2.9

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	339	24	44	512	19	20
Future Vol, veh/h	339	24	44	512	19	20
Conflicting Peds, #/hr	0	2	2	0	2	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	7	2	2	2	10
Mvmt Flow	361	26	47	545	20	21

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	389	0	1017	376
Stage 1	-	-	-	-	376	-
Stage 2	-	-	-	-	641	-
Critical Hdwy	-	-	4.12	-	6.42	6.3
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.39
Pot Cap-1 Maneuver	-	-	1170	-	263	653
Stage 1	-	-	-	-	694	-
Stage 2	-	-	-	-	525	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1167	-	251	651
Mov Cap-2 Maneuver	-	-	-	-	251	-
Stage 1	-	-	-	-	693	-
Stage 2	-	-	-	-	503	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	16.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	366	-	-	1167	-
HCM Lane V/C Ratio	0.113	-	-	0.04	-
HCM Control Delay (s)	16.1	-	-	8.2	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.4	-	-	0.1	-

Intersection	
Int Delay, s/veh	3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	24	388	514	132	92	20
Future Vol, veh/h	24	388	514	132	92	20
Conflicting Peds, #/hr	1	0	0	1	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	2	2	2	2	2
Mvmt Flow	25	408	541	139	97	21

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	681	0	-	0	1070	615
Stage 1	-	-	-	-	612	-
Stage 2	-	-	-	-	458	-
Critical Hdwy	4.14	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.236	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	902	-	-	-	245	491
Stage 1	-	-	-	-	541	-
Stage 2	-	-	-	-	637	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	901	-	-	-	236	489
Mov Cap-2 Maneuver	-	-	-	-	236	-
Stage 1	-	-	-	-	521	-
Stage 2	-	-	-	-	636	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	29.8
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	901	-	-	-	260
HCM Lane V/C Ratio	0.028	-	-	-	0.453
HCM Control Delay (s)	9.1	0	-	-	29.8
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	2.2

Appendix D: 5-Year Total Operations Synchro Reports

Intersection	
Int Delay, s/veh	1.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	457	13	17	158	24	45
Future Vol, veh/h	457	13	17	158	24	45
Conflicting Peds, #/hr	0	1	1	0	0	6
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	11	6	2	5
Mvmt Flow	476	14	18	165	25	47

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	491	0	685	490
Stage 1	-	-	-	-	484	-
Stage 2	-	-	-	-	201	-
Critical Hdwy	-	-	4.21	-	6.42	6.25
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.299	-	3.518	3.345
Pot Cap-1 Maneuver	-	-	1027	-	414	572
Stage 1	-	-	-	-	620	-
Stage 2	-	-	-	-	833	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1026	-	406	568
Mov Cap-2 Maneuver	-	-	-	-	406	-
Stage 1	-	-	-	-	619	-
Stage 2	-	-	-	-	818	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	13.4
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	499	-	-	1026	-
HCM Lane V/C Ratio	0.144	-	-	0.017	-
HCM Control Delay (s)	13.4	-	-	8.6	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.5	-	-	0.1	-

Intersection	
Int Delay, s/veh	6.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	43	418	236	44	108	68
Future Vol, veh/h	43	418	236	44	108	68
Conflicting Peds, #/hr	2	0	0	2	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	8	6	10	5	8	5
Mvmt Flow	52	510	288	54	132	83

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	344	0	-	0	931	320
Stage 1	-	-	-	-	317	-
Stage 2	-	-	-	-	614	-
Critical Hdwy	4.18	-	-	-	6.48	6.25
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	2.272	-	-	-	3.572	3.345
Pot Cap-1 Maneuver	1182	-	-	-	289	714
Stage 1	-	-	-	-	725	-
Stage 2	-	-	-	-	529	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1179	-	-	-	270	710
Mov Cap-2 Maneuver	-	-	-	-	270	-
Stage 1	-	-	-	-	679	-
Stage 2	-	-	-	-	528	-

Approach	EB	WB	SB
HCM Control Delay, s	0.8	0	29.5
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1179	-	-	-	355
HCM Lane V/C Ratio	0.044	-	-	-	0.605
HCM Control Delay (s)	8.2	0	-	-	29.5
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	3.8

Intersection	
Int Delay, s/veh	1.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	339	30	54	512	23	26
Future Vol, veh/h	339	30	54	512	23	26
Conflicting Peds, #/hr	0	2	2	0	2	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	7	2	2	2	10
Mvmt Flow	361	32	57	545	24	28

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	395	0	1040	379
Stage 1	-	-	-	-	379	-
Stage 2	-	-	-	-	661	-
Critical Hdwy	-	-	4.12	-	6.42	6.3
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.39
Pot Cap-1 Maneuver	-	-	1164	-	255	651
Stage 1	-	-	-	-	692	-
Stage 2	-	-	-	-	514	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1161	-	241	649
Mov Cap-2 Maneuver	-	-	-	-	241	-
Stage 1	-	-	-	-	691	-
Stage 2	-	-	-	-	488	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	16.6
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	362	-	-	1161	-
HCM Lane V/C Ratio	0.144	-	-	0.049	-
HCM Control Delay (s)	16.6	-	-	8.3	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.5	-	-	0.2	-

Intersection	
Int Delay, s/veh	3.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	30	388	514	151	103	24
Future Vol, veh/h	30	388	514	151	103	24
Conflicting Peds, #/hr	1	0	0	1	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	2	2	2	2	2
Mvmt Flow	32	408	541	159	108	25

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	701	0	-	0	1094	625
Stage 1	-	-	-	-	622	-
Stage 2	-	-	-	-	472	-
Critical Hdwy	4.14	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.236	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	887	-	-	-	237	485
Stage 1	-	-	-	-	535	-
Stage 2	-	-	-	-	628	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	886	-	-	-	225	483
Mov Cap-2 Maneuver	-	-	-	-	225	-
Stage 1	-	-	-	-	509	-
Stage 2	-	-	-	-	627	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	34.8
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	886	-	-	-	250
HCM Lane V/C Ratio	0.036	-	-	-	0.535
HCM Control Delay (s)	9.2	0	-	-	34.8
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	2.9

Appendix E: Traffic Signal Warrant

Town of Paradise - Traffic Signal & Pedestrian Signal Head Warrant Analysis

Main Street (name)	**St Thomas Line**	**Direction (EW or NS)**	**EW**	**Road Authority:**	**Town of Paradise**
Side Street (name)	**Lanark Drive**	**Direction (EW or NS)**	**NS**	**City:**	**Paradise, NL**
Quadrant / Int #		**Comments**	**Enter Comments about the analysis here.**	**Analysis Date:**	**2022 Jul 06, Wed**
				Count Date:	**2022 Jun 16, Thu**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**			**Date Entry Format:**	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	RT Channelization (y/n)	UpStream Signal (m)	# of Thru Lanes	LT Phase Type	RTOR Allowed (y/n)	Actuated Thru Phase
St Thomas Line	WB					1		n	650	1	perm	y	n
St Thomas Line	EB		1					n	2,000	1	perm	y	n
Lanark Drive	NB							n	2,000	0	perm	y	n
Lanark Drive	SB				1			n	2,000	1	perm	y	n

Are the Lanark Drive SB right turns significantly impeded by through movements? (y/n)	n
Are the St Thomas Line WB right turns significantly impeded by through movements? (y/n)	n
	y
	y

Saturation Flow Rates (if not default) (vphpl)		**Default Saturation Flow Rates (vphpl)**
Left Turn		1,650
Through		1,800
Right Turn		1,500

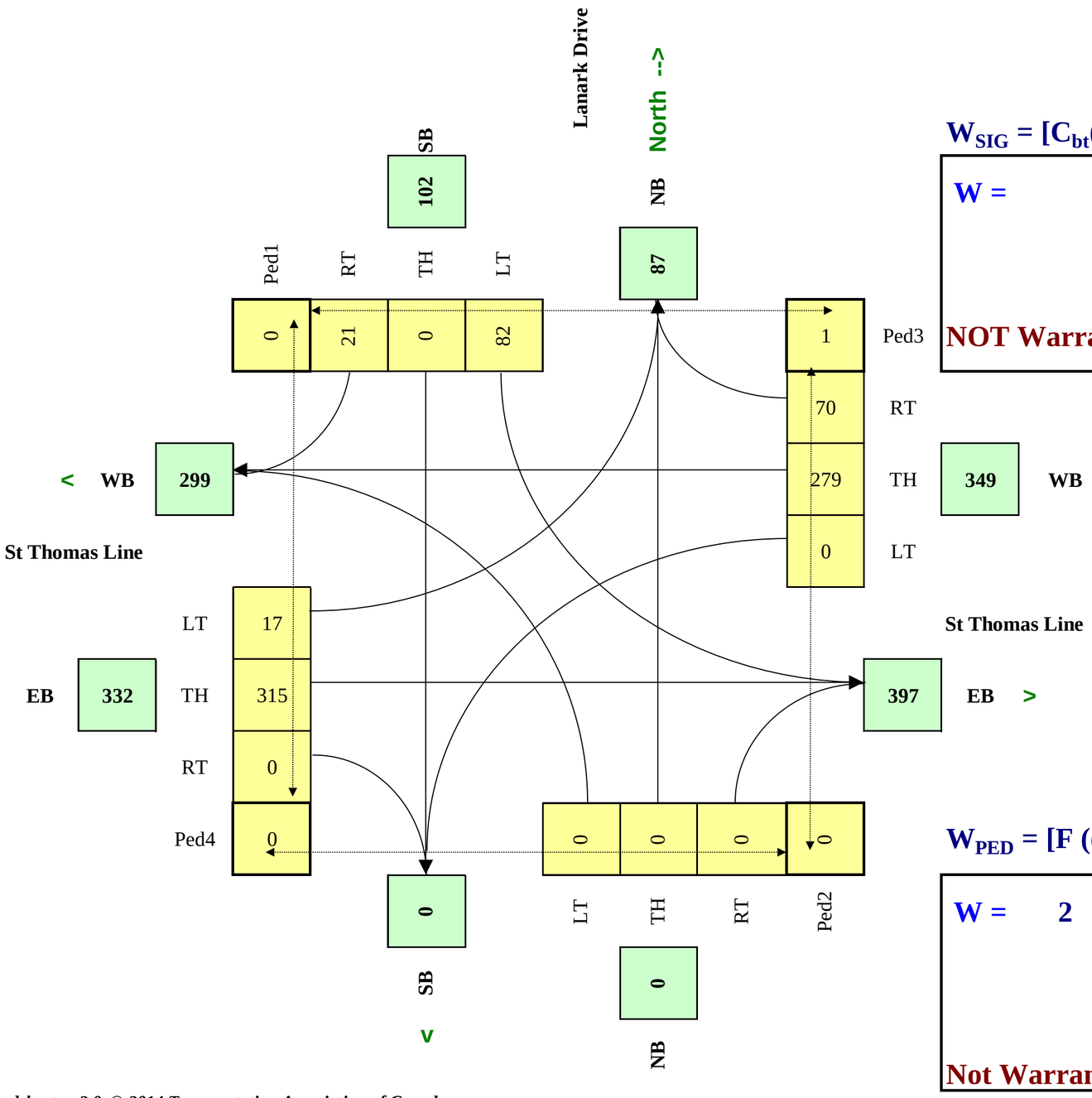
Demographics		
Elem. School/Mobility Challenged	(y/n)	y
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	y
Metro Area Population	(#)	22,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
St Thomas Line	EW	50	3.0%	n	
Lanark Drive	NS		3.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1 NS**	**Ped2 NS**	**Ped3 EW**	**Ped4 EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 - 8:00				99		12		130	33	1	307		0	0	0	0
				90		56		225	37	38	398		0	0	2	0
				59		4		173	54	9	204		0	0	0	0
				77		10		255	66	7	233		0	0	1	0
				72		20		442	125	19	362		0	0	3	0
				92		22		446	107	25	387		0	0	1	0
Total (6-hour peak)	**0**	**0**	**0**	**489**	**0**	**124**	**0**	**1,671**	**422**	**99**	**1,891**	**0**	**0**	**0**	**7**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**82**	**0**	**21**	**0**	**279**	**70**	**17**	**315**	**0**	**0**	**0**	**1**	**0**
Actual Pedestrian Crossing Distance (m)													20.0	14.0	14.0	14.0

Average 6-hour Peak Turning Movements



$W_{SIG} = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$

W =	36	36	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

$W_{PED} = [F\,((Xped_m)d_m/K_2) + (Xped_s)d_s/K_3)]$

W = 2

Not Warranted - Ped Vol<25(avg)

McCarthy Subdivision, Paradise, NL

Traffic Impact Assessment

Status: Draft Report – Updated for Revised Subdivision Layout

Date: March 22, 2024

Harbourside Transportation Consultants
8 Rowan Street, Suite 301
St. John's, NL, Canada A1B 4J9
Tel: (709) 579-6435
www.harboursidetransportation.com

Project Name: McCarthy Subdivision Traffic Impact Assessment

Project No.: 222059

Status: Draft Report - Updated for Revised Subdivision Layout

Date: March 22, 2024

Prepared for:

Pinnacle Engineering

Prepared by:

Mark Stuckless, P.Eng.

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Table of Contents

List of Appendices

List of Figures

List of Tables

1 Introduction

Pinnacle Engineering retained Harbourside Transportation Consultants to conduct a Traffic Impact Assessment for a residential development referred to as the McCarthy Subdivision located on Lanark Drive in Paradise, NL. Figure 1 illustrates the site location.

The study assesses current and future background traffic conditions within the study area, estimates the traffic generated by the development site, assesses the impacts of the site-generated traffic on the surrounding road network and identifies improvements required to accommodate the site generated traffic.

Figure 1: Site Location

2 Study Area

2.1 Road Network

The roadways of interest within the study area include:

- **Paradise Road:** a collector roadway[1] that runs from Topsail Road to St. Thomas Line. Paradise Road has a three-lane urban cross section with sidewalks on one or both sides of the roadway. Paradise Road has a posted speed limit of 50 km/hr.
- **St. Thomas Line**: a collector roadway that runs from Paradise Road north to the adjacent community of Portugal Cove-St. Philip's. St. Thomas Line has a three-lane urban cross section with sidewalks on one side of the roadway between Paradise Road and Ridgewood Drive. North of Ridgewood Drive Paradise Road has a two-lane rural cross section. St. Thomas Line has a posted speed limit of 50 km/hr.
- **Lanark Drive:** a collector roadway that runs from St. Thomas Line along Adams Pond. Segments of Lanark Drive are constructed as development occurs, when completed the roadway will form a loop around Adams Pond. Lanark Drive has a two-lane cross section with sidewalks on both sides of the roadway. Lanark Drive has a speed limit of 40 km/h.
- **Starlight Drive:** a local roadway that runs from Paradise Road to Rembrant Boulevard. Starlight Drive has a two-lane cross section with sidewalks on one side of the roadway. Starlight Drive has a speed limit of 40 km/h.
- **Rembrant Boulevard:** a local roadway that runs from Starlight Drive to Archibald Drive. Rembrant Boulevard has a two-lane cross section with sidewalks on one side of the roadway. Rembrant Boulevard has a speed limit of 40 km/h.

2.2 Intersections

The intersections assessed in this study include:

- **St. Thomas Line and Lanark Drive:** unsignalized three-leg intersection with stop control on the Lanark Drive approach; and
- **Paradise Road and Starlight Drive:** unsignalized three-leg intersection with stop control on the Starlight Drive approach. There is a westbound left turn lane on Paradise Road at the intersection.

[1] Development Regulations – Appendix F: Street Classification, Town of Paradise, September 2020.

3 Existing Traffic Operations

3.1 Traffic Volumes

Turning movement counts were collected at the study area intersections using Miovision 'Scout' video data collection devices. The turning movement counts recorded traffic data during the morning (AM) peak period (7:00 and 9:00 AM), mid-day peak period (11:00 AM and 1:00 PM) and afternoon (PM) peak period (4:00 and 6:00 PM) in June 2022. Motor vehicle and pedestrian volumes were reported in 15-minute intervals.

Figure 2 illustrates the existing base year weekday AM and PM peak hour traffic volumes at the study area intersections. Appendix A contains the traffic count data.

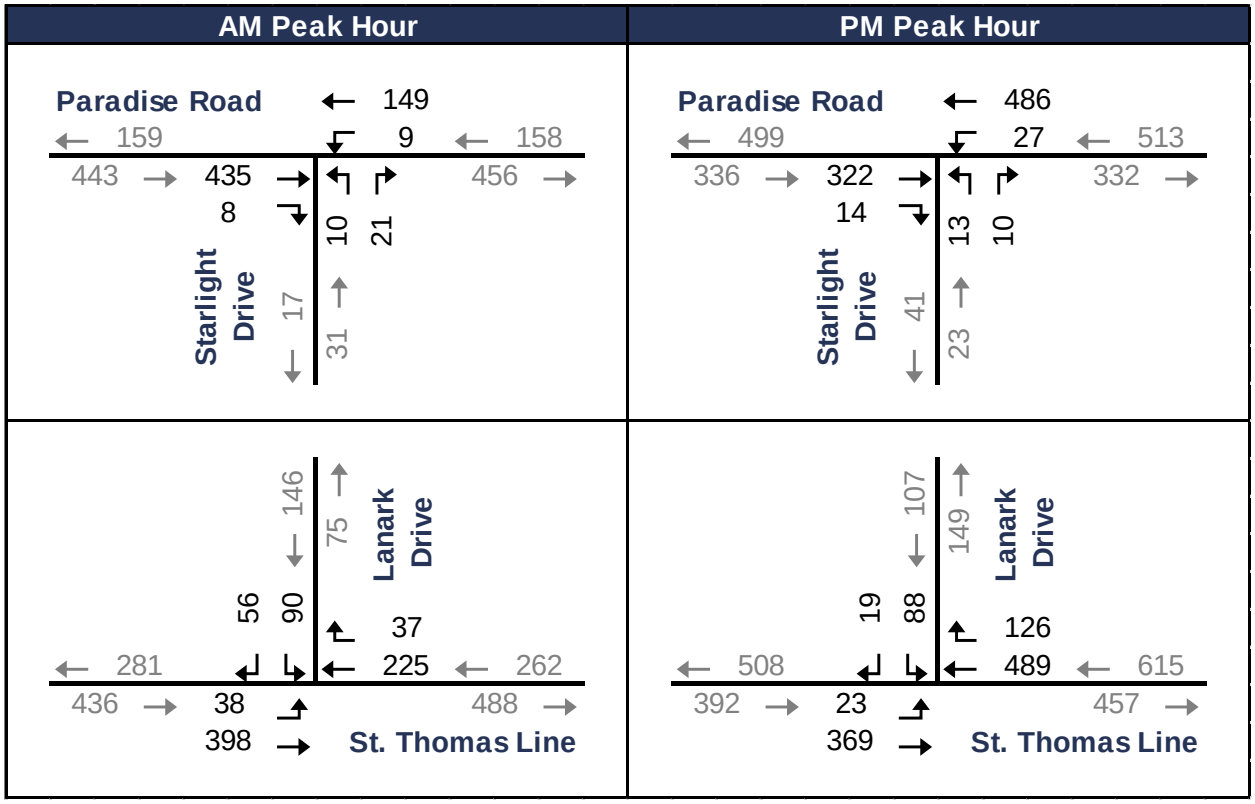


Figure 2: Existing Traffic Volumes

3.2 Existing Operations

Traffic operations at the study area intersections were evaluated using Synchro 11 and Highway Capacity Manual (HCM) 6th edition procedures. The intersection analysis considered the following measures of performance:

- Level of service (LOS) for each turning movement. LOS is a measure that describes the performance or efficiency of traffic flow based on the average control delay per vehicle. LOS is reported on a scale of A to F, where A represent the highest possible rating and LOS F represents the worst rating where the level of congestion is considered unacceptable. Table 1 summarizes the delay criteria for LOS at signalized and unsignalized intersections.
- The volume-to-capacity (v/c) ratio for each turning movement; and
- The 95th percentile queue lengths for each turning movement.

Table 1: Level of Service Criteria

LOS	Description	Signalized Delay	Unsignalized Delay
A	No congestion; most vehicles do not stop.	≤ 10 s/veh	≤ 10 s/veh
B	Very light congestion; some vehicles stop.	10-20 s/veh	10-15 s/veh
C	Light congestion; most vehicles stop.	20-35 s/veh	15-25 s/veh
D	Minor congestion; no long-standing queues.	35-55 s/veh	25-35 s/veh
E	Congestion; long-standing queues are formed.	55-80 s/veh	35-50 s/veh
F	Severe congestion; demand exceeds capacity.	≥ 80 s/veh	≥ 50 s/veh

The following criteria indicate critical conditions:

- LOS for an individual or shared movement exceeds LOS “D”;
- The v/c ratio for an individual or shared movement exceeds 0.85; or
- The 95th percentile length for an individual movement exceeds the available queue storage.

Mitigation measures may need to be considered for movements in critical conditions.

Existing operations at the study intersections were evaluated using the existing lane configuration, traffic control and traffic volumes (Figure 2). Table 2 and Table 3 summarize the results of the analysis for the AM and PM peak hours. No critical movements are identified; operations at both study intersections are considered acceptable. Appendix B contains the supporting detailed Synchro reports.

The Paradise Road & Starlight Drive intersection operates with minimal delay and queuing, and v/c ratios well within capacity during the AM and PM peak hours. The St. Thomas Line & Lanark Drive intersection operates with minimal delay and queuing, and v/c ratios well within capacity during the AM peak hour. During the PM peak hour, LOS D or minor congestion is observed on the Lanark Drive approach (stop-controlled). No significant or long-standing queues are formed and the v/c ratios are well within capacity during the PM peak hours.

Table 2: Existing Operations, AM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	435	8	443	9	149	158	10	21	31	632
	Delay	0.0	0.0	0.0	8.5	0.0	0.5	12.2		12.2	0.7
	LOS	A	A	A	A	A	A	B		B	A
	v/c	0.00	0.00		0.01	0.00		0.06			
	95th% Q	0.0	0.0		0.0	0.0		1.5			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	38	398	436	225	37	262	90	56	146	844
	Delay	8.1	0.0	0.7	0.0	0.0	0.0	22.4		22.4	4.2
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.04	0.00		0.00	0.00		0.47			
	95th% Q	0.8	0.0		0.0	0.0		18.2			

Table 3: Existing Operations, PM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	322	14	336	27	486	513	13	10	23	872
	Delay	0.0	0.0	0.0	8.1	0.0	0.4	15.1		15.1	0.6
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.00	0.00		0.02	0.00		0.06			
	95th% Q	0.0	0.0		0.8	0.0		1.5			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	23	369	392	489	126	615	88	19	107	1114
	Delay	9.0	0.0	0.5	0.0	0.0	0.0	26.4		26.4	2.7
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.03	0.00		0.00	0.00		0.40			
	95th% Q	0.8	0.0		0.0	0.0		14.4			

4 Development Concept

4.1 Development Description

The development site is located in the Lanark Drive area between Quantum Drive and Starlight Drive. The development proposal for the McCarthy Subdivision includes 135 single-family detached units.

The subdivision's road network will:

- Extend Lanark Drive to the north, from Quantum Drive and connecting to the existing segment of Lanark Drive near Tudor Avenue;
- Extend Rembrant Boulevard between Quantum Drive and Starlight Drive;
- Include one new cul-de-sac local roadway accessed from Lanark Drive (currently referred to as Street 'A');
- Include one new cul-de-sac local roadway accessed from Rembrant Boulevard (currently referred to as Street 'B'); and
- Include one new local roadway which will form a crescent shape between Rembrant Boulevard and Street 'B' (currently referred to as Street 'C').

Figure 3 illustrates the concept plan.

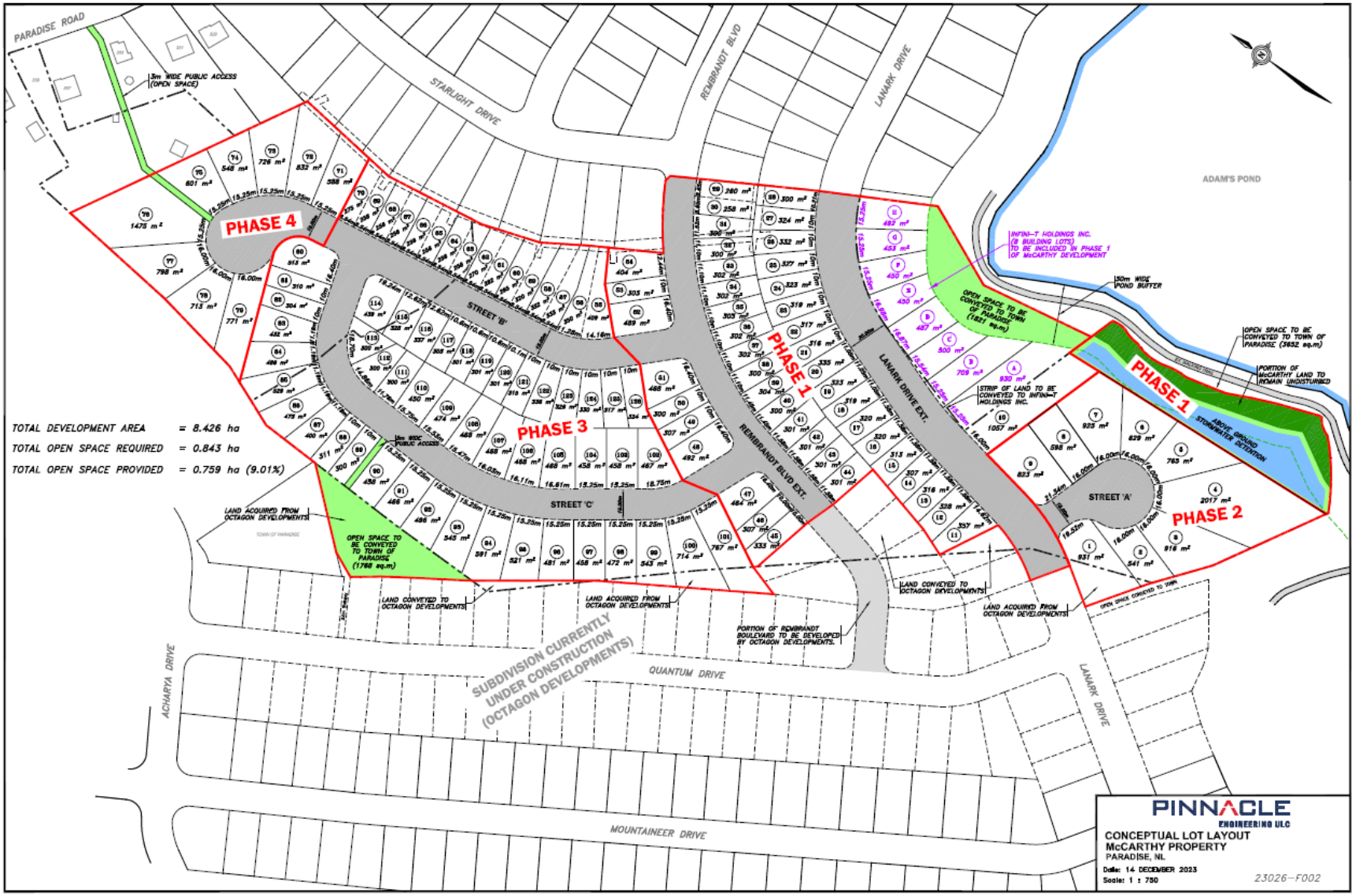


Figure 3: Site Concept Plan

4.2 Access Review

Until Lanark Drive is further extended to complete a loop around Adams Pond, it is anticipated that the proposed subdivision will be accessed primarily from St. Thomas Line via Lanark Drive and from Paradise Road via Starlight Drive. While access to Paradise Road will also be available via Archibald Drive and Acharya Drive, these are less direct routes and for the purposes of this study, the primary access points are considered to be existing intersections of Paradise Road & Starlight Drive and St. Thomas Line & Lanark Drive.

Available sight distance at these intersections was reviewed to confirm that the minimum stopping sight distance and turning sight distance requirements of the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads[2] are met. The minimum sight distance requirements for a two-lane roadway with a design speed of 50 km/h are:

- Minimum stopping sight distance = 65 metres
- Minimum turning sight distance – left-turn from stop = 105 metres
- Minimum turning sight distance – right-turn from stop = 95 metres

Minimum stopping and turning sight distance requirements are met in both directions at the intersections of Paradise Road & Starlight Drive and St. Thomas Line & Lanark Drive.

4.3 Site Plan Review

The site plan has not been reviewed in detail with respect to adherence to the Town of Paradise guidelines for curb radii, street centreline radii, etc. as this is typically completed as part of the Town's review process. For the most part, the proposed road network is the 'natural' extension of both Lanark Drive and Rembrant Boulevard. No issues are noted with the four internal intersections.

- Lanark Drive & Street 'A';
- Rembrant Boulevard & Street 'B';
- Rembrant Boulevard & Street 'C'; and
- Street 'B' & Street 'C'.

The sight distance at internal intersections between two low-volume local roadways should meet the TAC minimum stopping sight distance requirement of 65 metres for a design speed of 50 km/h.

[2] Geometric Design Guide for Canadian Roads, Transportation Association of Canada, June 2017.

4.4 Trip Generation

The Institute of Transportation Engineers (ITE) Trip Generation Manual[3] was used to estimate the site's vehicle trip generation. Land use code 210 Single-Family Detached Housing, General Urban/Suburban was used. Table 4 summarizes the trip generation rates for the land use code.

Table 4: Trip Generation Rates

Land Use	AM Peak Hour			PM Peak Hour		
	Rate	Entering	Exiting	Rate	Entering	Exiting
210 Single-Family Detached Housing	0.70	25%	75%	0.94	63%	37%
Note: Rates are in vehicles per hour (vph)/unit						

Table 5 summarizes the estimated trip generation for the subdivision. The development is forecast to generate approximate 95 vehicle trips during the AM peak hour (24 trips entering and 71 trips exiting) and approximately 127 vehicle trips during the PM peak hour (80 trips entering and 47 trips exiting).

Table 5: Estimated Trip Generation

Land Use	Units	AM Peak Hour			PM Peak Hour		
		Total	Entering	Exiting	Total	Entering	Exiting
210 Single-Family Detached	135	95	24	71	127	80	47
Note: Trips generated are in vehicles per hour (vph).							

4.5 Trip Distribution and Assignment

The site generated vehicle trips were distributed to the road network based on existing travel patterns observed in the turning movement counts.

The site generated vehicle trips were assigned to the two access points based on the following assumptions:

- 60 percent of site-generated traffic will access the site via Lanark Drive; and
- 40 percent of site-generated traffic will access the site via Starlight Drive.

Table 6 summarizes the trip distribution assumptions.

[3] Trip Generation Manual, 11th Edition, Institute of Transportation Engineers, September 2021

Table 6: Trip Distribution

Origin/ Destination	Route	Trip Distribution			
		AM Peak Hour		PM Peak Hour	
East	Paradise Road via Starlight Drive	60%	25%	70%	25%
	St. Thomas Line via Lanark Drive		35%		45%
West	Paradise Road via Starlight Drive	40%	15%	30%	15%
	St. Thomas Line via Lanark Drive		25%		15%
Total		100%	100%	100%	100%

Figure 4 illustrates the site generated traffic volumes for the weekday AM and PM peak hours. Appendix C contains the detailed traffic forecasts for the development application.

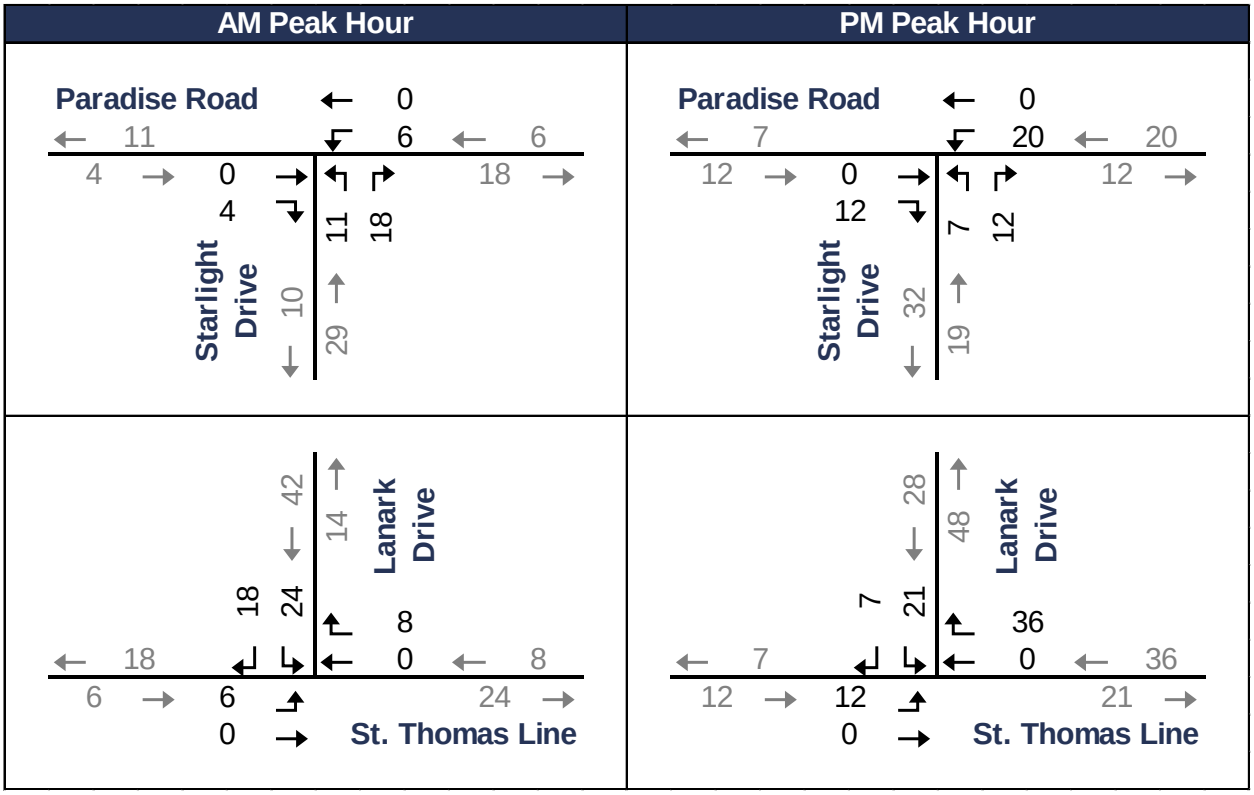


Figure 4: Site-Generated Traffic Volumes

5 Future Traffic Operations

One horizon year, five-years from the date of the study for the full build-out (Year 2027) has been assessed to estimate the impact of background traffic growth and the development.

5.1 Background Operations

The forecast background traffic volumes will consist of:

- Background traffic growth: the increase in non-site traffic is estimated to be 1.0% percent per year; and
- Traffic generated by adjacent developments:
  - Adams Pond Subdivision[4]: A 147-unit subdivision extending Lanark Drive and Rembrant Boulevard between Starlight Drive and Archibald Drive. The development is expected to generate 104 vehicle trips in the AM peak hour (26 trips entering, 78 trips exiting) and 138 vehicle trips in the PM peak hour (87 trips entering, 51 trips exiting). Primary access to the development will be from Paradise Road at Starlight Drive and Archibald Drive.

Figure 5 illustrates the future background traffic volumes for the weekday AM and PM peak hours.

[4] Adams Pond Subdivision Traffic Impact Assessment, Harbourside Transportation Consultants, February 2021.

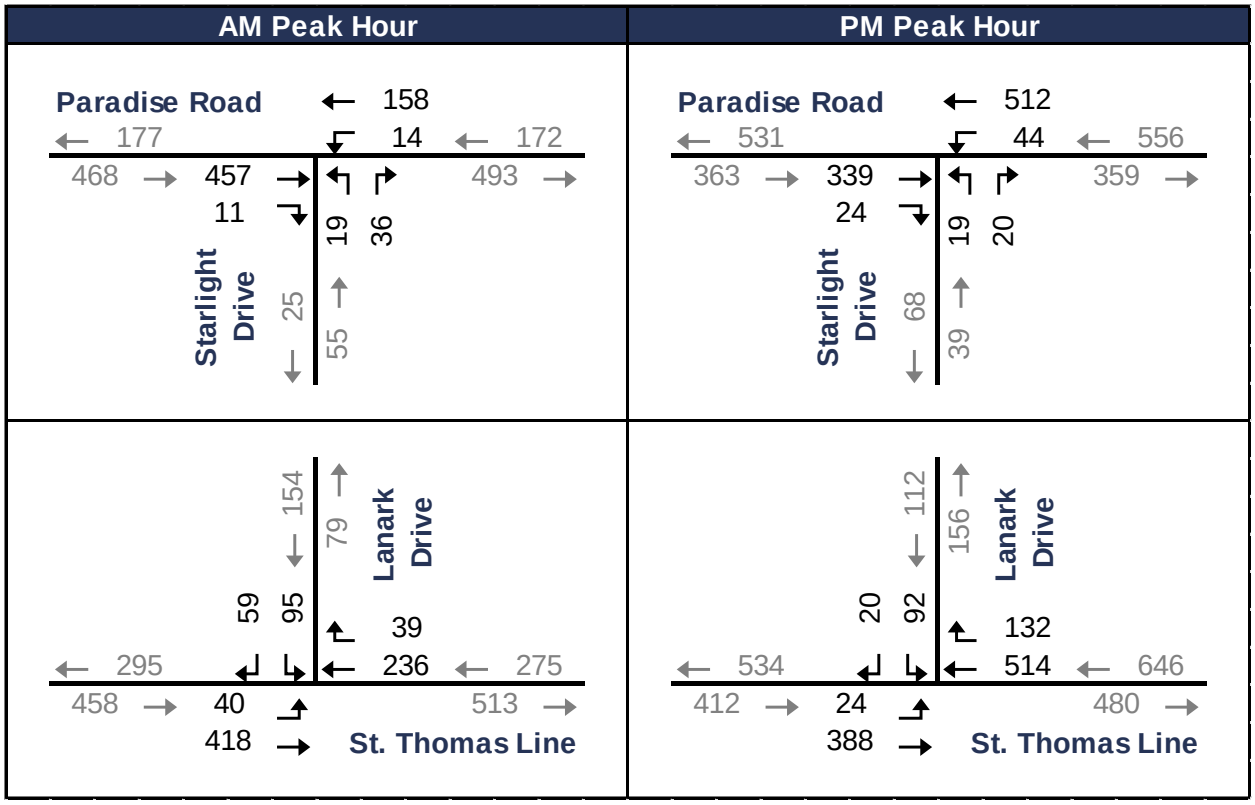


Figure 5: Background Traffic Volumes

Future background operations at the study intersections were evaluated using the same methodology used for existing conditions. No changes to existing traffic control and lane configurations are assumed.

Table 7 and Table 8 summarize the results of the analysis for the AM and PM peak hours. No critical movements are identified; operations at both study intersections are considered acceptable. The impacts of background traffic growth and adjacent developments are:

- Negligible increases in delay (approximately 1.0 second/vehicle or less) and queueing (less than 1 vehicle) are expected at Paradise Road & Starlight Drive; and
- Minor increases in delay (approximately 3.5 seconds/vehicle or less) and queueing (less than 1 vehicle) are expected at St. Thomas Line & Lanark Drive.

Appendix C contains the supporting detailed Synchro reports.

Table 7: Background Operations, AM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	457	11	468	14	158	172	19	36	55	695
	Delay	0.0	0.0	0.0	8.5	0.0	0.7	13.1		13.1	1.2
	LOS	A	A	A	A	A	A	B		B	A
	v/c	0.00	0.00		0.01	0.00		0.11			
	95th% Q	0.0	0.0		0.0	0.0		3.0			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	40	418	458	236	39	275	95	59	154	887
	Delay	8.2	0.0	0.7	0.0	0.0	0.0	25.4		25.4	4.8
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.04	0.00		0.00	0.00		0.52			
	95th% Q	0.8	0.0		0.0	0.0		22.0			

Table 8: Background Operations, PM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	339	24	363	44	512	556	19	20	39	958
	Delay	0.0	0.0	0.0	8.2	0.0	0.7	16.2		16.2	1.1
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.00	0.00		0.04	0.00		0.12			
	95th% Q	0.0	0.0		0.8	0.0		3.0			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	24	388	412	514	132	646	92	20	112	1170
	Delay	9.1	0.0	0.5	0.0	0.0	0.0	29.8		29.8	3.0
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.03	0.00		0.00	0.00		0.45			
	95th% Q	0.8	0.0		0.0	0.0		16.7			

5.2 Total Operations

The forecast total traffic volumes will consist of:

- The future background traffic volumes (background traffic growth and adjacent developments); and
- Traffic generated by the McCarthy Subdivision.

Figure 6 illustrates the future total traffic volumes for the weekday AM and PM peak hours.

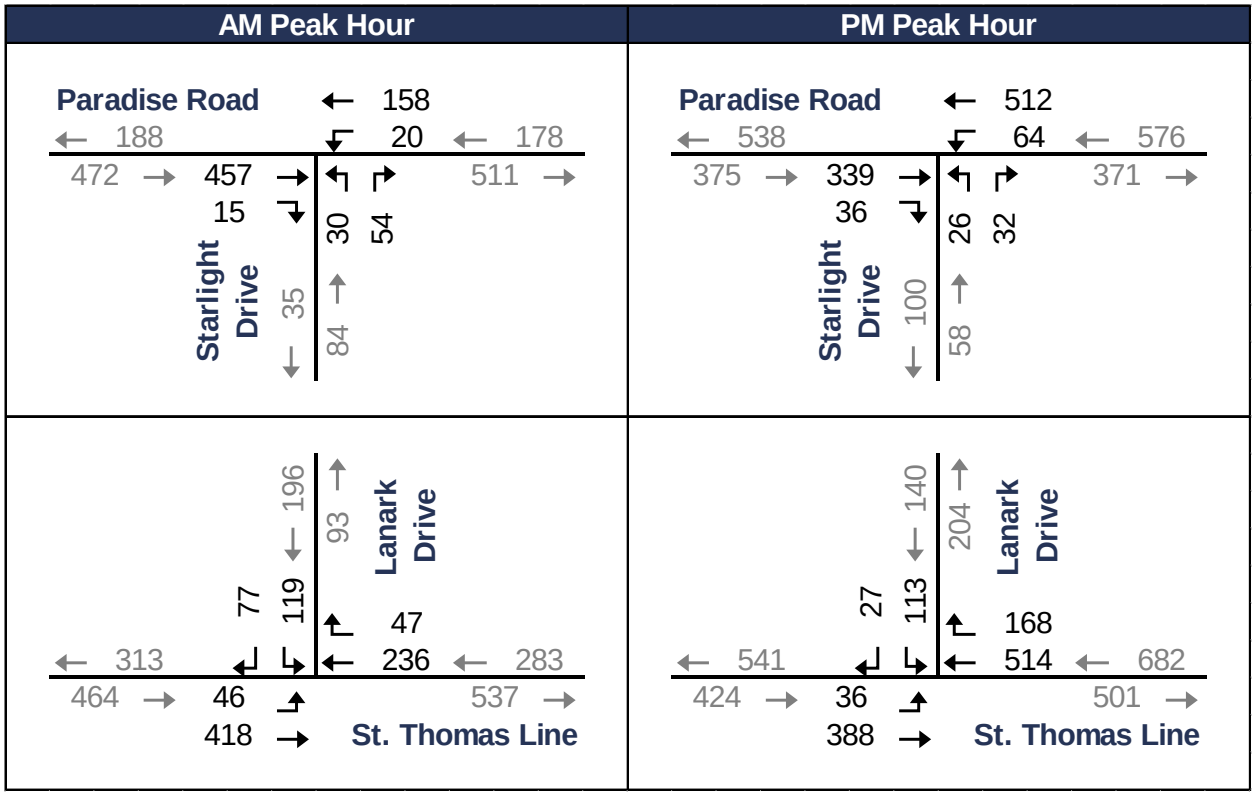


Figure 6: Total Traffic Volumes

Future total operations at the study intersections were evaluated using the same methodology used for existing and future background conditions. No changes to existing traffic control and lane configurations are assumed.

Table 9 and Table 10 summarize the results of the analysis for the AM and PM peak hours. The impacts of site-generated traffic are:

- Negligible increases in delay (less than 1.0 second/vehicle) and queueing (less than 1 vehicle) are expected at Paradise Road & Starlight Drive; and

- Minor increases in delay for the overall intersection (less than 3.0 seconds/vehicle). On the Lanark Drive approach (stop-controlled) increases to delay of 11.0 seconds/vehicle or less and queuing of approximately 2 vehicles are expected. During the PM peak hour, this will cause the LOS to deteriorate from LOS D to LOS E. The v/c ratio for the southbound movements is expected to remain well below capacity and queues are not expected to exceed 3-4 vehicles.

Separating the left turn and right turn movements on the Lanark Drive approach could mitigate overall delay on the approach. The existing width of the approach is sufficient that this could be achieved with changes to the pavement markings.

Appendix D contains the supporting detailed Synchro reports.

Table 9: Total Operations, AM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	457	15	472	20	158	178	30	54	84	734
	Delay	0.0	0.0	0.0	8.6	0.0	1.0	13.8		13.8	1.8
	LOS	A	A	A	A	A	A	B		B	A
	v/c	0.00	0.00		0.02	0.00		0.18			
	95th% Q	0.0	0.0		0.8	0.0		4.6			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	46	418	464	236	47	283	119	77	196	943
	Delay	8.2	0.0	0.8	0.0	0.0	0.0	34.6		34.6	7.6
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.05	0.00		0.00	0.00		0.68			
	95th% Q	0.8	0.0		0.0	0.0		36.5			

Table 10: Total Operations, PM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	339	36	375	64	512	576	26	32	58	1009
	Delay	0.0	0.0	0.0	8.3	0.0	0.9	17.1		17.1	1.5
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.00	0.00		0.06	0.00		0.17			
	95th% Q	0.0	0.0		1.5	0.0		4.6			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	36	388	424	514	168	682	113	27	140	1246
	Delay	9.3	0.0	0.8	0.0	0.0	0.0	40.6		40.6	4.8
	LOS	A	A	A	A	A	A	E		E	A
	v/c	0.04	0.00		0.00	0.00		0.54			
	95th% Q	0.8	0.0		0.0	0.0		22.0			

6 Remedial Measures

6.1 Traffic Signal Warrant

The Transportation Association of Canada (TAC) Traffic Signal and Pedestrian Head Warrant Handbook[5] provides guidance on the assessment of the need for traffic control signals at intersections. The procedure uses a “cumulative factors methodology” to identify if traffic control signals are warranted based on factors such as geometry, operating parameters, local demographics and pedestrian and vehicular volumes and conflicts. To warrant the installation of a traffic control signal, an intersection must score a minimum of 100 cumulative warrant points.

The traffic signal warrant analysis was completed for the intersection of St. Thomas Line & Lanark Drive using existing traffic volumes. The signal warrant is not satisfied (36 cumulative warrant points); no improvements to the existing form of stop control are recommended. Appendix E contains the warrant analysis.

[5] TAC Traffic Signal and Pedestrian Head Warrant Handbook, June 2014.

6.2 Left Turn Lane Warrant

The Ministry of Transportation of Ontario (MTO) Supplement for the TAC Geometric Design Guide for Canadian Roads[6] provides guidance on the assessment of the need for left turn lanes at unsignalized intersections. The methodology uses a series of nomographs to identify if a left turn lane is warranted based on factors such as design speed, advancing volumes, left turn volume as a percentage of advancing volumes and opposing volumes.

The left turn lane warrant analysis was completed for the eastbound direction on St. Thomas Line using the future total traffic volumes.

Figure 7 illustrates the left turn warrant analysis for the AM peak hour, where the left turning volume represents approximately 10% of advancing volumes. A left turn lane with a minimum storage length of 15 metres is warranted; it should be noted that the result falls approximately on the warrant line indicating that the threshold is narrowly met.

Figure 8 illustrates the left turn warrant analysis for the PM peak hour, where the left turning volume represents approximately 8.5% of advancing volumes. A left turn lane with a minimum storage length of 15 metres is warranted.

[6] MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads, Appendix 9 for Chapter 9 Intersections, June 2017.

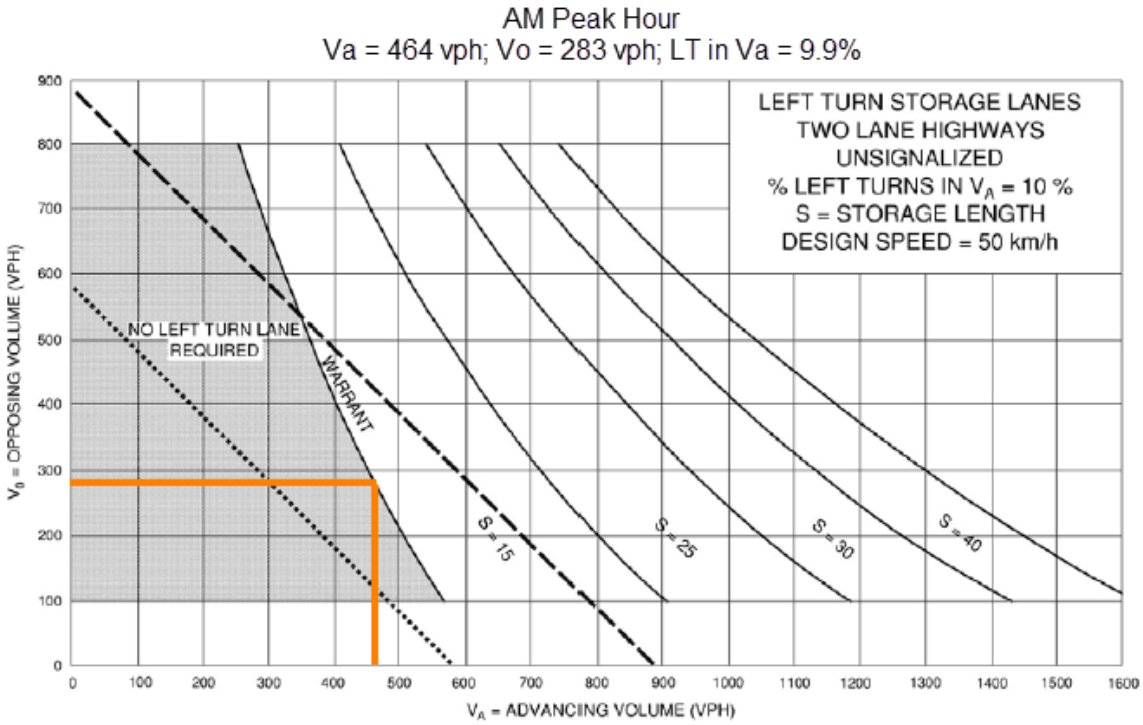


Figure 7: Left Turn Lane Warrant, St. Thomas Line AM Peak Hour

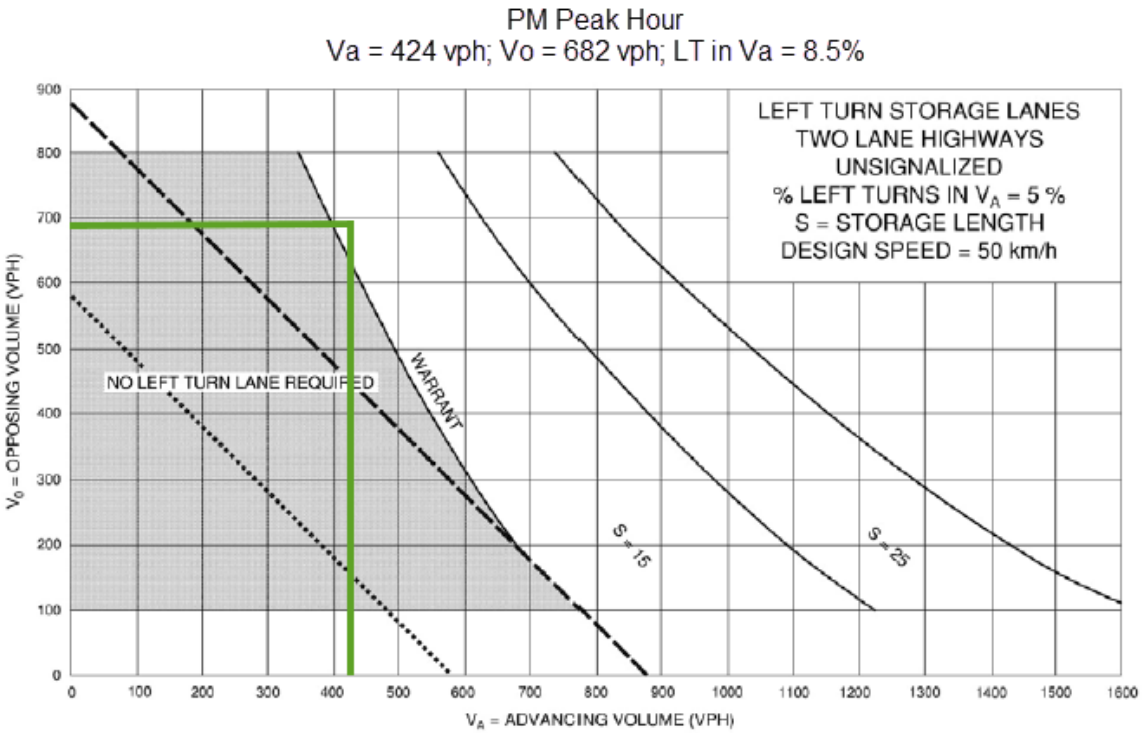


Figure 8: Left Turn Lane Warrant, St. Thomas Line PM Peak Hour

A storage lane could be accommodated within the existing pavement width on St. Thomas Line. Due to the close proximity of Sullivans Road on the opposing side of St. Thomas Line, however, the storage lane would extend across the Sullivans Road approach and vehicles queued in the lane would temporarily block left turns into and out of Sullivans Road. There is also an existing crosswalk in this area. Figure 9 illustrates the existing configuration of the Lanark Drive and Sullivans Road intersections on St. Thomas Line.

Figure 9: St. Thomas Line & Lanark Drive

While the crosswalk could be relocated either to the west side of Sullivans Road, or to the east side of Lanark Drive, neither of these scenarios is ideal. The left turn volume from Lanark Drive to St. Thomas Line is significantly higher than the right turn volume and moving the crosswalk to the east of Lanark would unnecessarily introduce more vehicle-pedestrian conflicts. There is an existing driveway directly across from the existing pedestrian lowback on the west side of Sullivans Road which would require pushing the crossing point even further to the west. Because the pedestrian ‘desire line’ is anticipated to be between the north and south sides of St. Thomas Line at Lanark Drive, pedestrians are more likely to continue crossing at the established crossing point.

Furthermore, it is likely that vehicles are already queuing in the available space in the median area on St. Thomas Line to turn left to either Lanark Drive of Sullivan's Road. The traffic analysis indicates that future left turn queues at Lanark Drive are not expected to exceed a couple of vehicles with average delay of less than 10 seconds, and given the low volumes anticipated to be generated by less than 15 single-family homes on Sullivans Road, no operational or safety concerns are expected to arise from this configuration.

Considering these factors, it is recommended that the existing intersection configuration be maintained unless the Town is aware, or becomes aware, of operational issues at this location.

6.3 Traffic Calming

The Town has indicated that data collected on Lanark Drive shows that vehicle speeds are generally higher than the posted speed limit of 40 km/h. The completion of the segment of Lanark Drive included with this development will provide a connection between St. Thomas Line and the residential areas in the Starlight Drive/Archibald Drive area. Increases in traffic volumes on the existing segments of Lanark Drive are expected to result from completing this segment and also from the future development of Lanark Drive around Adams Pond. Because the roadway characteristics of Lanark Drive, particularly the width, are conducive to higher speeds, traffic calming measures could be implemented when constructing this segment and other future segments of Lanark Drive to mitigate speeds on the roadway.

Lanark Drive is a collector roadway with a face of curb to face of curb width of approximately 15.0 meters. These characteristics (i.e., classification/use and width) are not conducive to supporting a 40 km/h speed limit. A review of the posted speed limit and operating speed data should be completed to determine if the speed limit is appropriate based on the function and characteristics of the roadway and also to verify the magnitude of the speeding issue as it relates to the appropriate speed limit.

Some common methods of achieving speed reductions include horizontal deflection, vertical deflection and road narrowing. Horizontal deflection treatments include treatments such as chicanes and miniature roundabouts which require vehicles to shift their horizontal path of travel. Vertical deflection treatments cause a quick shift in a vehicles vertical path of travel (usually upward movement), resulting in an unpleasant sensation if the movement is completed at higher speeds. Motorists, as such, tend to reduce their speed to traverse the vertical deflection. Roadway narrowing treatments are traffic calming measures which cause a narrowing of the road. These measures are intended to make motorist feel more confined which can encourage reduced speeds. The width of Lanark drive is not conducive to chicane type treatments and miniature roundabouts are better suited to a more wholistic design – being incorporated at multiple

intersections along the route to control speeds along the street, not just at a single location. Lanark Drive is more conducive to road narrowing and vertical deflection type treatments combined with other traffic calming measures such as speed display devices and regular enforcement.

Figure 10 illustrates an example of traffic calming measures already implemented on Lanark Drive at the intersection with Archibald Drive. The installation makes use of both vertical deflection in the form of a raised crosswalk, and roadway narrowing through the use of curb extensions. Both of these traffic calming measures are considered appropriate for use on neighbourhood local and collector roadways and provide benefits for speed reduction[7]. Specific to this development, the only opportunity for a similar type treatment would at the intersection with Street 'A', this location may not necessarily be preferred, or conducive, to a crosswalk installation.

Figure 10: Traffic Calming Measures at Lanark Drive & Archibald Drive

Other vertical deflection measures could include speed tables or cushions. To control speeds along the entire street, a series of speed tables or cushions is more effective than a single installation. The spacing of the speed tables will affect vehicle operating speeds.

[7] Canadian Guide to Traffic Calming, Second Edition, Transportation Association of Canada, February 2018.

Spacing of the tables/cushions should be determined based on the targeted operating speed and should not exceed 150 metres to achieve speeds under 50 km/h[8]. The segment of Lanark Drive constructed as part of this development is approximately 200 metres long which does not provide sufficient length for a series of speed tables or cushions.

Based on the length of this segment there is limited ability to provide traffic calming measures that will have a significant impact on reducing vehicles speeds on this segment alone. To successfully manage speeds on Lanark Drive, the Town should review the corridor as a whole and consider implementing traffic calming measures on existing segments as well as new segments including raised crosswalks and curb extensions at major intersections and lane narrowing with a series of speed tables/cushions between intersections. Given the width of Lanark Drive, other roadway narrowing measures should be considered between intersections as well. This can be accomplished with pavement markings, such as the Town has implemented on Sgt. Donald Lucas Drive and Brougham Drive.

7 Conclusion

Pinnacle Engineering retained Harbourside Transportation Consultants to conduct a Traffic Impact Assessment for a residential development referred to as the McCarthy Subdivision located in Paradise, NL.

The study assesses current and future background traffic conditions within the study area, estimates the traffic generated by the development site, assesses the impacts of the site-generated traffic on the surrounding road network and identifies improvements required to accommodate the site generated traffic.

The development site is located in the Lanark Drive area between Quantum Drive and Starlight Drive. The development proposal for the McCarthy Subdivision includes 135 single-family detached units.

The subdivision's road network will:

- Extend Lanark Drive from Quantum Drive to the north connecting to the existing segment of Lanark Drive near Tudor Avenue;
- Extend Rembrant Boulevard between Quantum Drive and Starlight Drive;

[8] Updated Guidelines for the Design and Application of Speed Humps, Parkhill, M., Sooklall, R. & Bahar, G., CITE 2007 Conference, Toronto, ON, Canada. Microsoft Word - ITE - Speed Humps - Parkhill et al.doc (nacto.org)

- Include one new cul-de-sac local roadway accessed from Lanark Drive (currently referred to as Street ‘A’);
- Include one new cul-de-sac local roadway accessed from Rembrant Boulevard (currently referred to as Street ‘B’); and
- Include on new local roadway which will form a crescent shape between Rembrant Boulevard and Street ‘B’ (currently referred to as Street ‘C’).

Until Lanark Drive is further extended to complete a loop around Adams Pond, it is anticipated that the proposed subdivision will be accessed primarily from St. Thomas Line via Lanark Drive and from Paradise Road via Starlight Drive. While access to Paradise Road will also be available via Archibald Drive and Acharya Drive, these are less direct routes and for the purposes of this study, the primary access points are considered to be existing intersections of Paradise Road & Starlight Drive and St. Thomas Line & Lanark Drive. Minimum stopping and turning sight distance requirements are met in both directions at these intersections.

Based on the investigations carried out, it is concluded that:

- **Existing Traffic Operations:** No capacity issues are identified at the two intersections; traffic operations are considered acceptable.
- **Site-Generated Traffic:** The development is forecast to generate approximate 95 vehicle trips during the AM peak hour (24 trips entering and 71 trips exiting) and approximately 127 vehicle trips during the PM peak hour (80 trips entering and 47 trips exiting).
- **5-year Background Traffic Operations:** No capacity issues are forecast at the intersections with the addition of generalized traffic growth and the adjacent Adams Pond Subdivision.
- **5-year Total Traffic Operations:** The addition of site-generated traffic will cause the Lanark Drive approach to St Thomas Line to deteriorate from LOS D to LOS E during the PM peak hour. The v/c ratio for the southbound movements is expected to remain well below capacity and queues are not expected to exceed 3-4 vehicles.
- **Remedial Measures:** Providing a separate lane for the left turn and right turn movements on the Lanark Drive approach could mitigate overall delay on the approach. The existing width of the approach is sufficient that this could be achieved through changes to pavement markings.

  The forecast future traffic volumes at the intersection of St. Thomas Line & Lanark Drive do not warrant traffic signals; no improvements to the existing form of stop control are recommended. An eastbound left turn lane with a minimum storage

length of 15 metres was found to be warranted on St. Thomas Line. This issue is discussed in detail in Section 6.2 and, considering several factors, it is recommended that the existing configuration on St. Thomas Line at the intersection of St. Thomas Line and Lanark Drive/Sullivans Road be maintained unless the Town is aware, or becomes aware, of any operational issues at this location.

- **Traffic Calming:** The Town has indicated that data collected on Lanark Drive shows that vehicle speeds are generally higher than the posted speed limit of 40 km/h. The segment of Lanark Drive constructed as part of this development is approximately 200 metres long and has only one minor intersection (Street ‘A’). Traffic calming measures implemented on this segment alone are not expected to have a significant impact on reducing speeds along the entire corridor. However, at minimum it is recommended that lane narrowing pavement markings be implemented and that any mid-block crosswalks installed on this segment (none are currently proposed) be constructed as a raised crosswalk with curb extensions. To successfully manage speeds on Lanark Drive, the Town should review the corridor as a whole, review the posted speed limit, and consider implementing traffic calming measures along the entire corridor including raised crosswalks and curb extensions at major intersections and lane narrowing with speed a series of speed tables/cushions between intersections.

Appendix A: Traffic Data

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

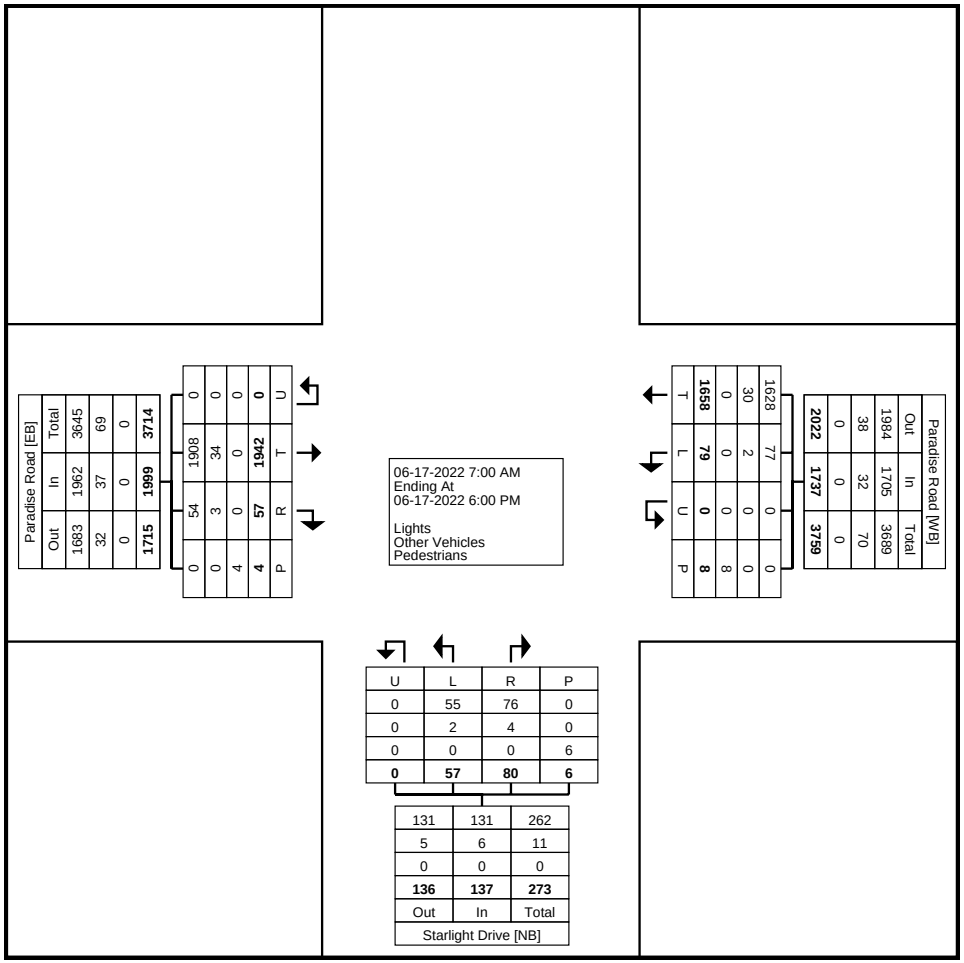
Turning Movement Data

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
7:00 AM	70	0	0	0	70	0	19	0	0	19	1	5	0	0	6	95
7:15 AM	102	1	0	0	103	1	23	0	2	24	2	3	0	0	5	132
7:30 AM	133	1	0	0	134	2	25	0	1	27	2	2	0	1	4	165
7:45 AM	83	2	0	0	85	5	44	0	0	49	3	7	0	0	10	144
Hourly Total	388	4	0	0	392	8	111	0	3	119	8	17	0	1	25	536
8:00 AM	117	2	0	0	119	2	35	0	0	37	1	3	0	0	4	160
8:15 AM	102	3	0	0	105	0	45	0	5	45	4	9	0	0	13	163
8:30 AM	87	1	0	0	88	1	41	0	0	42	4	3	0	0	7	137
8:45 AM	89	2	0	0	91	0	47	0	0	47	2	1	0	0	3	141
Hourly Total	395	8	0	0	403	3	168	0	5	171	11	16	0	0	27	601
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11:00 AM	68	2	0	0	70	2	44	0	0	46	1	5	0	0	6	122
11:15 AM	56	2	0	0	58	3	62	0	0	65	0	5	0	1	5	128
11:30 AM	77	1	0	0	78	0	66	0	0	66	2	1	0	0	3	147
11:45 AM	82	3	0	1	85	2	61	0	0	63	4	2	0	1	6	154
Hourly Total	283	8	0	1	291	7	233	0	0	240	7	13	0	2	20	551
12:00 PM	72	3	0	0	75	3	55	0	0	58	2	3	0	0	5	138
12:15 PM	73	5	0	0	78	3	47	0	0	50	0	4	0	0	4	132
12:30 PM	56	0	0	1	56	3	65	0	0	68	6	5	0	1	11	135
12:45 PM	70	4	0	0	74	2	60	0	0	62	1	1	0	0	2	138
Hourly Total	271	12	0	1	283	11	227	0	0	238	9	13	0	1	22	543
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	72	5	0	0	77	3	102	0	0	105	5	2	0	0	7	189
4:15 PM	67	3	0	0	70	8	119	0	0	127	4	4	0	0	8	205
4:30 PM	79	3	0	0	82	7	117	0	0	124	2	2	0	0	4	210
4:45 PM	79	3	0	0	82	8	117	0	0	125	3	0	0	0	3	210
Hourly Total	297	14	0	0	311	26	455	0	0	481	14	8	0	0	22	814
5:00 PM	77	6	0	0	83	3	123	0	0	126	4	7	0	0	11	220
5:15 PM	87	2	0	2	89	9	129	0	0	138	4	1	0	2	5	232
5:30 PM	77	3	0	0	80	6	113	0	0	119	0	3	0	0	3	202
5:45 PM	67	0	0	0	67	6	99	0	0	105	0	2	0	0	2	174
Hourly Total	308	11	0	2	319	24	464	0	0	488	8	13	0	2	21	828
Grand Total	1942	57	0	4	1999	79	1658	0	8	1737	57	80	0	6	137	3873
Approach %	97.1	2.9	0.0	-	-	4.5	95.5	0.0	-	-	41.6	58.4	0.0	-	-	-
Total %	50.1	1.5	0.0	-	51.6	2.0	42.8	0.0	-	44.8	1.5	2.1	0.0	-	3.5	-
Lights	1908	54	0	-	1962	77	1628	0	-	1705	55	76	0	-	131	3798

% Lights	98.2	94.7	-	-	98.1	97.5	98.2	-	-	98.2	96.5	95.0	-	-	95.6	98.1
Other Vehicles	34	3	0	-	37	2	30	0	-	32	2	4	0	-	6	75
% Other Vehicles	1.8	5.3	-	-	1.9	2.5	1.8	-	-	1.8	3.5	5.0	-	-	4.4	1.9
Pedestrians	-	-	-	4	-	-	-	-	8	-	-	-	-	6	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	100.0	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Data Plot

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

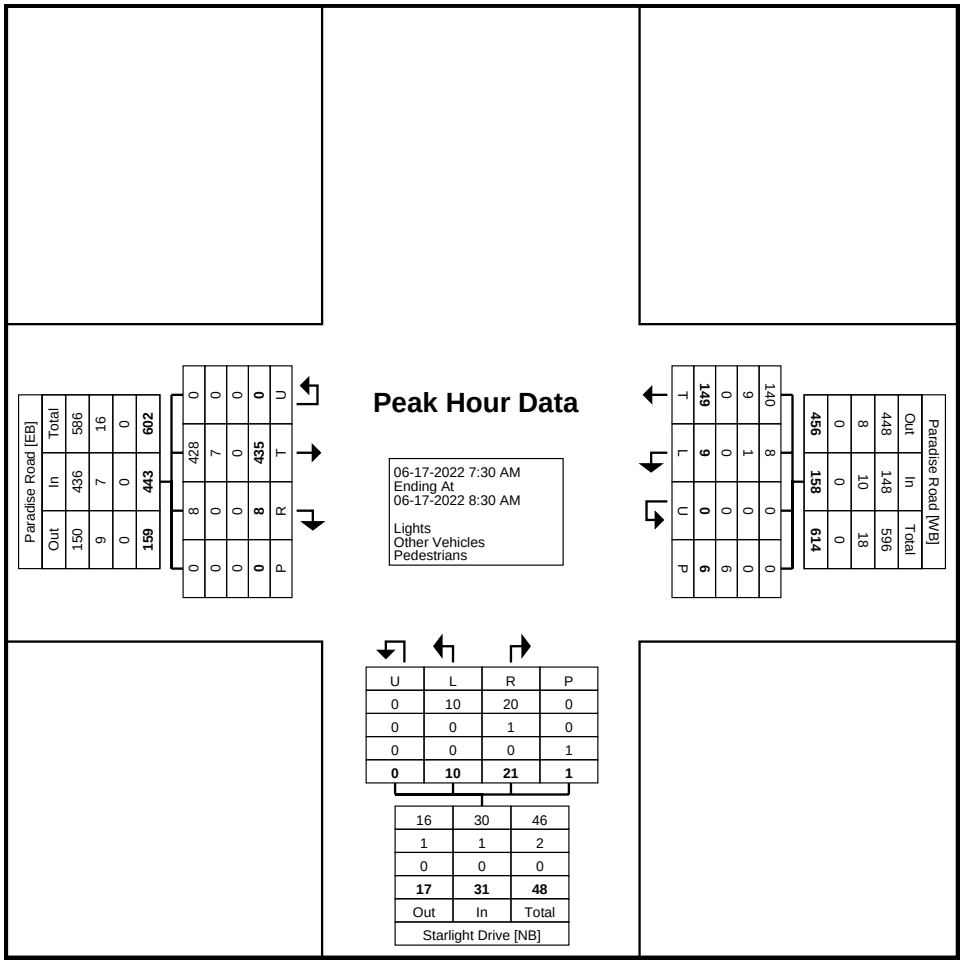
Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

Turning Movement Peak Hour Data (7:30 AM)

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
7:30 AM	133	1	0	0	134	2	25	0	1	27	2	2	0	1	4	165
7:45 AM	83	2	0	0	85	5	44	0	0	49	3	7	0	0	10	144
8:00 AM	117	2	0	0	119	2	35	0	0	37	1	3	0	0	4	160
8:15 AM	102	3	0	0	105	0	45	0	5	45	4	9	0	0	13	163
Total	435	8	0	0	443	9	149	0	6	158	10	21	0	1	31	632
Approach %	98.2	1.8	0.0	-	-	5.7	94.3	0.0	-	-	32.3	67.7	0.0	-	-	-
Total %	68.8	1.3	0.0	-	70.1	1.4	23.6	0.0	-	25.0	1.6	3.3	0.0	-	4.9	-
PHF	0.818	0.667	0.000	-	0.826	0.450	0.828	0.000	-	0.806	0.625	0.583	0.000	-	0.596	0.958
Lights	428	8	0	-	436	8	140	0	-	148	10	20	0	-	30	614
% Lights	98.4	100.0	-	-	98.4	88.9	94.0	-	-	93.7	100.0	95.2	-	-	96.8	97.2
Other Vehicles	7	0	0	-	7	1	9	0	-	10	0	1	0	-	1	18
% Other Vehicles	1.6	0.0	-	-	1.6	11.1	6.0	-	-	6.3	0.0	4.8	-	-	3.2	2.8
Pedestrians	-	-	-	0	-	-	-	-	6	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	100.0	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Peak Hour Data Plot (7:30 AM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

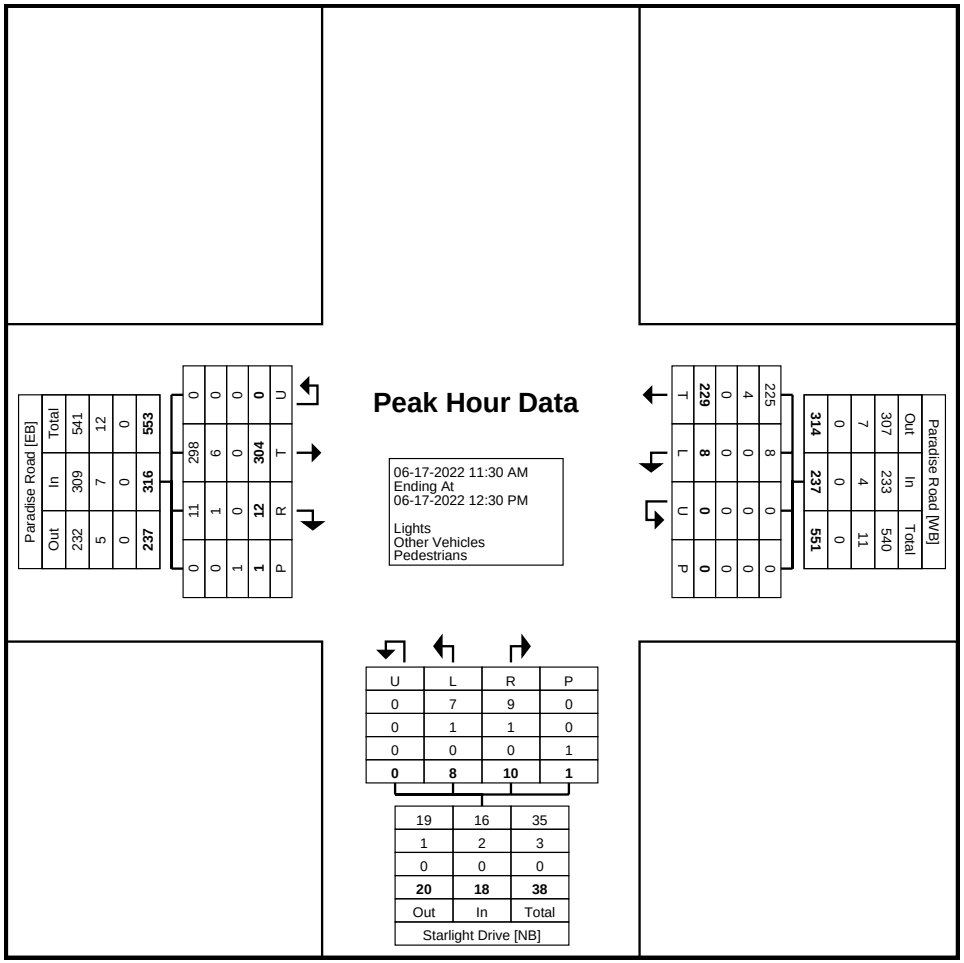
Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

Turning Movement Peak Hour Data (11:30 AM)

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
11:30 AM	77	1	0	0	78	0	66	0	0	66	2	1	0	0	3	147
11:45 AM	82	3	0	1	85	2	61	0	0	63	4	2	0	1	6	154
12:00 PM	72	3	0	0	75	3	55	0	0	58	2	3	0	0	5	138
12:15 PM	73	5	0	0	78	3	47	0	0	50	0	4	0	0	4	132
Total	304	12	0	1	316	8	229	0	0	237	8	10	0	1	18	571
Approach %	96.2	3.8	0.0	-	-	3.4	96.6	0.0	-	-	44.4	55.6	0.0	-	-	-
Total %	53.2	2.1	0.0	-	55.3	1.4	40.1	0.0	-	41.5	1.4	1.8	0.0	-	3.2	-
PHF	0.927	0.600	0.000	-	0.929	0.667	0.867	0.000	-	0.898	0.500	0.625	0.000	-	0.750	0.927
Lights	298	11	0	-	309	8	225	0	-	233	7	9	0	-	16	558
% Lights	98.0	91.7	-	-	97.8	100.0	98.3	-	-	98.3	87.5	90.0	-	-	88.9	97.7
Other Vehicles	6	1	0	-	7	0	4	0	-	4	1	1	0	-	2	13
% Other Vehicles	2.0	8.3	-	-	2.2	0.0	1.7	-	-	1.7	12.5	10.0	-	-	11.1	2.3
Pedestrians	-	-	-	1	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Peak Hour Data Plot (11:30 AM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

Turning Movement Peak Hour Data (4:30 PM)

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
4:30 PM	79	3	0	0	82	7	117	0	0	124	2	2	0	0	4	210
4:45 PM	79	3	0	0	82	8	117	0	0	125	3	0	0	0	3	210
5:00 PM	77	6	0	0	83	3	123	0	0	126	4	7	0	0	11	220
5:15 PM	87	2	0	2	89	9	129	0	0	138	4	1	0	2	5	232
Total	322	14	0	2	336	27	486	0	0	513	13	10	0	2	23	872
Approach %	95.8	4.2	0.0	-	-	5.3	94.7	0.0	-	-	56.5	43.5	0.0	-	-	-
Total %	36.9	1.6	0.0	-	38.5	3.1	55.7	0.0	-	58.8	1.5	1.1	0.0	-	2.6	-
PHF	0.925	0.583	0.000	-	0.944	0.750	0.942	0.000	-	0.929	0.813	0.357	0.000	-	0.523	0.940
Lights	318	13	0	-	331	27	484	0	-	511	13	9	0	-	22	864
% Lights	98.8	92.9	-	-	98.5	100.0	99.6	-	-	99.6	100.0	90.0	-	-	95.7	99.1
Other Vehicles	4	1	0	-	5	0	2	0	-	2	0	1	0	-	1	8
% Other Vehicles	1.2	7.1	-	-	1.5	0.0	0.4	-	-	0.4	0.0	10.0	-	-	4.3	0.9
Pedestrians	-	-	-	2	-	-	-	-	0	-	-	-	-	2	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
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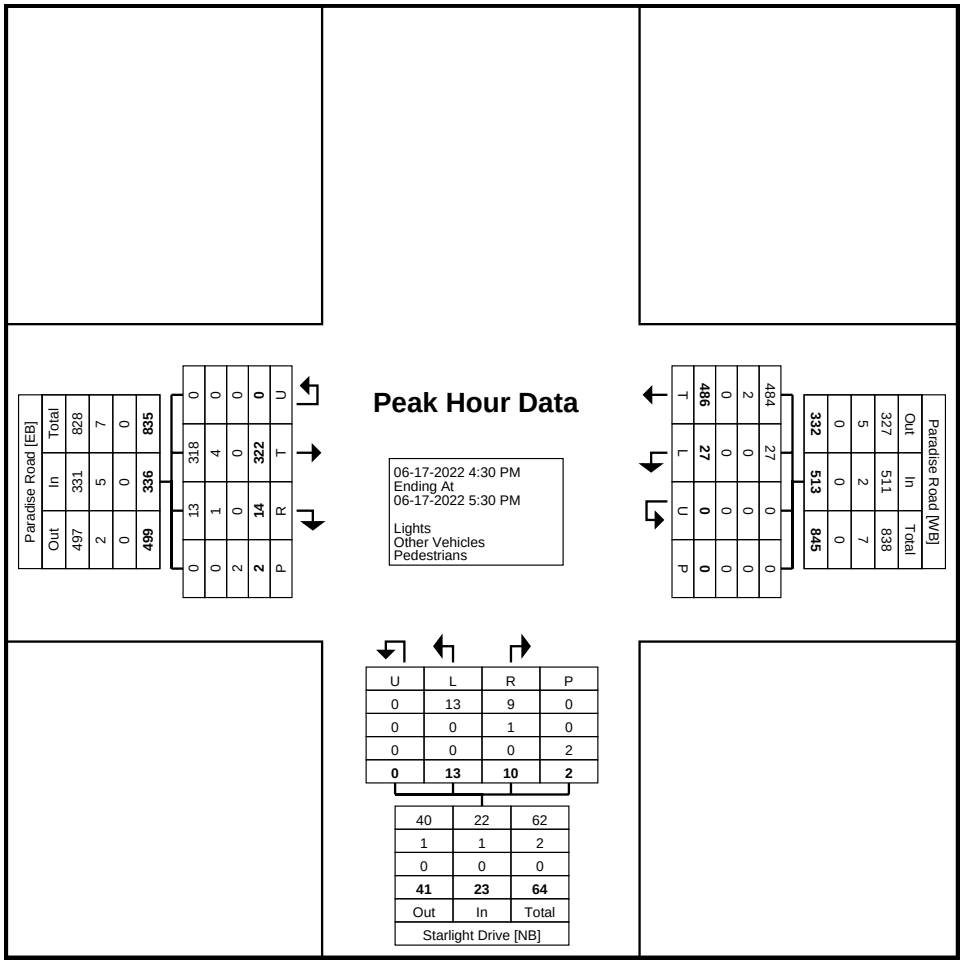
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Peak Hour Data Plot (4:30 PM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

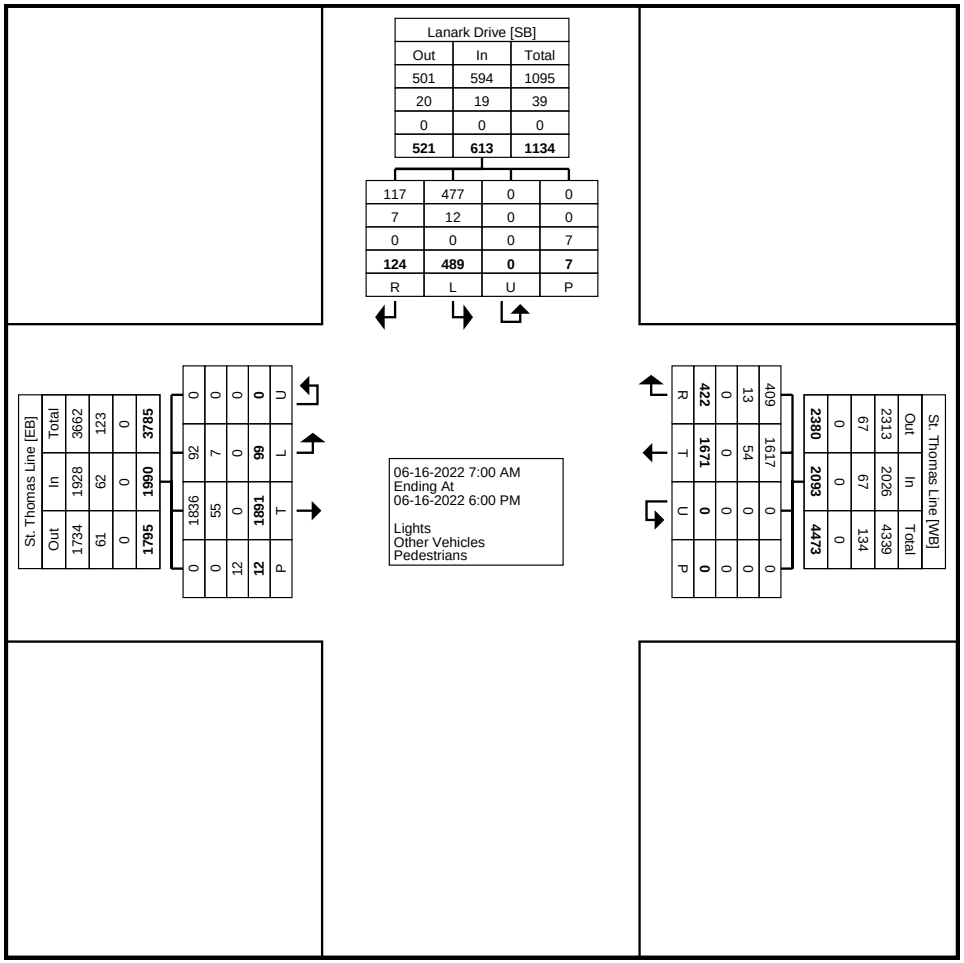
Turning Movement Data

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
7:00 AM	0	35	0	0	35	20	7	0	0	27	15	1	0	0	16	78
7:15 AM	1	77	0	0	78	27	8	0	0	35	28	0	0	0	28	141
7:30 AM	0	106	0	0	106	42	8	0	0	50	21	7	0	0	28	184
7:45 AM	0	89	0	0	89	41	10	0	0	51	35	4	0	0	39	179
Hourly Total	1	307	0	0	308	130	33	0	0	163	99	12	0	0	111	582
8:00 AM	4	91	0	0	95	39	11	0	0	50	26	5	0	0	31	176
8:15 AM	5	106	0	1	111	63	6	0	0	69	26	13	0	2	39	219
8:30 AM	11	120	0	2	131	70	8	0	0	78	25	22	0	0	47	256
8:45 AM	18	81	0	0	99	53	12	0	0	65	13	16	0	0	29	193
Hourly Total	38	398	0	3	436	225	37	0	0	262	90	56	0	2	146	844
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11:00 AM	1	49	0	0	50	49	15	0	0	64	13	1	0	0	14	128
11:15 AM	3	42	0	0	45	30	9	0	0	39	17	1	0	0	18	102
11:30 AM	1	45	0	0	46	32	15	0	0	47	14	2	0	0	16	109
11:45 AM	4	68	0	0	72	62	15	0	0	77	15	0	0	0	15	164
Hourly Total	9	204	0	0	213	173	54	0	0	227	59	4	0	0	63	503
12:00 PM	1	56	0	0	57	52	17	0	0	69	11	1	0	0	12	138
12:15 PM	2	52	0	0	54	68	8	0	0	76	19	0	0	0	19	149
12:30 PM	1	69	0	0	70	72	27	0	0	99	24	3	0	0	27	196
12:45 PM	3	56	0	0	59	63	14	0	0	77	23	6	0	1	29	165
Hourly Total	7	233	0	0	240	255	66	0	0	321	77	10	0	1	87	648
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	2	88	0	1	90	91	26	0	0	117	18	5	0	1	23	230
4:15 PM	6	94	0	3	100	98	30	0	0	128	16	6	0	2	22	250
4:30 PM	7	90	0	1	97	122	30	0	0	152	21	5	0	0	26	275
4:45 PM	4	90	0	1	94	131	39	0	0	170	17	4	0	0	21	285
Hourly Total	19	362	0	6	381	442	125	0	0	567	72	20	0	3	92	1040
5:00 PM	8	90	0	1	98	148	26	0	0	174	16	5	0	0	21	293
5:15 PM	4	79	0	1	83	109	31	0	0	140	30	4	0	1	34	257
5:30 PM	7	110	0	0	117	101	30	0	0	131	25	6	0	0	31	279
5:45 PM	6	108	0	1	114	88	20	0	0	108	21	7	0	0	28	250
Hourly Total	25	387	0	3	412	446	107	0	0	553	92	22	0	1	114	1079
Grand Total	99	1891	0	12	1990	1671	422	0	0	2093	489	124	0	7	613	4696
Approach %	5.0	95.0	0.0	-	-	79.8	20.2	0.0	-	-	79.8	20.2	0.0	-	-	-
Total %	2.1	40.3	0.0	-	42.4	35.6	9.0	0.0	-	44.6	10.4	2.6	0.0	-	13.1	-
Lights	92	1836	0	-	1928	1617	409	0	-	2026	477	117	0	-	594	4548

% Lights	92.9	97.1	-	-	96.9	96.8	96.9	-	-	96.8	97.5	94.4	-	-	96.9	96.8
Other Vehicles	7	55	0	-	62	54	13	0	-	67	12	7	0	-	19	148
% Other Vehicles	7.1	2.9	-	-	3.1	3.2	3.1	-	-	3.2	2.5	5.6	-	-	3.1	3.2
Pedestrians	-	-	-	12	-	-	-	-	0	-	-	-	-	7	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Data Plot

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

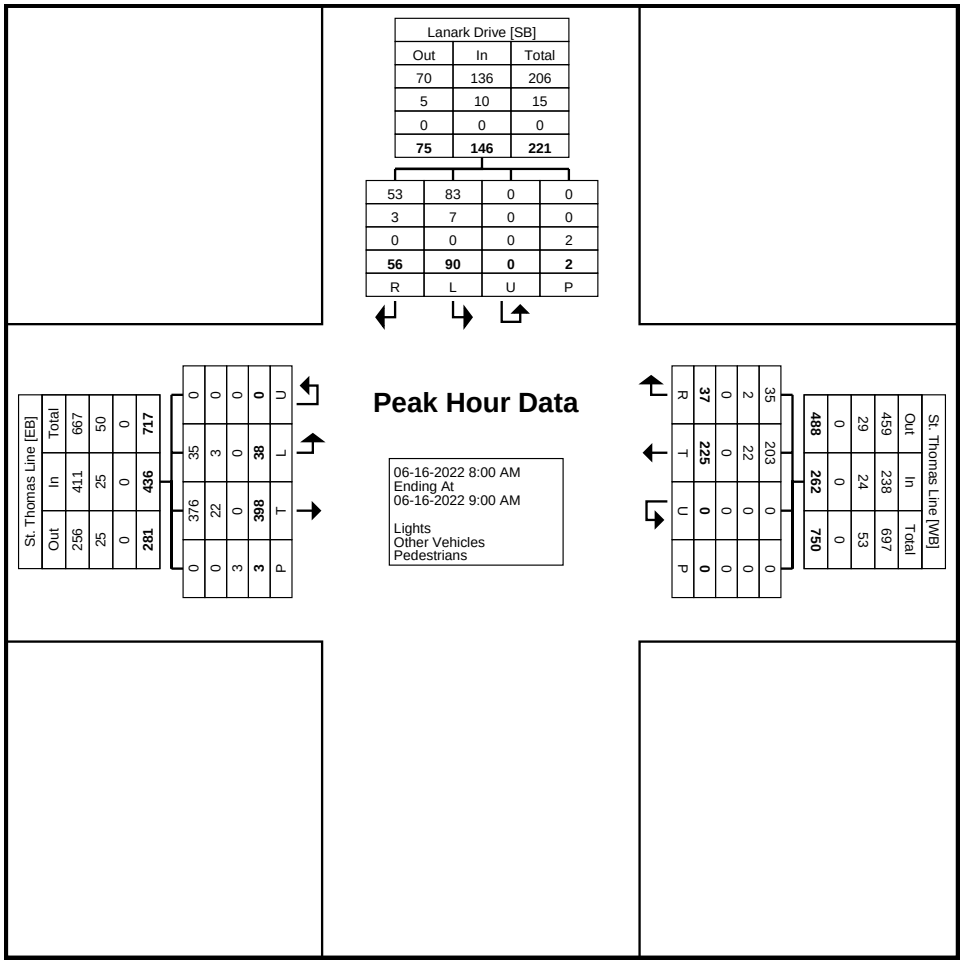
Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

Turning Movement Peak Hour Data (8:00 AM)

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
8:00 AM	4	91	0	0	95	39	11	0	0	50	26	5	0	0	31	176
8:15 AM	5	106	0	1	111	63	6	0	0	69	26	13	0	2	39	219
8:30 AM	11	120	0	2	131	70	8	0	0	78	25	22	0	0	47	256
8:45 AM	18	81	0	0	99	53	12	0	0	65	13	16	0	0	29	193
Total	38	398	0	3	436	225	37	0	0	262	90	56	0	2	146	844
Approach %	8.7	91.3	0.0	-	-	85.9	14.1	0.0	-	-	61.6	38.4	0.0	-	-	-
Total %	4.5	47.2	0.0	-	51.7	26.7	4.4	0.0	-	31.0	10.7	6.6	0.0	-	17.3	-
PHF	0.528	0.829	0.000	-	0.832	0.804	0.771	0.000	-	0.840	0.865	0.636	0.000	-	0.777	0.824
Lights	35	376	0	-	411	203	35	0	-	238	83	53	0	-	136	785
% Lights	92.1	94.5	-	-	94.3	90.2	94.6	-	-	90.8	92.2	94.6	-	-	93.2	93.0
Other Vehicles	3	22	0	-	25	22	2	0	-	24	7	3	0	-	10	59
% Other Vehicles	7.9	5.5	-	-	5.7	9.8	5.4	-	-	9.2	7.8	5.4	-	-	6.8	7.0
Pedestrians	-	-	-	3	-	-	-	-	0	-	-	-	-	2	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Peak Hour Data Plot (8:00 AM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

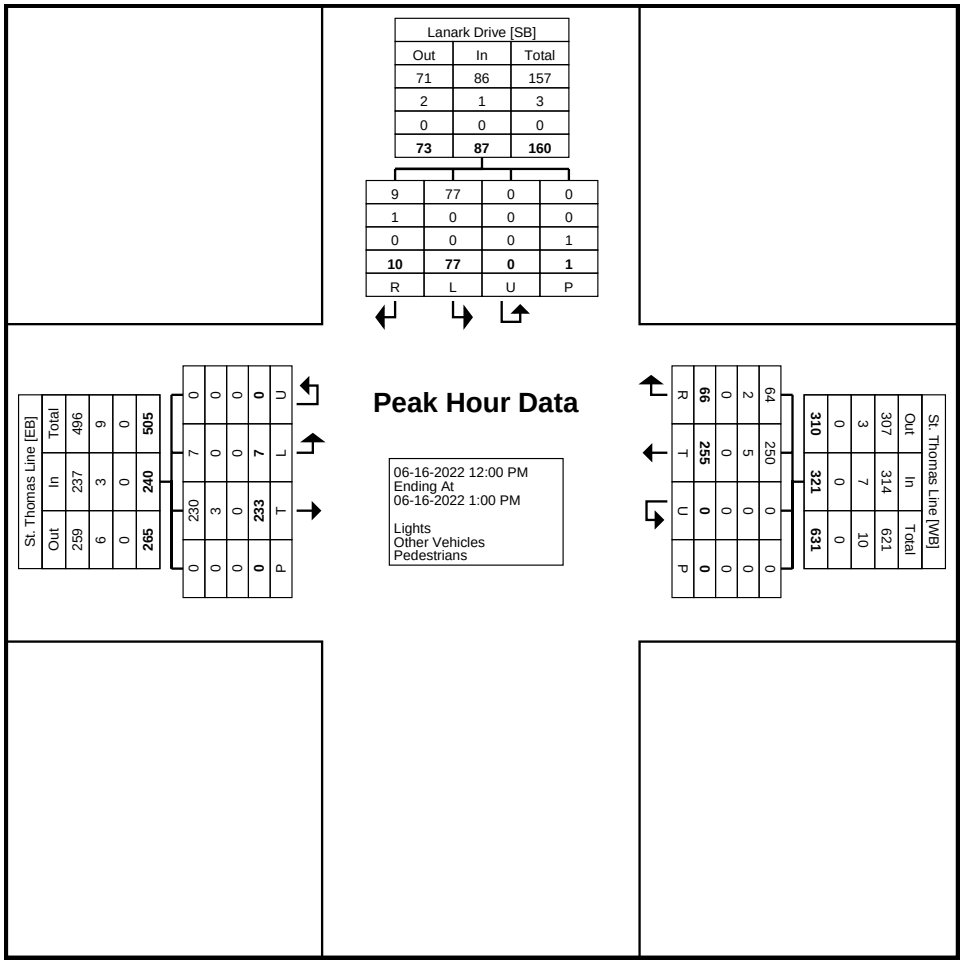
Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

Turning Movement Peak Hour Data (12:00 PM)

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
12:00 PM	1	56	0	0	57	52	17	0	0	69	11	1	0	0	12	138
12:15 PM	2	52	0	0	54	68	8	0	0	76	19	0	0	0	19	149
12:30 PM	1	69	0	0	70	72	27	0	0	99	24	3	0	0	27	196
12:45 PM	3	56	0	0	59	63	14	0	0	77	23	6	0	1	29	165
Total	7	233	0	0	240	255	66	0	0	321	77	10	0	1	87	648
Approach %	2.9	97.1	0.0	-	-	79.4	20.6	0.0	-	-	88.5	11.5	0.0	-	-	-
Total %	1.1	36.0	0.0	-	37.0	39.4	10.2	0.0	-	49.5	11.9	1.5	0.0	-	13.4	-
PHF	0.583	0.844	0.000	-	0.857	0.885	0.611	0.000	-	0.811	0.802	0.417	0.000	-	0.750	0.827
Lights	7	230	0	-	237	250	64	0	-	314	77	9	0	-	86	637
% Lights	100.0	98.7	-	-	98.8	98.0	97.0	-	-	97.8	100.0	90.0	-	-	98.9	98.3
Other Vehicles	0	3	0	-	3	5	2	0	-	7	0	1	0	-	1	11
% Other Vehicles	0.0	1.3	-	-	1.3	2.0	3.0	-	-	2.2	0.0	10.0	-	-	1.1	1.7
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Peak Hour Data Plot (12:00 PM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

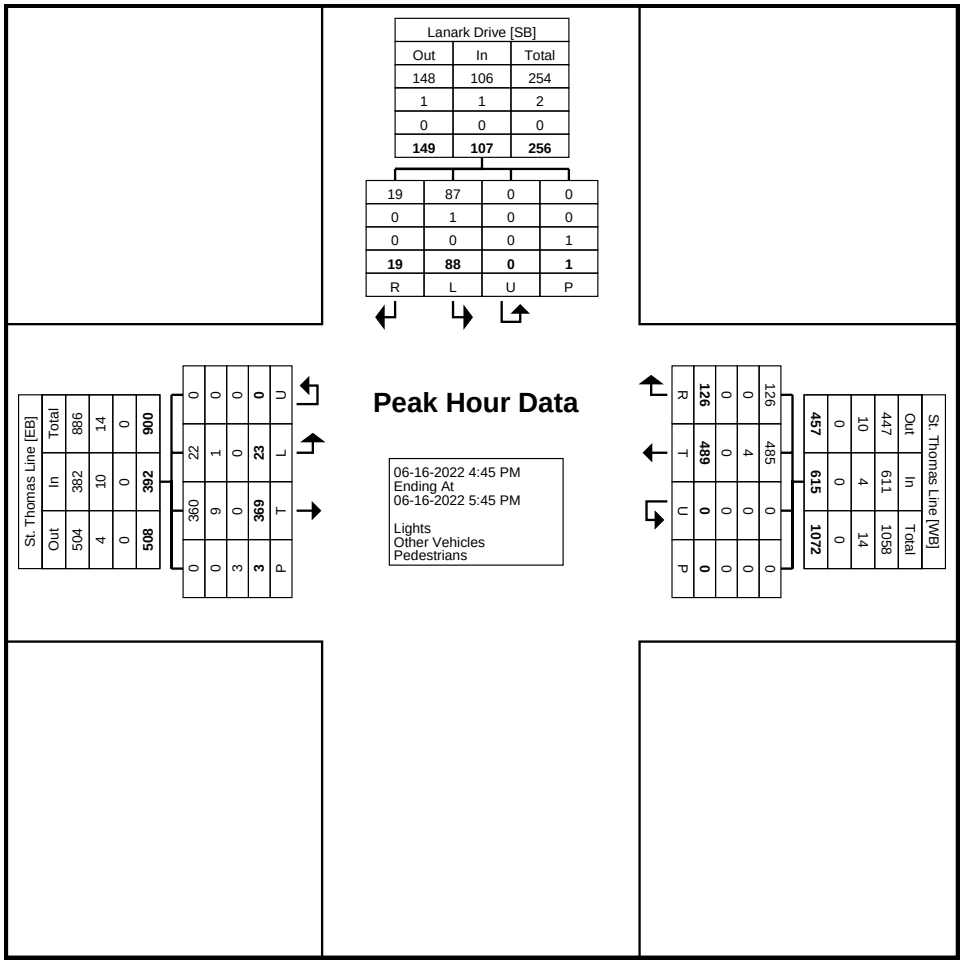
Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

Turning Movement Peak Hour Data (4:45 PM)

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
4:45 PM	4	90	0	1	94	131	39	0	0	170	17	4	0	0	21	285
5:00 PM	8	90	0	1	98	148	26	0	0	174	16	5	0	0	21	293
5:15 PM	4	79	0	1	83	109	31	0	0	140	30	4	0	1	34	257
5:30 PM	7	110	0	0	117	101	30	0	0	131	25	6	0	0	31	279
Total	23	369	0	3	392	489	126	0	0	615	88	19	0	1	107	1114
Approach %	5.9	94.1	0.0	-	-	79.5	20.5	0.0	-	-	82.2	17.8	0.0	-	-	-
Total %	2.1	33.1	0.0	-	35.2	43.9	11.3	0.0	-	55.2	7.9	1.7	0.0	-	9.6	-
PHF	0.719	0.839	0.000	-	0.838	0.826	0.808	0.000	-	0.884	0.733	0.792	0.000	-	0.787	0.951
Lights	22	360	0	-	382	485	126	0	-	611	87	19	0	-	106	1099
% Lights	95.7	97.6	-	-	97.4	99.2	100.0	-	-	99.3	98.9	100.0	-	-	99.1	98.7
Other Vehicles	1	9	0	-	10	4	0	0	-	4	1	0	0	-	1	15
% Other Vehicles	4.3	2.4	-	-	2.6	0.8	0.0	-	-	0.7	1.1	0.0	-	-	0.9	1.3
Pedestrians	-	-	-	3	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Peak Hour Data Plot (4:45 PM)

Appendix B: Existing Operations Synchro Reports

Intersection	
Int Delay, s/veh	0.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	435	8	9	149	10	21
Future Vol, veh/h	435	8	9	149	10	21
Conflicting Peds, #/hr	0	1	1	0	0	6
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	11	6	2	5
Mvmt Flow	453	8	9	155	10	22

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	462	0	631	464
Stage 1	-	-	-	-	458	-
Stage 2	-	-	-	-	173	-
Critical Hdwy	-	-	4.21	-	6.42	6.25
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.299	-	3.518	3.345
Pot Cap-1 Maneuver	-	-	1053	-	445	592
Stage 1	-	-	-	-	637	-
Stage 2	-	-	-	-	857	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1052	-	441	588
Mov Cap-2 Maneuver	-	-	-	-	441	-
Stage 1	-	-	-	-	636	-
Stage 2	-	-	-	-	849	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	12.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	531	-	-	1052	-
HCM Lane V/C Ratio	0.061	-	-	0.009	-
HCM Control Delay (s)	12.2	-	-	8.5	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Intersection	
Int Delay, s/veh	4.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	38	398	225	37	90	56
Future Vol, veh/h	38	398	225	37	90	56
Conflicting Peds, #/hr	2	0	0	2	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	8	6	10	5	8	5
Mvmt Flow	46	485	274	45	110	68

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	321	0	-	0	876	302
Stage 1	-	-	-	-	299	-
Stage 2	-	-	-	-	577	-
Critical Hdwy	4.18	-	-	-	6.48	6.25
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	2.272	-	-	-	3.572	3.345
Pot Cap-1 Maneuver	1206	-	-	-	312	731
Stage 1	-	-	-	-	739	-
Stage 2	-	-	-	-	550	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1203	-	-	-	295	727
Mov Cap-2 Maneuver	-	-	-	-	295	-
Stage 1	-	-	-	-	699	-
Stage 2	-	-	-	-	549	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	22.4
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1203	-	-	-	382
HCM Lane V/C Ratio	0.039	-	-	-	0.466
HCM Control Delay (s)	8.1	0	-	-	22.4
HCM Lane LOS	A	A	-	-	C
HCM 95th %tile Q(veh)	0.1	-	-	-	2.4

Intersection	
Int Delay, s/veh	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	322	14	27	486	13	10
Future Vol, veh/h	322	14	27	486	13	10
Conflicting Peds, #/hr	0	2	2	0	2	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	7	2	2	2	10
Mvmt Flow	343	15	29	517	14	11

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	360	0	930	353
Stage 1	-	-	-	-	353	-
Stage 2	-	-	-	-	577	-
Critical Hdwy	-	-	4.12	-	6.42	6.3
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.39
Pot Cap-1 Maneuver	-	-	1199	-	297	673
Stage 1	-	-	-	-	711	-
Stage 2	-	-	-	-	562	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1196	-	289	671
Mov Cap-2 Maneuver	-	-	-	-	289	-
Stage 1	-	-	-	-	710	-
Stage 2	-	-	-	-	547	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	15
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	384	-	-	1196	-
HCM Lane V/C Ratio	0.064	-	-	0.024	-
HCM Control Delay (s)	15	-	-	8.1	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.1	-

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	23	369	489	126	88	19
Future Vol, veh/h	23	369	489	126	88	19
Conflicting Peds, #/hr	1	0	0	1	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	2	2	2	2	2
Mvmt Flow	24	388	515	133	93	20

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	649	0	-	0	1019	586
Stage 1	-	-	-	-	583	-
Stage 2	-	-	-	-	436	-
Critical Hdwy	4.14	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.236	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	927	-	-	-	263	510
Stage 1	-	-	-	-	558	-
Stage 2	-	-	-	-	652	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	926	-	-	-	254	508
Mov Cap-2 Maneuver	-	-	-	-	254	-
Stage 1	-	-	-	-	539	-
Stage 2	-	-	-	-	651	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	26.4
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	926	-	-	-	279
HCM Lane V/C Ratio	0.026	-	-	-	0.404
HCM Control Delay (s)	9	0	-	-	26.4
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	1.9

Appendix C: 5-Year Background Operations Synchro Reports

Intersection	
Int Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	457	11	14	158	19	36
Future Vol, veh/h	457	11	14	158	19	36
Conflicting Peds, #/hr	0	1	1	0	0	6
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	11	6	2	5
Mvmt Flow	476	11	15	165	20	38

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	488	0	678	489
Stage 1	-	-	-	-	483	-
Stage 2	-	-	-	-	195	-
Critical Hdwy	-	-	4.21	-	6.42	6.25
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.299	-	3.518	3.345
Pot Cap-1 Maneuver	-	-	1030	-	418	573
Stage 1	-	-	-	-	620	-
Stage 2	-	-	-	-	838	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1029	-	411	569
Mov Cap-2 Maneuver	-	-	-	-	411	-
Stage 1	-	-	-	-	619	-
Stage 2	-	-	-	-	825	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	13.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	502	-	-	1029	-
HCM Lane V/C Ratio	0.114	-	-	0.014	-
HCM Control Delay (s)	13.1	-	-	8.5	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	40	418	236	39	95	59
Future Vol, veh/h	40	418	236	39	95	59
Conflicting Peds, #/hr	2	0	0	2	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	8	6	10	5	8	5
Mvmt Flow	49	510	288	48	116	72

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	338	0	-	0	922	317
Stage 1	-	-	-	-	314	-
Stage 2	-	-	-	-	608	-
Critical Hdwy	4.18	-	-	-	6.48	6.25
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	2.272	-	-	-	3.572	3.345
Pot Cap-1 Maneuver	1188	-	-	-	293	717
Stage 1	-	-	-	-	727	-
Stage 2	-	-	-	-	532	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1185	-	-	-	275	713
Mov Cap-2 Maneuver	-	-	-	-	275	-
Stage 1	-	-	-	-	683	-
Stage 2	-	-	-	-	531	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	25.4
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1185	-	-	-	360
HCM Lane V/C Ratio	0.041	-	-	-	0.522
HCM Control Delay (s)	8.2	0	-	-	25.4
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	2.9

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	339	24	44	512	19	20
Future Vol, veh/h	339	24	44	512	19	20
Conflicting Peds, #/hr	0	2	2	0	2	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	7	2	2	2	10
Mvmt Flow	361	26	47	545	20	21

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	389	0	1017	376
Stage 1	-	-	-	-	376	-
Stage 2	-	-	-	-	641	-
Critical Hdwy	-	-	4.12	-	6.42	6.3
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.39
Pot Cap-1 Maneuver	-	-	1170	-	263	653
Stage 1	-	-	-	-	694	-
Stage 2	-	-	-	-	525	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1167	-	251	651
Mov Cap-2 Maneuver	-	-	-	-	251	-
Stage 1	-	-	-	-	693	-
Stage 2	-	-	-	-	503	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	16.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	366	-	-	1167	-
HCM Lane V/C Ratio	0.113	-	-	0.04	-
HCM Control Delay (s)	16.1	-	-	8.2	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.4	-	-	0.1	-

Intersection	
Int Delay, s/veh	3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	24	388	514	132	92	20
Future Vol, veh/h	24	388	514	132	92	20
Conflicting Peds, #/hr	1	0	0	1	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	2	2	2	2	2
Mvmt Flow	25	408	541	139	97	21

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	681	0	-	0	1070	615
Stage 1	-	-	-	-	612	-
Stage 2	-	-	-	-	458	-
Critical Hdwy	4.14	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.236	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	902	-	-	-	245	491
Stage 1	-	-	-	-	541	-
Stage 2	-	-	-	-	637	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	901	-	-	-	236	489
Mov Cap-2 Maneuver	-	-	-	-	236	-
Stage 1	-	-	-	-	521	-
Stage 2	-	-	-	-	636	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	29.8
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	901	-	-	-	260
HCM Lane V/C Ratio	0.028	-	-	-	0.453
HCM Control Delay (s)	9.1	0	-	-	29.8
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	2.2

Appendix D: 5-Year Total Operations Synchro Reports

Intersection	
Int Delay, s/veh	1.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	457	15	20	158	30	54
Future Vol, veh/h	457	15	20	158	30	54
Conflicting Peds, #/hr	0	1	1	0	0	6
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	11	6	2	5
Mvmt Flow	476	16	21	165	31	56

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	493	0	692	491
Stage 1	-	-	-	-	485	-
Stage 2	-	-	-	-	207	-
Critical Hdwy	-	-	4.21	-	6.42	6.25
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.299	-	3.518	3.345
Pot Cap-1 Maneuver	-	-	1026	-	410	571
Stage 1	-	-	-	-	619	-
Stage 2	-	-	-	-	828	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1025	-	401	567
Mov Cap-2 Maneuver	-	-	-	-	401	-
Stage 1	-	-	-	-	618	-
Stage 2	-	-	-	-	811	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1	13.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	494	-	-	1025	-
HCM Lane V/C Ratio	0.177	-	-	0.02	-
HCM Control Delay (s)	13.8	-	-	8.6	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.6	-	-	0.1	-

Intersection	
Int Delay, s/veh	7.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	46	418	236	47	119	77
Future Vol, veh/h	46	418	236	47	119	77
Conflicting Peds, #/hr	2	0	0	2	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	8	6	10	5	8	5
Mvmt Flow	56	510	288	57	145	94

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	347	0	-	0	941	322
Stage 1	-	-	-	-	319	-
Stage 2	-	-	-	-	622	-
Critical Hdwy	4.18	-	-	-	6.48	6.25
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	2.272	-	-	-	3.572	3.345
Pot Cap-1 Maneuver	1179	-	-	-	285	712
Stage 1	-	-	-	-	723	-
Stage 2	-	-	-	-	524	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1176	-	-	-	265	708
Mov Cap-2 Maneuver	-	-	-	-	265	-
Stage 1	-	-	-	-	674	-
Stage 2	-	-	-	-	523	-

Approach	EB	WB	SB
HCM Control Delay, s	0.8	0	34.6
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1176	-	-	-	351
HCM Lane V/C Ratio	0.048	-	-	-	0.681
HCM Control Delay (s)	8.2	0	-	-	34.6
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	4.8

Intersection	
Int Delay, s/veh	1.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	339	36	64	512	26	32
Future Vol, veh/h	339	36	64	512	26	32
Conflicting Peds, #/hr	0	2	2	0	2	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	7	2	2	2	10
Mvmt Flow	361	38	68	545	28	34

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	401	0	1065	382
Stage 1	-	-	-	-	382	-
Stage 2	-	-	-	-	683	-
Critical Hdwy	-	-	4.12	-	6.42	6.3
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.39
Pot Cap-1 Maneuver	-	-	1158	-	246	648
Stage 1	-	-	-	-	690	-
Stage 2	-	-	-	-	502	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1155	-	231	647
Mov Cap-2 Maneuver	-	-	-	-	231	-
Stage 1	-	-	-	-	689	-
Stage 2	-	-	-	-	471	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	17.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	358	-	-	1155	-
HCM Lane V/C Ratio	0.172	-	-	0.059	-
HCM Control Delay (s)	17.1	-	-	8.3	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.6	-	-	0.2	-

Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	36	388	514	168	113	27
Future Vol, veh/h	36	388	514	168	113	27
Conflicting Peds, #/hr	1	0	0	1	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	2	2	2	2	2
Mvmt Flow	38	408	541	177	119	28

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	719	0	-	0	1115	634
Stage 1	-	-	-	-	631	-
Stage 2	-	-	-	-	484	-
Critical Hdwy	4.14	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.236	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	873	-	-	-	230	479
Stage 1	-	-	-	-	530	-
Stage 2	-	-	-	-	620	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	872	-	-	-	217	477
Mov Cap-2 Maneuver	-	-	-	-	217	-
Stage 1	-	-	-	-	500	-
Stage 2	-	-	-	-	619	-

Approach	EB	WB	SB
HCM Control Delay, s	0.8	0	40.6
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	872	-	-	-	242
HCM Lane V/C Ratio	0.043	-	-	-	0.609
HCM Control Delay (s)	9.3	0	-	-	40.6
HCM Lane LOS	A	A	-	-	E
HCM 95th %tile Q(veh)	0.1	-	-	-	3.6

Appendix E: Traffic Signal Warrant

Town of Paradise - Traffic Signal & Pedestrian Signal Head Warrant Analysis

Main Street (name)	**St Thomas Line**	**Direction (EW or NS)**	**EW**	**Road Authority:**	**Town of Paradise**
Side Street (name)	**Lanark Drive**	**Direction (EW or NS)**	**NS**	**City:**	**Paradise, NL**
Quadrant / Int #		**Comments**	**Enter Comments about the analysis here.**	**Analysis Date:**	**2022 Jul 06, Wed**
				Count Date:	**2022 Jun 16, Thu**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**			**Date Entry Format:**	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	RT Channelization (y/n)	UpStream Signal (m)	# of Thru Lanes	LT Phase Type	RTOR Allowed (y/n)	Actuated Thru Phase
St Thomas Line	WB					1		n	650	1	perm	y	n
St Thomas Line	EB		1					n	2,000	1	perm	y	n
Lanark Drive	NB							n	2,000	0	perm	y	n
Lanark Drive	SB				1			n	2,000	1	perm	y	n

Are the Lanark Drive SB right turns significantly impeded by through movements? (y/n)	n
Are the St Thomas Line WB right turns significantly impeded by through movements? (y/n)	n
	y
	y

Saturation Flow Rates (if not default) (vphpl)		**Default Saturation Flow Rates (vphpl)**
Left Turn		1,650
Through		1,800
Right Turn		1,500

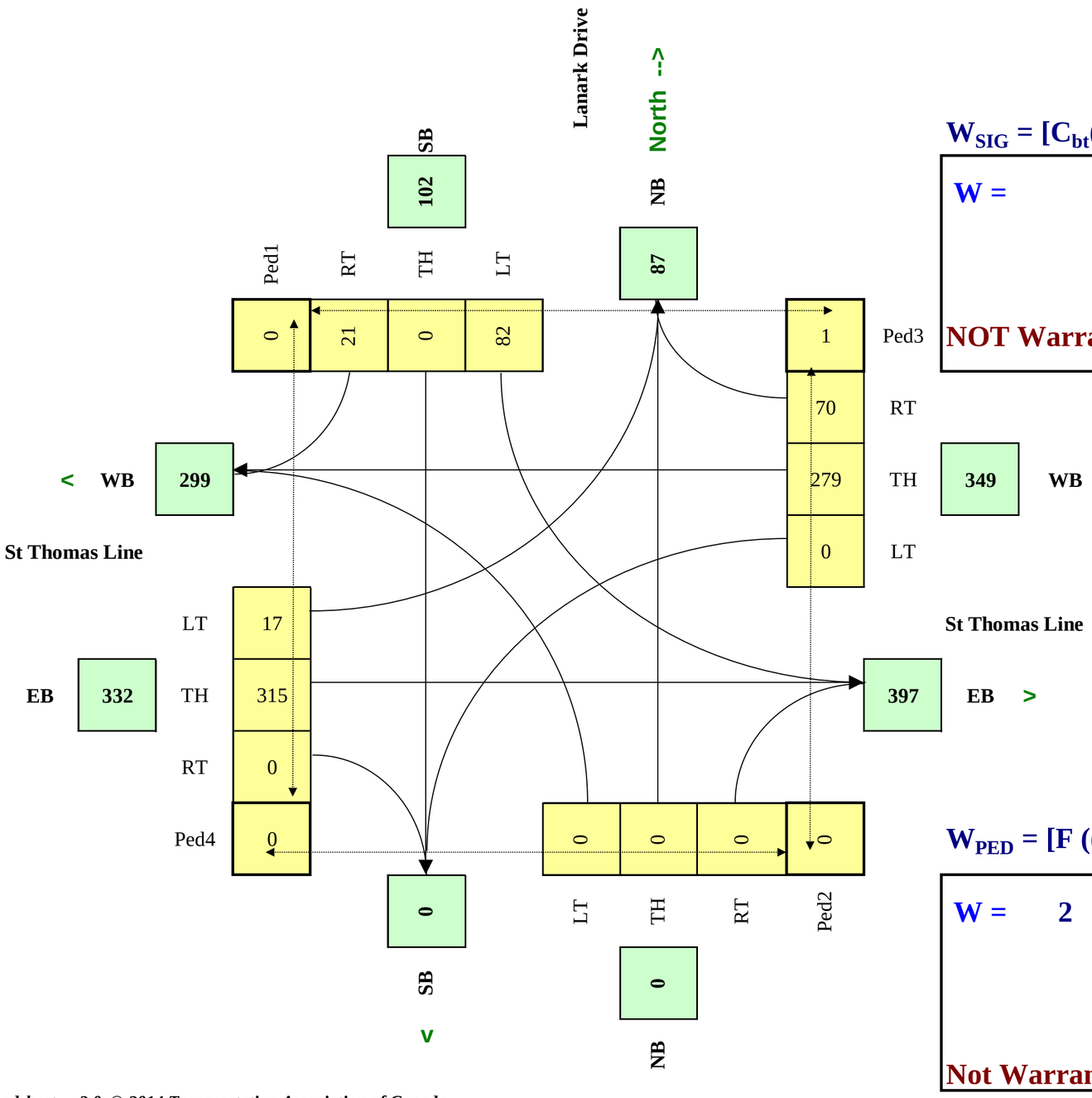
Demographics		
Elem. School/Mobility Challenged	(y/n)	y
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	y
Metro Area Population	(#)	22,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
St Thomas Line	EW	50	3.0%	n	
Lanark Drive	NS		3.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1 NS**	**Ped2 NS**	**Ped3 EW**	**Ped4 EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 - 8:00				99		12		130	33	1	307		0	0	0	0
				90		56		225	37	38	398		0	0	2	0
				59		4		173	54	9	204		0	0	0	0
				77		10		255	66	7	233		0	0	1	0
				72		20		442	125	19	362		0	0	3	0
				92		22		446	107	25	387		0	0	1	0
Total (6-hour peak)	**0**	**0**	**0**	**489**	**0**	**124**	**0**	**1,671**	**422**	**99**	**1,891**	**0**	**0**	**0**	**7**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**82**	**0**	**21**	**0**	**279**	**70**	**17**	**315**	**0**	**0**	**0**	**1**	**0**
Actual Pedestrian Crossing Distance (m)													20.0	14.0	14.0	14.0

Average 6-hour Peak Turning Movements



$W_{SIG} = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$

W =	36	36	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

$W_{PED} = [F\,((Xped_m)d_m/K_2) + (Xped_s)d_s/K_3)]$

W = 2

Not Warranted - Ped Vol<25(avg)

KARWOOD MARKET AREA
TRAFFIC STUDY

PREPARED FOR:
TOWN OF PARADISE

PREPARED BY:
Harbourside Transportation Consultants

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September 15, 2017

Status: Draft Report – Revision 1

For Client Review Only

HTC File #16334

HARBOURSIDE
Transportation Consultants

PROJECT NAME: KARWOOD MARKET AREA – TRAFFIC STUDY

PROJECT NUMBER: 16334

Client:	Town of Paradise
Status:	Draft Report Revision 1 – September 15, 2017 Draft Report – Issued for Client Review – December 19, 2016

ENGINEERING SEAL

PERMIT TO PRACTICE

	PREPARED BY:	REVIEWED BY:	APPROVED BY:
Name:	E. Allaire	M. MacDonald	R. King
Initial:	[redacted]		
Date:	September 15, 2017	September 15, 2017	September 15, 2017

Executive Summary

Harbourside Transportation Consultants (HTC) was retained by the Town of Paradise to prepare a Traffic Study for the Karwood Market and Octagon Pond areas throughout the Town of Paradise. These areas have been subject to a number of development proposals over the past few years. This study will provide direction to the Town of Paradise staff on road network improvements that will be required with the anticipated level of development that is expected to occur over the project timeframes. The project planning horizons for this study are to the year 2021 (5 years) and to the year 2026 (10 years).

Study Area

The study area for this project focused on intersections along Topsail Road between McNamara Drive and Karwood Drive and along Kenmount Road from McNamara Drive to Bruce Street. Traffic counts were collected during the morning (AM) and afternoon (PM) peak traffic periods at several locations throughout the study area.

Synchro Models

HTC constructed 4 different Synchro models for the study area. The scenarios included:

- Scenario 0 – Existing Conditions (2016): A scenario reflecting the existing conditions in the study area.
- Scenario 1 – 5-year Projection (2021): A projection of normal growth to the year 2021 with the 5-year development horizon projected on the study network.
- Scenario 2 – 10-year Projection (2026): A projection of normal growth to the year 2026 with the 10-year development horizon projected on the study network.
- Scenario 3 – 10-year Projection with connection to Route 2 (2026): A projection of normal growth to the year 2026 with the 10-year development horizon. The road network was modified to include a roadway connection to the Route 2 Interchange.

Existing Conditions Results

The analysis of the existing conditions, Scenario 0, within the study area shows a number of problems during both the AM and PM peak hours. The more predominant problems relate to Topsail Road/Karwood Drive, Kenmount Road/Bremigens Boulevard and Kenmount Road/Route 1 Southbound Ramp in both the AM and PM peak hours. These intersections experienced LOS E or F on a number of approaches.

The intersection of Topsail Road/Karwood Drive experiences high levels of delay, however, due to physical constraints, the geometry of the intersection cannot be improved or converted to a roundabout. The optimal solution to reduce congestion at this location is to provide alternative routes for traffic travelling along Topsail Road and Karwood Drive.

Conceptual Road Network

HTC updated the conceptual road network, to reflect the updated Land Use Plan for the Town of Paradise and the projected developments plans for the Karwood Market and Octagon Pond Areas. The road network includes seven (7) new roadways and connections throughout the study network. The updated conceptual road network includes:

- A main north/south collector road for the Octagon Pond Development Area,
- A connection between the Octagon Pond road and Shalloway Place to the west of the study area,
- A proposed new road between Kenmount Road and McNamara Drive,
- An extension of Bremigens Boulevard to the east,

- A connection between Kenmount Road and the extension of Bremigens Boulevard, and
- An extension of Kenmount Road towards the proposed Route 2 Interchange.

Trip Generation & Trip Distribution

The trip generation rates for the development projections in this study were based on information obtained from the 9th edition of the Institute of Transportation Engineers (ITE) ***Trip Generation Manual***; 13 different land use codes were used. The new development in the study area is expected to generate 1,211 trips in the AM peak hour (725 in/486 out) and 1,104 trips in the PM peak (491 in/613 out) in the 0-5 year horizon and 2,050 trips in the AM peak hour (1,283 in/767 out) and 2,401 trips in the PM peak (1,025 in/1,376 out) in the 5-10 year horizon. These trips include reductions for internal captures and for pass-by trips for the commercial development Karwood Market Area.

The site-generated traffic was distributed to the existing road network using 2025 VISUM models that were adjusted for the study area. HTC used the models to complete a number of select project zone analyses, the details of which have been noted in Section 5.2.

Future Conditions Results

Scenario 1

Over the next five years, the study area for this project is expected to experience significant growth. New road connections and intersection upgrading will be required. This scenario included the new road connection from McNamara Drive to Kenmount Road and the extension of Kenmount Road towards the Octagon Pond area. This scenario also reflected a road network with 7 roundabouts, both new and existing. The results of the Scenario 1 analysis show all roundabouts operating with LOS D or better. Two signalized intersections throughout the study area, Karwood Drive/Topsail Road and Kenmount Road/Bruce Street/Route 1 NB, experience LOS E or F on a number of approaches during both the AM and PM peak hours. The intersection of Kenmount Road/Bruce Street/Route 1 NB should be converted to a roundabout to deal with congestion problems. This intersection was modelled as a roundabout in the 10-year horizon scenarios.

Scenario 2

The results of the Scenario 2 analysis, which include the 10-year horizon for the projected development and the same road network connections as Scenario 1, show very similar results. In both the AM and PM peak hours, the intersection at Topsail Road/Karwood Drive has movements experiencing LOS E or LOS F. Queues at the Topsail Road/Karwood Drive intersection extend to the Topsail Road/Paradise Road intersection causing delays in the eastbound direction at Topsail Road/Paradise Road. All other study intersections operate at LOS D or better.

Scenario 3

The results of the Scenario 3 analysis, which includes the same road network and intersection configurations as Scenario 2 but incorporate a connection to the Route 2 interchange, show very similar results as Scenario 2. In both the AM and PM peak hours, the intersection at Topsail Road/Karwood Drive have movements experiencing LOS E or LOS F. The connection to Route 2 slightly reduces the traffic volumes on Topsail Road, however, the queues at the Topsail Road/Karwood Drive intersection continue to affect the Topsail Road/Paradise Road intersection. All other study intersections operate at LOS D or better.

Road Network Improvements

HTC has proposed a total of 12 new roundabouts, seven (7) new roadways and upgrades to two (2) of the existing roadways, Kenmount Road and McNamara Drive. The land required for the right-of-way of the proposed roundabouts and streets should be reserved by the Town of Paradise, as soon as possible, to ensure future development does not occur where roundabouts and roads are proposed.

Active Transportation

HTC prepared cross sections for the new roadways throughout the study area as well as cross sections for the upgrades of both Kenmount Road and McNamara Drive. All cross sections feature a 4.0m wide multi-use trail and a 1.85 m sidewalk both with buffers of at least 2.0m from the roadway. The multiuse trail system is well connected throughout the study are and connects to the T'Railway along the Octagon Pond North/South Connection. The proposed multiuse trail system will form the basis for a well-connected trail system in the area.

The network improvements from the Town's Active Transportation Plan located within the study area were identified. One of the network improvements is included as a recommendation of this study, the new roadway by the soccer fields is anticipated for 2021 and will feature a multiuse trail and sidewalk as per the Active Transportation Plan.

Recommended Implementation

The recommended intersection and road network improvements required to accommodate the traffic expected to be generated in the Karwood Market and Octagon Pond Development Areas over the 5 year and 10-year development horizons are listed in Table 1. HTC has also noted a number of other improvements that will be required in the 10 year plus timeframe. The letters associated with each roundabout correspond to the roundabout locations shown in Figure 9. The total cost for all roadway improvements is $37 million. Improvements were assigned a priority ranking of high, medium or low.

Table 1 - Road Network Improvements

5-year Network Improvements			Cost	Priority
B	Kenmount Road/Route 1 SB Ramps	$	750,000	High
C	Kenmount Road/McNamara Drive Extension	$	750,000	Medium
D	McNamara Drive Extension Internal Roundabout	$	500,000	Medium
E	Kenmount Road/McNamara Drive/Bremigens Blvd	$	500,000	High
J	Sgt Donald Lucas Drive/Octagon Pond Connection	$	500,000	Low
K	McNamara Drive/McNamara Drive Extension	$	500,000	Medium
L	Topsail Road/McNamara Drive/Clearview Heights	$	1,600,000	High
	Total 5-year Roundabouts Cost	**$**	**5,100,000**	
Street 1 - North/South Octagon Pond Connection (20% Complete)		$	1,040,000	Low
Street 3 - McNamara Drive Extension - 3-lane cross section		$	4,400,000	Medium
Street 5 - Kenmount Road Extension to Route 2 Interchange (30% complete)		$	1,740,000	Low
Street 7 - McNamara Drive Extension Connection to Kenmount Road - 3-lane cross section		$	950,000	Medium
	Total 5-year New Roadways Cost	**$**	**8,130,000**	
Kenmount Road (2 lane to 4 lane cross section w/ median)		$	6,500,000	Medium
	Total 5-year Road Improvement Cost	**$**	**6,500,000**	
	Total 5-year Network Improvement Cost	**$**	**19,730,000**	

10-year Network Improvements			Cost	Priority
A	Kenmount Road/Bruce Street/Route 1 NB On-Ramp	$	750,000	High
F	Kenmount Road Extension/Octagon Pond Connection	$	500,000	Medium
I	Octagon Pond Connection, South of Sgt Donald Lucas Drive	$	500,000	Low
	Total 10-year Roundabouts Cost	**$**	**1,750,000**	
Street 1 - North/South Octagon Pond Connection (60% Complete)		$	2,080,000	Low
Street 3 - McNamara Drive Extension - 5-lane cross section		$	800,000	Medium
Street 5 - Kenmount Road Extension to Route 2 Interchange (100% complete)		$	4,060,000	Medium
Street 7 - McNamara Drive Extension Connection to Kenmount Road - 5-lane cross section		$	200,000	Medium
	Total 10-year New Roadways Cost	**$**	**7,140,000**	
McNamara Drive (3 lane to 5 lane cross section)		$	600,000	Medium
	Total 10-year Road Improvement Cost	**$**	**600,000**	
	Total 10-year Network Improvement Cost	**$**	**9,490,000**	

>10-year Network Improvements			Cost	Priority
G	Octagon Pond Connection, North of Kenmount Road Extension	$	500,000	Medium
H	Octagon Pond Connection/Shalloway Place Extension	$	500,000	Medium
	Total >10-year Roundabouts Cost	**$**	**1,000,000**	
Street 1 - North/South Octagon Pond Connection (100% Complete)		$	2,080,000	Medium
Street 2 - Octagon Pond Connection to Shalloway Place		$	1,800,000	Low
Street 4 - Bremigens Boulevard Extension Connection to Kenmount Road		$	1,100,000	Low
Street 6 - Bremigens Boulevard Extension		$	1,800,000	Low
	Total >10-year New Roadways Cost	**$**	**6,780,000**	
	Total >10-year Network Improvement Cost	**$**	**7,780,000**	

Table of Contents

List of Figures

List of Tables

Appendices

1 Introduction

1.1 Background

Harbourside Transportation Consultants (HTC) was retained by the Town of Paradise to prepare a Traffic Study for the Karwood Market and Octagon Pond development areas in the Town of Paradise, NL. These areas have been the subject of a number of development proposals over the past few years. The study will be expected to provide direction to Town staff on the road network improvements that will be required with the anticipated levels of development expected to take place in both development areas over the 5 year and 10-year planning horizons.

1.2 Methodology

The following methodology was used by HTC in the course of completing this Traffic Study of the Karwood Market and Octagon Pond development areas.

Information Gathering

HTC met with the Town of Paradise and various developers to obtain the background information and the proposed development concepts for the Karwood Market area and for the lands adjacent to Octagon Pond. The limits of the study were defined and realistic timeframes were established for developments proposed within the study area.

Data Collection

HTC deployed MioVision video traffic counters to collect traffic count information that was required for this project. A total of eight (8) intersections were counted for the traffic study.

Trip Generation/Trip Distribution

HTC developed the trip generation rates for the developments proposed within the study area based on the 9th edition of the ITE Trip Generation Manual. HTC distributed the site-generated traffic onto the study area road network using expanded versions of the VISUM models developed originally by the City of St. John's for both the AM and PM peak hour periods. The traffic generated by the new development was distributed to the study area road network using the select zone feature of the VISUM software.

Existing Capacity Analysis

HTC built an existing conditions Synchro model of the study area intersections. This model was used to determine the level of service (LOS) for a number of different scenarios for all specified study area intersections. The roundabout was analyzed using Arcady software.

Conceptual Road Network

HTC's analysis of the study area was based on a road network framework that has evolved over the course of a number of different planning studies including the Paradise Transportation Study (2011) and the Paradise Traffic Improvement Plan (2014). This road network has been appropriately configured for the adjacent land uses/access and expected traffic volumes. HTC focused on the major roadways and intersections throughout the study area to best achieve a safe, efficient and well-connected road network.

Future Capacity Analysis

HTC used the existing conditions Synchro model as the base model for all the future analysis scenarios. Three different future scenario Synchro models were developed. Design traffic volumes were developed for these models using a standard yearly growth factor for the background volumes and volumes derived from the VISUM models for the new development zones using the select zone feature of the VISUM software. All roundabouts were analyzed using Arcady software. The analysis scenarios included:

Scenario 0: Existing Conditions
Scenario 1: 5-year projection of growth and development (2021)
Scenario 2: 10-year projection of growth and development (2026)
Scenario 3: 10-year projection of growth and development with a connection to Route 2 (2026)

Road Network Improvements

HTC reviewed the proposed access options for the various developments from Kenmount Road, Karwood Drive and McNamara Drive. Different cross sections were prepared for each roadway with conceptual drawings showing the plan and profiles.

Active Transportation

HTC reviewed the network improvements outlined in the Town's Active Transportation Plan that improve both the safety and the walking environment for active transportation users. HTC looked at opportunities to add and/or enhance active transportation infrastructure in the study area.

Findings & Recommendations

HTC will meet with the Town of Paradise to review the initial findings and recommendations of the analysis. Any required changes will be incorporated in the final report.

1.3 Study Area

The study area is located in the Town of Paradise, NL and, as shown in Figure 1, is generally bound by the Outer Ring Road on the east, Route 2 on the south, Three Island Pond Road on the west and Topsail Road on the north. Speed limits in the study area are posted at 50 km/hr on Kenmount Road, Paradise Road and Trails End Drive, 60 km/hr on Topsail Road, 40 km/hr on McNamara Drive and 30 km/hr on Karwood Drive.

The number of lanes on the major study area roadways are listed below:

- Topsail Road – 5-lane cross section
- Kenmount Road – 2-lane cross section
- Karwood Drive – 4-lane cross section
- McNamara Drive – 2-lane cross section
- Paradise Road – 2-lane cross section
- Trails End Drive – 2-lane cross section

Figure 1 - Study area

1.4 Traffic Counts

The traffic counts for this project were gathered by Harbourside Transportation Consultants using three Miovision 'Scout' video traffic counters. Traffic count data for this project were recorded at the following times and locations, which are shown in Figure 1.

1. Topsail Road/McNamara Drive/Clearview Heights – Tuesday, February 2, 2016
2. Topsail Road/Paradise Road – Tuesday, February 2, 2016
3. Topsail Road/Karwood Drive/Trails End Drive – Tuesday, February 2, 2016
4. Kenmount Road/McNamara Drive/Bremigens Boulevard – Thursday, May 5, 2016
5. Kenmount Road/Karwood Drive – Thursday, May 19, 2016
6. Kenmount Road/Route 1 SB Ramps – Thursday, May 5, 2016
7. Kenmount Road/Route 1 NB Off-Ramps – Thursday, May 5, 2016
8. Kenmount Road/Bruce Street/Route 1 NB On-Ramp – Tuesday, May 3, 2016

The traffic count data collected by HTC has been included in Appendix A.

1.5 Horizon Year and Growth Rates

For the purposes of this project, HTC selected a background traffic growth rate of 1.0%, which was deemed a reasonable growth rate for background traffic in the Town of Paradise. Morning (AM) and evening (PM) peak hour volumes were factored by this growth rate to reflect normal increases in traffic that can be expected on the study area road network without the proposed development. The horizon years for the study were established at a 5-year projection of growth and development to the year 2021 and a 10 year projection of growth and development to the year 2026.

1.6 Stakeholder Interviews

HTC conducted stakeholder interviews to establish development projections for the 5-year and 10-year study horizons. HTC conducted interviews with Karwood Developments, Fairview Investments, and the Eastern School District. A meeting was held with the Town of Paradise to discuss the findings.

Karwood Developments

HTC met with Greg Hussey, Brian Bugden and Dennis Newhook of Karwood Developments on May 17, 2016 to discuss their development plans for the Karwood Market and Market Ridge areas. Karwood Developments is a major land owner in the study area, with plans for a large commercial development along Kenmount Road, known as the Karwood Market. They are also responsible for the Market Ridge residential housing development which is just north of the Karwood Market development.

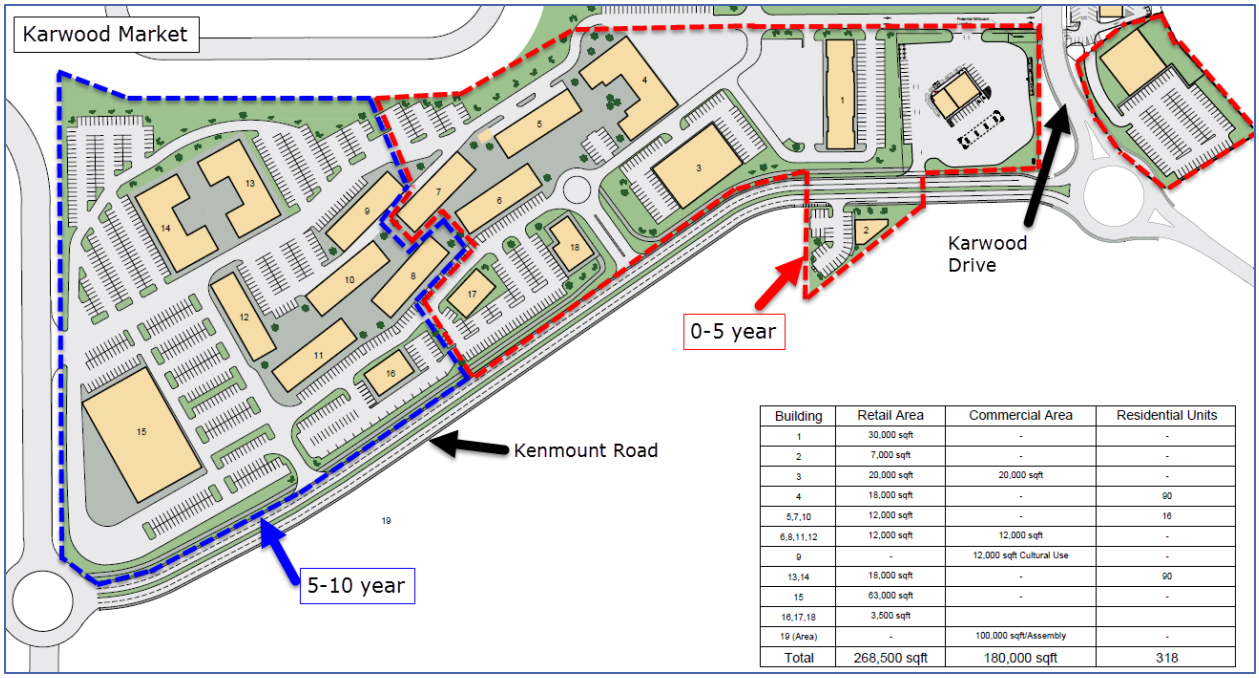
Karwood Developments provided HTC with a concept plan of the proposed Karwood Market area on Kenmount Road. The concept plan shows a number of roadways and internal roadway connections that are conceptual in nature; the concept plan has no level of municipal approval at this point in time.

Karwood Developments indicated that the two corner properties on the northwest and northeast quadrants of the Karwood Drive/Kenmount Road roundabout are currently vacant. Irving has expressed an interest in purchasing the northwest lot.

Following HTC's meeting, Karwood provided a more detailed breakdown of the 5, 10 and 20 year projections for the Karwood Market development, the Market Ridge development and for development plans they have in the Bremigens Boulevard area. The information included:

- Land Use
- Projected Gross Floor Area
- Access locations into the developments
- A Conceptual Road Network

The concept plan for the Karwood Market, along with the 5 and 10 year projections for development are shown in Figure 2. The development projections include a gas station, a medical center, retail, office, restaurants, and light industrial and residential uses.



Building	Retail Area	Commercial Area	Residential Units
1	30,000 sqft	-	-
2	7,000 sqft	-	-
3	20,000 sqft	20,000 sqft	-
4	18,000 sqft	-	90
5,7,10	12,000 sqft	-	16
6,8,11,12	12,000 sqft	12,000 sqft	-
9	-	12,000 sqft Cultural Use	-
13,14	18,000 sqft	-	90
15	63,000 sqft	-	-
16,17,18	3,500 sqft		
19 (Area)	-	100,000 sqft/Assembly	-
Total	268,500 sqft	180,000 sqft	318

Figure 2 - Karwood Market Development Concept Plan

Fairview Investments

HTC met with Barry Clarke and Jeff Clarke of Fairview Investments on June 2, 2016 to discuss development plans for the Octagon Pond area. An overview of Fairview's property holdings in this area was provided. Their property, for the most part, is bounded by Octagon Pond and McNamara Drive to the east, Route 2 and Three Island Pond Road to the south and west and by Topsail Road to the north. There are other property owners in that area as well, including Joanne Dobbin and Steven Stanford. Their land holdings are considered minor when compared to the Fairview Investments holdings, and accordingly, they were not interviewed as part of this study.

Tract Consulting Ltd. completed a development concept plan approximately 13 years ago, for Fairview Investments land holdings in the Octagon Pond area. There was also a traffic study completed for this area which was accepted by the Town of Paradise. The concept plan, shown in Figure 3, made provisions for some 1,800 – 2,400 residential dwelling units proposed to be developed at that time.

Fairview Investments was unable to provide a timeframe of when any of the property would be developed as they are still in discussions with the Town of Paradise. Therefore, HTC referred to the Tract Study to establish development projections.

The road network that had been originally proposed for the Octagon Pond Development, shown in Figure 3, has been modified since the Tract Study was completed. The road network on the north section of the Octagon Pond Development, west of Octagon Pond, has been planned as a residential area with an Elementary School. On the south/southeast section of the proposed development, the planned road to connect with the Route 2 interchange conflicts with the previous intentions to develop this area primarily for residential use. Fairview Investments were accepting of the proposed commercial and light industrial land uses have been introduced on both sides of the future connector roadway to the Route 2 interchange. This land use change allows a more compatible buffer to be introduced between Route 2 and the residential development in the area.

Figure 3 - Development Concept Plan for Fairview Investment's Octagon Pond Residential Development

Eastern School District

HTC spoke to Mr. Jim Sinnott, Eastern School District's Director of Facilities and Custodial Management, on July 27, 2016 to discuss the proposed locations and size of schools that were currently being contemplated for the Market Ridge area. During the discussion, Mr. Sinnott mentioned that the high school that had been proposed for the area has been postponed indefinitely, and that the junior high school was postponed for an additional two years. The proposed junior high school was intended to accommodate a total of 1,000 students. Site locations that were under consideration included lands near the Dianna Whalen Soccer Complex. This location within the Town of Paradise was considered to be ideal with the existing recreational

facilities that are already in the immediate area and that could be easily incorporated into the school's recreational programs. The horizon year for the junior high school was 2021 for the school to be fully constructed and open for students. The high school was not included in the 5-year or 10-year horizon for this report.

Town of Paradise

Once all of the stakeholder interviews were completed, HTC met with the Town of Paradise to discuss the findings and to get their views on proposed developments that are expected to occur over the 5 and 10-year planning periods within the study area. Other developments that were mentioned included the COIL development and the development of the individual light industrial lots along Kenmount Road that were not currently built out. The COIL development which is located just west of the Kenmount Road/ McNamara Drive intersection is not expected to be developed within the timeframes under consideration by this report. HTC included the additional industrial properties noted by The Town of Paradise in the applicable 5-year and 10-year horizons.

1.7 Development Projections

The traffic projections that were developed by HTC for the study area and for both horizon periods considered (2021 and 2026) were developed based on the information obtained from the stakeholder interviews and the meeting with the Town of Paradise. The information was separated into two areas using McNamara Drive as the dividing line. The area east of McNamara Drive is referred to as the "Karwood Area" and the area to the west the "Octagon Pond Area". The proposed developments that were considered in both areas are described below within the timeframes of 0-5 years and 5-10 years.

Table 2 - Development Projections – 2021 & 2026

Karwood Area			
Development	**0-5 year Horizon (2021)**	**5-10 year Horizon (2026)**	**Total Development by 2026**
Gas Station	8 Fueling Stations	-	**8 Fueling Stations**
Medical Centre	30,000 sq. ft.	-	**30,000 sq. ft.**
Retail	81,000 sq. ft.	147,000 sq. ft.	**228,000 sq. ft.**
Office	93,050 sq. ft.	86,000 sq. ft.	**179,050 sq. ft.**
Residential	202 Dwelling Units	246 Dwelling Units	**448 Dwelling Units**
Industrial	68,300 sq. ft.	218,000 sq. ft.	**286,300 sq. ft.**
Restaurant	8,350 sq. ft.	3,500 sq. ft.	**11,850 sq. ft.**
Institutional	1,000 students	-	**1,000 students**
Culture Use	-	12,000 sq. ft.	**12,000 sq. ft.**

Octagon Pond Area			
Development	**0-5 year Horizon (2021)**	**5-10 year Horizon (2026)**	**Total Development by 2026**
Residential Low-Density	35 Dwelling Units	14 Dwelling Units	**49 Dwelling Units**
Residential Medium-Density	140 Dwelling Units	56 Dwelling Units	**196 Dwelling Units**
Residential High-Density	-	105 Dwelling Units	**105 Dwelling Units**
Commercial	10,000 sq. ft.	10,000 sq. ft.	**20,000 sq. ft.**
Industrial	125,000 sq. ft.	125,000 sq. ft.	**250,000 sq. ft.**

2 Intersection Performance/Capacity Analysis

2.1 Standard Terms and Measure of Performance

There are three primary measures of performance that are typically used to evaluate the performance of an intersection. These are outlined below.

Volume to Capacity Ratio (v/c) – Volume to capacity ratios relate the estimated traffic volumes (demand volume) to the theoretical maximum volume that could be accommodated (capacity volume/adjusted saturation flow rate). As the v/c ratio approaches 1.0, the movement has reduced ability to accommodate any additional volume of traffic. Generally, intersection control or road infrastructure movements can alleviate any reduced residual capacity.

Level of Service (LOS) – LOS is a qualitative measure which describes operational conditions. It is based on service measures such as freedom to maneuver, travel time, speed, and traffic interruptions. LOS is expressed as a scale from 'A' to 'F', where LOS A represents free flow conditions or very low delay (less than 10 seconds per vehicle at an intersection), and LOS F represents delay times that are unacceptable to motorists using the facility (greater than 50 seconds at a STOP sign or roundabout control or greater than 80 seconds at traffic signals). Generally speaking, a minimum of LOS D is considered acceptable. Table 3 shown below describes the level of service criteria for both signalized and two way stop controlled intersections.

Table 3 - LOS Criteria Signalized, Roundabout and Unsignalized Intersections

LOS	Signalized Intersection Control Delay (seconds per vehicle)	Level of Service (LOS) Descriptions	Roundabout Intersection Control Delay (seconds per vehicle)	Two Way Stop Controlled Intersection Control Delay (seconds per vehicle)
A	≤ 10 sec	Very low delay. Majority of through traffic on main street does not stop at all. **(Excellent)**	≤ 10 sec	≤ 10 sec
B	10 – 20 sec	Somewhat higher delay. More vehicles have to stop for red lights. **(Very Good)**	10 – 15 sec	10 – 15 sec
C	20 – 35 sec	Higher level of congestion and vehicles wait through more than one signal indication, occasionally backups may develop, however traffic flow is still stable and acceptable. **(Good)**	15 – 25 sec	15 – 25 sec
D	35 – 55 sec	Congestion is noticeable and delays may become extensive. Most cars have to wait more than one red light to pass. This threshold is the upper limit for design. **(Satisfactory)**	25 – 35 sec	25 – 35 sec
E	55 – 80 sec	Congested conditions. Traffic fills intersection capacity with long queues and delays. Many vehicles need to wait more than one green indication. The LOS is nearing capacity and is unsatisfactory. **(Unsatisfactory)**	35 – 50 sec	35 – 50 sec
F	≥ 80 sec	Very congested conditions. Traffic demand exceeds capacity of the intersection with very long queues and delays. The LOS is generally considered to be unacceptable. **(Unacceptable)**	≥ 50 sec	≥ 50 sec

Queue Capacity – Queue capacity at intersections is critical to the performance of the network. As part of the analysis process, queue lengths will be examined and recommendations made to ensure that sufficient vehicle storage is available to maintain efficient traffic flow. The 95% percentile queue length is the length of queue which is exceeded only 5% of the time.

2.2 Software Used in Analysis

HTC used the Synchro/SimTraffic v9 software as the primary evaluation tool for the analysis completed for this report. Synchro was used to analyze network intersections and their LOS measure of performance based on the methodology of the Highway Capacity Manual (Transportation Research Board). SimTraffic, the micro-simulation component of the software package, was also used in the course of the analysis to check delay, illustrate and identify interactions between individual driver types and to illustrate the effects of adjacent or closely spaced intersections.

The combination of the two software's allows the analyst to review the intersections using two different approaches. The Synchro software is used to individually analyze intersections, while the SimTraffic software analyzes the network as a whole. SimTraffic will identify external influences on intersections such as spillbacks from an upstream/downstream intersection.

The ARCADY/Junctions 8 software was used to analyze the roundabout options throughout the study area. ARCADY uses an empirical model based on the application of statistical regression of a large data set of observed roundabout operations in the United Kingdom. The tool is intended to aid designers in selecting the best geometry for a given location and traffic demand. The research on which these models are based showed that the entrance capacity was sensitive to entry lane geometry (width, flare, curb radius, angle) and roundabout diameter, as well as to conflicting flow.

VISUM is a macroscopic transportation planning modelling software package that was used in the study to distribute the traffic associated with the growth scenarios for 2021 and 2026 to the study area road network.

2.3 Scenarios for Level of Service Analysis

For the purpose of this Transportation Master Plan, HTC completed and analyzed four network scenarios. These network scenarios are described as follows:

- Scenario 0 – Existing Conditions (2016): A scenario reflecting the existing conditions in the study area.
- Scenario 1 – 5-year Projection (2021): A projection of normal growth to the year 2021 with the 5-year development horizon projected on the study network.
- Scenario 2 – 10-year Projection (2026): A projection of normal growth to the year 2026 with the 10-year development horizon projected on the study network.
- Scenario 3 – 10-year Projection with connection to Route 2 (2026): A projection of normal growth to the year 2026 with the 10-year development horizon. The road network was modified to include a roadway connection to the Route 2 Interchange.

Sections 3 and 6 of the report summarize the results of the Synchro and Arcady level of service analyses that were conducted on the study area intersections for Scenarios 0 through 3. The design volumes used in the different scenarios can be found in Appendix B. The summary tables for both the Synchro/SimTraffic and Arcady results can be found in Appendix C and the detailed Synchro/SimTraffic analysis results can be found in Appendix D. The VISUM model assumptions can be found in Appendix G.

3 Existing Conditions (2016)

3.1 Scenario 0 – Existing Conditions (2016) Level of Service Analysis

HTC built both an AM and PM peak hour Synchro model for the study area intersections using the traffic volumes obtained and described in Section 1.4. The hourly volumes for both the AM and PM peak hours were used to represent existing conditions in 2016. It should be noted that these volumes balance well throughout all links and intersections in the models. The existing traffic controller timings and phasing plans for the four (4) signalized intersections within the study area were obtained from field data collection. The signalized intersections include:

- Topsail Road/McNamara Drive
- Topsail Road/Paradise Road
- Topsail Road/Karwood Drive
- Kenmount Road/Bruce Street

The level of service conditions throughout the study area under the existing conditions scenario (2016) are shown in Figure 4. The results of the analysis show some movements operating at LOS E or F during both the AM and PM peak hour.

Topsail Road/McNamara Drive/Clearview Heights

During the AM peak hour, the intersection operates at an acceptable level of service with all movements operating at LOS D or better. During the PM peak hour, the overall intersection operates at an acceptable level of service. The shared northbound left-turn/through movements operate at LOS E.

Topsail Road/Paradise Road

The intersection operates at acceptable levels of service, LOS D or better, in both the AM and PM peak hour.

Topsail Road/Karwood Drive

During the AM peak hour, the shared eastbound through/right-turn movements at the intersection operate at LOS E. During the PM peak hour, the shared westbound through/right-turn movements operate at LOS E. This intersection shows signs of capacity and congestion problems during both peak periods.

Kenmount Road/McNamara Drive/Bremigens Boulevard

During the AM peak hour, this all-way stopped controlled intersection operates at an overall LOS E. The southbound left-turn/through movements operating at LOS F. During the PM peak hour, the intersection operates at LOS E. The southbound left-turn/through movements operate at LOS E and the westbound left-turn/through movements operate at LOS F.

Kenmount Road/Karwood Drive

The existing roundabout at this location operates at acceptable levels of service, LOS D or better, in both the AM and PM peak hour.

Kenmount Road/Route 1 SB Ramps

During the AM peak hour, the unsignalized intersection operates at an overall LOS E. The Route 1 SB off-ramp left-turn movement operates at LOS F and is over capacity. During the PM peak hour, the overall intersection operates at LOS F. The Route 1 southbound left-turn/right-turn movements operates at LOS F.

Kenmount Road/Bruce Street

During the AM peak hour, the intersection operates at an acceptable level of service with all movements operating at LOS D or better. During the PM peak hour, the intersection operates at an overall LOS E. The northbound left-turn and through/right-turn movements at the intersection of Kenmount Road and Bruce Street operate at LOS F.

Overall the majority of the intersections within the study area, with the exception of the intersection of McNamara Drive and Kenmount Road and the Kenmount Road intersection with the Route 1 SB off-ramp, operate fairly well during both the AM and PM peak traffic periods.

The intersections of McNamara Drive and Kenmount Road and the intersection of Kenmount Road with the Route 1 SM off-ramp were evaluated to determine whether or not a higher level of traffic control (traffic signals) was required to handle the existing traffic flows at both intersections. Details of this investigation are noted in section 3.2.

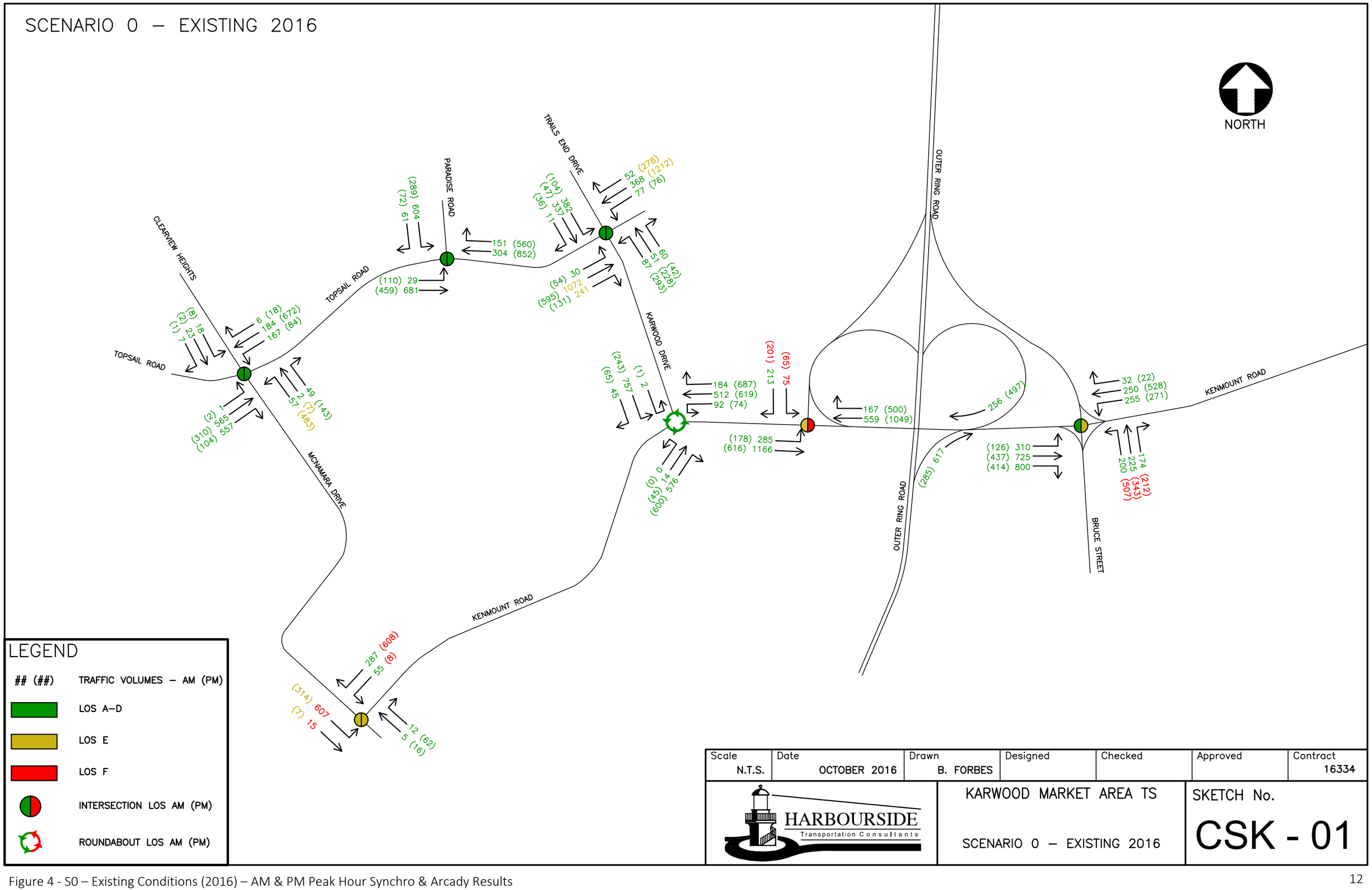
3.2 Existing Conditions – Traffic Signal Warrant Analysis

HTC used the Transportation Association of Canada's (TAC) Canadian Traffic Signal Warrant Matrix Procedure to evaluate whether or not traffic signals should be considered for two intersections located within the study area. The TAC signal matrix evaluates vehicle to vehicle and vehicle to pedestrian interactions. The warrant is further refined and adjusted based on demographic information including population, the presence of transit routes or schools, etc., producing a final warrant point value. Some of the data that is required for this warrant procedure is also subjective in nature such as the inputs for being "near a school". This procedure also incorporates collision prediction theory which anticipates the amount of collisions based on traffic volume and intersection geometry. In order for traffic signals to be considered within this warrant procedure, an intersection must score 100 priority points or more. A traffic signal installation would be deemed unwarranted if the scoring is less than 100 points.

A traffic signal warrant analysis was completed for the Kenmount Road and McNamara Drive/Bremigens Boulevard intersection using the traffic volumes collected on May 5th, 2016, and existing lane configurations. The intersection scored a total of 17 priority points. Therefore, this intersection should not be considered for the installation of traffic signals at this point in time.

A traffic signal warrant analysis also was completed for the Kenmount Road and Route 1 SB Ramps intersection using the traffic volumes collected on May 5th, 2016, and existing lane configurations. The intersection scored a total of 208 priority points. Therefore, this intersection should be considered now for a higher level of traffic control such as the installation of traffic signals, or installation of a roundabout. The traffic signal warrant analysis calculation sheets for both intersections can be found in Appendix E.

SCENARIO 0 – EXISTING 2016



LEGEND

## (##)	TRAFFIC VOLUMES – AM (PM)
	LOS A–D
	LOS E
	LOS F
	INTERSECTION LOS AM (PM)
	ROUNDABOUT LOS AM (PM)

Scale	Date	Drawn	Designed	Checked	Approved	Contract
N.T.S.	OCTOBER 2016	B. FORBES				16334

HARBOURSIDE Transportation Consultants

KARWOOD MARKET AREA TS

SCENARIO 0 – EXISTING 2016

SKETCH No.

CSK - 01

Figure 4 - S0 – Existing Conditions (2016) – AM & PM Peak Hour Synchro & Arcady Results

4 Description of Study Area Network

The road network for the Karwood Market area has already, to a large extend, been conceptualized by previous planning studies including the Paradise Transportation Study (2011), the Paradise Traffic Improvement Plan (2014) and the Route 2 traffic study (2016). HTC reviewed the conceptual road alignments presented in these documents and made modifications to reflect the updated land use plan for the Town of Paradise and the projected developments plans for the Karwood Market area.

HTC has updated the conceptual road network, which includes seven (7) new roadways and connections throughout the study network. Descriptions of the new roadways are provided below. The updated road network is shown in Figure 5.

Street 1: North/South Octagon Pond Collector Road

The development contemplated in the Octagon Pond area under the concept plan that had been developed by Tract Consulting for Fairview Investments reflects an overall intention to develop all the lands in the area for residential uses. Many of the roadways in this plan have indirect connections that limit traffic flows. HTC is proposing a somewhat more direct route extending from Sgt. Donald Lucas Drive to a connection with a new roadway that extends from Kenmount Road to the location on Route 2 that is being considered for a new interchange. HTC has also introduced a number of roundabouts along this roadway which will discourage through traffic to some degree and control speeds along this route. HTC is suggesting a roadway cross-section consisting of a single traffic lane in each direction, a 4.0 meter AT trail on one side of the road and a standard sidewalk on the other separated by a boulevard. Reference Figure No. 12 for the exact configuration being suggested. Residential development with direct driveway access should not be permitted along the majority of the roadway's frontage without exception, as the roadway nears the commercial zoned lands suggested along roadway 5. Please note, that HTC is also suggesting a direct connection be made to roadway 1 from Shalloway Place. Traffic calming measures can be implemented in the Three Island Pond area if this connection draws any significant amount of through traffic. It should also be noted that the street 1 can be shifted somewhat in the east/west directions to accommodate an efficient development of the residential lands in this area.

Street 2: Octagon Pond Connection to Shalloway Place

This proposed connection from the Octagon Pond Development to Shalloway Place provides a secondary connection to the Three Island Pond Residential Area. This connection may increase the amount of through traffic on Three Island Pond Road and Buckingham Drive. As indicated previously when this connection is made a further assessment may have to be completed to determine if traffic calming measures should be put in place.

Streets 3 & 7: McNamara Drive Extension & the McNamara Drive Extension Connection to Kenmount Road

The extension of McNamara Drive to Kenmount Road is a highly attractive route for vehicles which allows commuting traffic to bypass an industrial portion of McNamara Drive and reduce travel times. The road will provide access to proposed schools, soccer fields, and residential development and to the Karwood Market development. This proposed connection comes with its own challenges, with steep grades, potential right-of-way issues and property boundaries. HTC focused on balancing issues such as impacts to the land owners with respect to the right-of-way and the functionality of the roadway.

Street 4 & 6: Bremigens Boulevard Extension Connection to Kenmount Road & Bremigens Boulevard Extension

Bremigens Boulevard is only partially constructed at this point in time. This roadway should be extended around Bremigens Pond to form either a direct or indirect connection with Kenmount Road at the street 7 intersection point with Kenmount Road. This roadway extension will allow additional industrial land in the area to be developed. It should be noted that the development of both of these roadways should be developer driven and financed. These roadways are not required to accommodate the overall increase in traffic flows in the study area.

Street 5: Kenmount Road Extension to Route 2 Interchange

The extension of Kenmount Road to the west towards Three Island Pond and Route 2 via the proposed Route 2 interchange, is expected to be a roadway that will be well utilized by the residents of the Town of Paradise. This new roadway allows a future connection to Route 2 which will alleviate traffic pressures on Topsail Road and along segments of Kenmount Road. This roadway also allows property that had previously been considered for residential uses under the Tract Consulting Octagon Pond Development Concept Plan to be considered for industrial and/or commercial uses.

4.1 Street Plan and Profiles

HTC developed a digital terrain model of the study area using AutoCAD Civil 3D and the lidar obtained for the study area. Using this model, HTC developed preliminary center line profiles of streets 1-7 to ensure vertical alignments fall within acceptable limits that are constructible. A maximum gradient of 10% was used as the upper limit in this process. A more detailed predesign of these roadways will be necessary to finalize both the horizontal and vertical alignment of these roadways. The conceptual plan and profiles for streets 1-7 can be found in Appendix F.

No.	DESCRIPTION	Date (12/13/16)	By
	ISSUE or REVISION		

Client

HARBOURSIDE Transportation Consultants

Project

KARWOOD MARKET AREA TS

PARADISE, NL

Title

TRANSPORTATION NETWORK PLAN

Scale	Date
1:15000	DECEMBER 2016
	Drawn B.F. / Designed C.M.
	Checked M.M. / Approved R.K.
	Contract No. 16334
	Drawing No. C-01A

Figure 5 – Conceptual Road Network

5 Trip Generation/Trip Distribution

5.1 Trip Generation

HTC quantified the trip generation rates for the expected levels of development for the years 0-5 and 5-10 using the Institute of Transportation Engineers (ITE) 9th edition of the ***Trip Generation Manual***. A total of 13 land use codes were used to determine the additional trips on the network for both the 2021 and 2026 horizon years. These land uses included:

- 'General Light Industrial' (Land Use Code 110),
- 'Single-Family Detached Housing' (Land Use Code 210),
- 'Apartment' (Land Use Code 220),
- 'Residential Condominium/Townhouse' (Land Use Code 230),
- 'Low-Rise Residential Condominium/Townhouse' (Land Use Code 231),
- 'Multipurpose Recreational Facility' (Land Use Code 435),
- 'Junior High School' (Land Use Code 522),
- 'General Office Building' (Land Use Code 710),
- 'Medical/Dental Centre' (Land Use Code 720),
- 'Free-Standing Discount Store' (Land Use Code 815),
- 'Quality Restaurant' (Land Use Code 931),
- 'Fast-Food Restaurant with Drive-Thru' (Land Use Code 935), and
- 'Gasoline/Service Station with Convenience Market' (Land Use Code 945).

For the Karwood Area, the 0-5 year scenario is expected to generate 1,077 trips in the AM peak hour (643 trips in/434 trips out) and 1,147 trips in the PM peak hour (534 trips in/613 trips out). The 5-10 year scenario will generate 1,715 trips in the AM peak hour (1,086 trips in/629 trips out) and 2,463 trips in the PM peak hour (1,108 in/1,355 out).

For the Octagon Pond Area, the 0-5 year scenario is expected to generate 258 trips in the AM peak hour (144 trips in/114 trips out) and 347 trips in the PM peak hour (152 trips in/195 trips out). The 5-10 year scenario will generate 507 trips in the AM peak hour (283 trips in/224 trips out) and 670 trips in the PM peak hour (283 trips in/387 trips out).

It should be noted that the scenarios are cumulative, meaning that the trips from the 0-5 year scenario are included in the total trips for the 5-10 year scenario for both development areas.

HTC reduced the trips generated for the Karwood Market Area for both the year 2021 and 2026 to reflect pass-by trips and internally captured trips. Pass-by trips are defined as trips that are generated by a particular land use but are not considered 'additional or new' trips that should be added to the roadway. Internally captured trips are defined as trips that are generated by a mixed-use development that both begin and end within a development. Therefore, a percentage of the trips are reduced to reflect internal trips on the internal development network. HTC used the Trafficware trip generation software to determine the appropriate reduction for trips generated by the following Land Use codes:

- 'Free-Standing Discount Store' (Land Use Code 815) – PM Peak Hour = 17% reduction.
- 'Quality Restaurant' (Land Use Code 931) – PM Peak Hour = 44% reduction.
- 'Gasoline/Service Station with Convenience Market' (Land Use Code 945) – AM Peak Hour = 62% reduction and PM Peak Hour = 56 % reduction.

The trip generation rates for both the AM and PM peak hours of adjacent stream traffic are noted below in Table 4 for the 2021-year horizon and in Table 5 for the 2026-year horizon.

Table 4 - Proposed Development Trip Generation Rates Year 2021 – AM and PM Peak Hour

Land Use (2021)	Number	Unit	1000 sq ft GFA * Coverage	ITE Code	AM Peak Rate	AM Peak Trip Gen	AM Peak In	AM Peak Out	PM Peak Rate	PM Peak Rate Gen	PM Peak In	PM Peak Out
Karwood Area (2021)												
Irving Gas Station - Convenience Store	8	Fuelling Stations	-	945	10.16	82	41	41	13.51	109	55	54
Irving Gas Station - Fast-Food restaurant with Drive thru	1,346	sq. ft.	1.3	935	24.43	33	16	17	44.99	61	32	29
Building #1 - Medical/Dental Centre	30,000	sq. ft.	30.0	720	0.53	16	13	3	1.06	32	11	21
Building #2 - Retail	7,000	sq. ft.	7.0	815	1.06	8	6	2	4.98	35	18	17
Building #3 - Retail	20,000	sq. ft.	20.0	815	1.06	22	15	7	4.98	100	50	50
Building #3 - Office	20,000	sq. ft.	20.0	710	1.56	32	29	3	1.49	30	6	24
Building #4 - Retail	18,000	sq. ft.	18.0	815	1.06	20	14	6	4.98	90	45	45
Building #4 - Residential	90	DU	-	220	0.51	46	10	36	0.62	56	37	19
Building #5 - Retail	12,000	sq. ft.	12.0	815	1.06	13	9	4	4.98	60	30	30
Building #5 - Residential	16	DU	-	220	0.51	9	2	7	0.62	10	7	3
Building #6 - Retail	12,000	sq. ft.	12.0	815	1.06	13	9	4	4.98	60	30	30
Building #6 - Office	12,000	sq. ft.	12.0	710	1.56	19	17	2	1.49	18	4	14
Building #7 - Retail	12,000	sq. ft.	12.0	815	1.06	13	9	4	4.98	60	30	30
Building #7 - Residential	16	DU	-	220	0.51	9	2	7	0.62	10	7	3
Building #17 - Restaurant	3,500	sq. ft.	3.5	931	0.81	3	2	1	7.49	27	19	8
Building #18 - Restaurant	3,500	sq. ft.	3.5	931	0.81	3	2	1	7.49	27	19	8
Building #19 - Office	50,000	sq. ft.	50.0	710	1.56	78	69	9	1.49	75	13	62
Building (RDBT) - Office	11,050	sq. ft.	11.1	710	1.56	18	16	2	1.49	17	3	14
Residential Areas												
Residential (Townhouses)	80	DU	-	230	0.44	36	7	29	0.52	42	29	13
Junior High School	1,000	Students	-	522	0.54	540	297	243	0.16	160	79	81
Bremigen's Pond Area												
Industrial (2.5 acre, 15.3% coverage)	16,662	sq. ft.	16.7	110	0.92	16	15	1	0.97	17	3	14
Industrial (7.75 acre, 15.3% coverage)	51,651	sq. ft.	51.7	110	0.92	48	43	5	0.97	51	7	44
Future Development Total - Karwood Area 2021						**1077**	**643**	**434**		**1147**	**534**	**613**
Internal Capture Trips						74	37	37		268	134	134
Pass-By Trips						50	25	25		122	61	61
Future Volume Added to Adjacent Streets (Karwood Area - 2021)						**953**	**581**	**372**		**757**	**339**	**418**
Octagon Pond Area (2021)												
Residential Low-Density	35	DU	-	210	0.75	27	7	20	1.00	35	23	12
Residential Medium-Density	140	DU	-	210	0.75	105	27	78	1.00	140	89	51
Residential High-Density	0	DU	-	231	0.67	0	0	0	0.78	0	0	0
Commercial	10,000	sq. ft.	10	815	1.06	11	8	3	4.98	50	25	25
Light Industrial	125,000	sq. ft.	125	110	0.92	115	102	13	0.97	122	15	107
Future Volume Added to Adjacent Streets (Octagon Pond - 2021)						**258**	**144**	**114**		**347**	**152**	**195**
Future Total Volume Added to Adjacent Street - 2021						**1211**	**725**	**486**		**1104**	**491**	**613**

Notes: 1. HTC did not did not make any allowances in the design volumes to reflect pass-by or internally captured trips for the commercial development in the Octagon Pond Area. The floor area for the anticipated commercial development is small and reductions to reflect pass-by or internally captured trips was deemed unnecessary.

2. The building numbers referenced in the Karwood Area are shown in Figure No. 2.

Table 5 - Proposed Development Trip Generation Rates Year 2026 – AM and PM Peak Hour

Land Use (2026)	Number	Unit	1000 sq ft GFA * Coverage	ITE Code	AM Peak Rate	AM Peak Trip Gen	AM Peak In	AM Peak Out	PM Peak Rate	PM Peak Rate Gen	PM Peak In	PM Peak Out
Karwood Area (2026)												
Irving Gas Station - Convenience Store	8	Fuelling Stations	-	945	10.16	82	41	41	13.51	109	55	54
Irving Gas Station - Fast-Food restaurant with Drive thru	1,346	sq. ft.	1.3	935	24.43	33	16	17	44.99	61	32	29
Building #1 - Medical/Dental Centre	30,000	sq. ft.	30.0	720	0.53	16	13	3	1.06	32	11	21
Building #2 - Retail	7,000	sq. ft.	7.0	815	1.06	8	6	2	4.98	35	18	17
Building #3 - Retail	20,000	sq. ft.	20.0	815	1.06	22	15	7	4.98	100	50	50
Building #3 - Office	20,000	sq. ft.	20.0	710	1.56	32	29	3	1.49	30	6	24
Building #4 - Retail	18,000	sq. ft.	18.0	815	1.06	20	14	6	4.98	90	45	45
Building #4 - Residential	90	DU	-	220	0.51	46	10	36	0.62	56	37	19
Building #5 - Retail	12,000	sq. ft.	12.0	815	1.06	13	9	4	4.98	60	30	30
Building #5 - Residential	16	DU	-	220	0.51	9	2	7	0.62	10	7	3
Building #6 - Retail	12,000	sq. ft.	12.0	815	1.06	13	9	4	4.98	60	30	30
Building #6 - Office	12,000	sq. ft.	12.0	710	1.56	19	17	2	1.49	18	4	14
Building #7 - Retail	12,000	sq. ft.	12.0	815	1.06	13	9	4	4.98	60	30	30
Building #7 - Residential	16	DU	-	220	0.51	9	2	7	0.62	10	7	3
Building #8 - Retail	12,000	sq. ft.	12.0	815	1.06	13	9	4	4.98	60	30	30
Building #8 - Office	12,000	sq. ft.	12.0	710	1.56	19	17	2	1.49	18	4	14
Building #9 - Cultural Use	12,000	sq. ft.	12.0	435	0.00	0	0	0	3.58	43	24	19
Building #10 - Retail	12,000	sq. ft.	12.0	815	1.06	13	9	4	4.98	60	30	30
Building #10 - Residential	16	DU	-	220	0.51	9	2	7	0.62	10	7	3
Building #11 - Retail	12,000	sq. ft.	12.0	815	1.06	13	9	4	4.98	60	30	30
Building #11 - Office	12,000	sq. ft.	12.0	710	1.56	19	17	2	1.49	18	4	14
Building #12 - Retail	12,000	sq. ft.	12.0	815	1.06	13	9	4	4.98	60	30	30
Building #12 - Office	12,000	sq. ft.	12.0	710	1.56	19	17	2	1.49	18	4	14
Building #13 - Retail	18,000	sq. ft.	18.0	815	1.06	20	14	6	4.98	90	45	45
Building #13 - Residential	90	DU	-	220	0.51	46	10	36	0.62	56	37	19
Building #14 - Retail	18,000	sq. ft.	18.0	815	1.06	20	14	6	4.98	90	45	45
Building #14 - Residential	90	DU	-	220	0.51	46	10	36	0.62	56	37	19
Building #15 - Retail	63,000	sq. ft.	63.0	815	1.06	67	46	21	4.98	314	157	157
Building #16 - Restaurant	3,500	sq. ft.	3.5	931	0.81	3	2	1	7.49	27	19	8
Building #17 - Restaurant	3,500	sq. ft.	3.5	931	0.81	3	2	1	7.49	27	19	8
Building #18 - Restaurant	3,500	sq. ft.	3.5	931	0.81	3	2	1	7.49	27	19	8
Building #19 - Office	100,000	sq. ft.	100.0	710	1.56	156	138	18	1.49	149	26	123
Building (RDBT) - Office	11,050	sq. ft.	11.1	710	1.56	18	16	2	1.49	17	3	14
Residential Areas												
Residential (Townhouses)	80	DU	-	230	0.44	36	7	29	0.52	42	29	13
Residential (RMD)	30	DU	-	210	0.75	23	6	17	1.00	30	19	11
Residential (RMD)	20	DU	-	210	0.75	15	4	11	1.00	20	13	7
Junior High School	1,000	Students	-	522	0.54	540	297	243	0.16	160	79	81
Bremigen's Pond Area												
Private Property (17.3 acre, 15.3% coverage)	115,299	sq. ft.	115.3	110	0.92	107	95	12	0.97	112	14	98
Town of Paradise Property (15.4 acres, 15.3% coverage)	102,636	sq. ft.	102.6	110	0.92	95	84	11	0.97	100	12	88
Industrial (2.5 acre, 15.3% coverage)	16,662	sq. ft.	16.7	110	0.92	16	15	1	0.97	17	3	14
Industrial (7.75 acre, 15.3% coverage)	51,651	sq. ft.	51.7	110	0.92	48	43	5	0.97	51	7	44
Future Development Total - Karwood Area 2026						**1715**	**1086**	**629**		**2463**	**1108**	**1355**
Internal Capture Trips						122	61	61		498	249	249
Pass-By Trips						50	25	25		234	117	117
Future Volume Added to Adjacent Streets (Karwood Area - 2026)						**1543**	**1000**	**543**		**1731**	**742**	**989**
Octagon Pond (2026)												
Residential Low-Density	49	DU	-	210	0.75	37	10	27	1.00	49	31	18
Residential Medium-Density	196	DU	-	210	0.75	147	37	110	1.00	196	124	72
Residential High-Density	105	DU	-	231	0.67	71	18	53	0.78	82	48	34
Commercial	20,000	sq. ft.	20	815	1.06	22	15	7	4.98	100	50	50
Light Industrial	250,000	sq. ft.	250	110	0.92	230	203	27	0.97	243	30	213
Future Volume Added to Adjacent Streets (Octagon Pond - 2026)						**507**	**283**	**224**		**670**	**283**	**387**
Future Total Volume Added to Adjacent Street - 2026						**2050**	**1283**	**767**		**2401**	**1025**	**1376**

Notes: 1. HTC did not did not make any allowances in the design volumes to reflect pass-by or internally captured trips for the commercial development in the Octagon Pond Area. The floor area for the anticipated commercial development is small and reductions to reflect pass-by or internally captured trips was deemed unnecessary.

2. The building numbers referenced in the Karwood Area are shown in Figure No. 2.

5.2 VISUM Modelling

As indicated previously, VISUM is a macroscopic transportation planning modelling software package that is used to model transportation networks and travel demands to forecast traffic flows under a different network conditions. In 2011, the City of St. John's developed a number of VISUM transportation planning models including models for the AM and PM peaks hours for traffic conditions present in 2010, 2015 and 2025. For the purposes of completing this study, the study team updated the 2025 version of the VISUM model to reflect the existing and future road networks throughout the Town of Paradise, with focus specifically in the Karwood Market Area.

HTC's modelling staff had a detailed look at the zones in the immediate area of the Karwood Market to ensure they were coded correctly in the original model production and to ensure they were indeed functioning and generating traffic properly. Thirteen different traffic analysis zones (TAZ's) were examined and adjusted accordingly to reflect the existing uses in each of these zones. The 17 new project zones were coded using the ITE trip generation rates instead of the standard VISUM model zone inputs. Details of the VISUM model adjustments and the trip generation rates used for the new project zones can be found in Appendix G.

5.3 Trip Distribution

HTC used the existing Synchro/SimTraffic model in Scenario 0 – Existing Conditions to develop the future condition scenarios. The 2016 existing base model volumes were adjusted to produce base volumes for the study horizon year of 2021 and 2026 using a standard 1.0% growth rate per year. The trip generation rates, that were developed by HTC for the year 2021 (5-year horizon) and 2026 (10-year horizon), were entered as attributes of the project zones of the VISUM models. The trips associated with each zone were then distributed to the road network along defined multi point assignments (MPAs). MPAs are manually attached to project zones based existing traffic patterns and local knowledge of the study area.

The traffic flows associated with the new project zones and horizon timeframes were determined using the "select zone analysis" feature of the VISUM software. These volumes were then superimposed on the base volumes for each of the defined scenarios to produce the design volumes that were used in each of the scenarios analyzed. The design traffic volumes are noted in Appendix B.

Details of the new project zones, and the multi point assignments used in both the 2021 and 2026 VISUM models are included in Appendix G.

6 Future Condition Scenarios

6.1 Scenario 1 – 5-year Projection (2021) Level of Service Analysis

The Scenario 1 Synchro models for the AM and PM peak hours were developed using the design volumes described previously in section 5.3. This scenario is based on a 5-year development horizon. The traffic signal timings were optimized for all signalized intersections throughout the study.

For this scenario, it was assumed that the three existing intersections recommended to be converted to roundabouts by 2021 were reconstructed. These intersections were analyzed as roundabouts using the Arcady software. In addition, all new intersections in the study area were analyzed as roundabouts. The roundabout locations considered in this scenario included:

- Kenmount Road/Karwood Drive
- Topsail Road/McNamara Drive
- Kenmount Road/McNamara Drive/Bremigens Boulevard
- Kenmount Road/Route 1 SB Ramps
- Kenmount Road/McNamara Drive Extension
- McNamara Drive Extension Internal Roundabout
- McNamara Drive/McNamara Drive Extension

This scenario includes the new roads from McNamara Drive to Kenmount Road and the first 200 metre portion of Kenmount Road extension that will be constructed to accommodate the development anticipated for the 0-5 year timeframe (2021).

The level of service conditions throughout the study area under Scenario 1 (2021) are shown in Figure 6. The results of the analysis show some movements operating at LOS E or F during both the AM and PM peak hour.

Topsail Road/Paradise Road

The intersection operates at acceptable levels of service, LOS D or better, in both the AM and PM peak hour.

Topsail Road/Karwood Drive

During the AM peak hour, the overall intersection operates at LOS E. The shared eastbound through/right-turn movements are operating at LOS F and are over capacity. The southbound movements are operating at LOS E. The SimTraffic analysis indicates that all eastbound movements are operating at LOS F and the southbound movements are operating at LOS F.

During the PM peak hour, the overall intersection operates at an acceptable level of service. The shared westbound through/right-turn movement are operating at LOS E and is nearing capacity and the northbound left-turn is operating at LOS E. The SimTraffic analysis shows all westbound movements operating at LOS F, with the overall intersection operating at LOS E.

Kenmount Road/Bruce Street

During the AM peak hour, the overall intersection operates at an acceptable level of service. In Synchro all movements operate at LOS D or better. The SimTraffic analysis result show the northbound left-turn and through/right-turn movements operating at LOS E and LOS F, respectively.

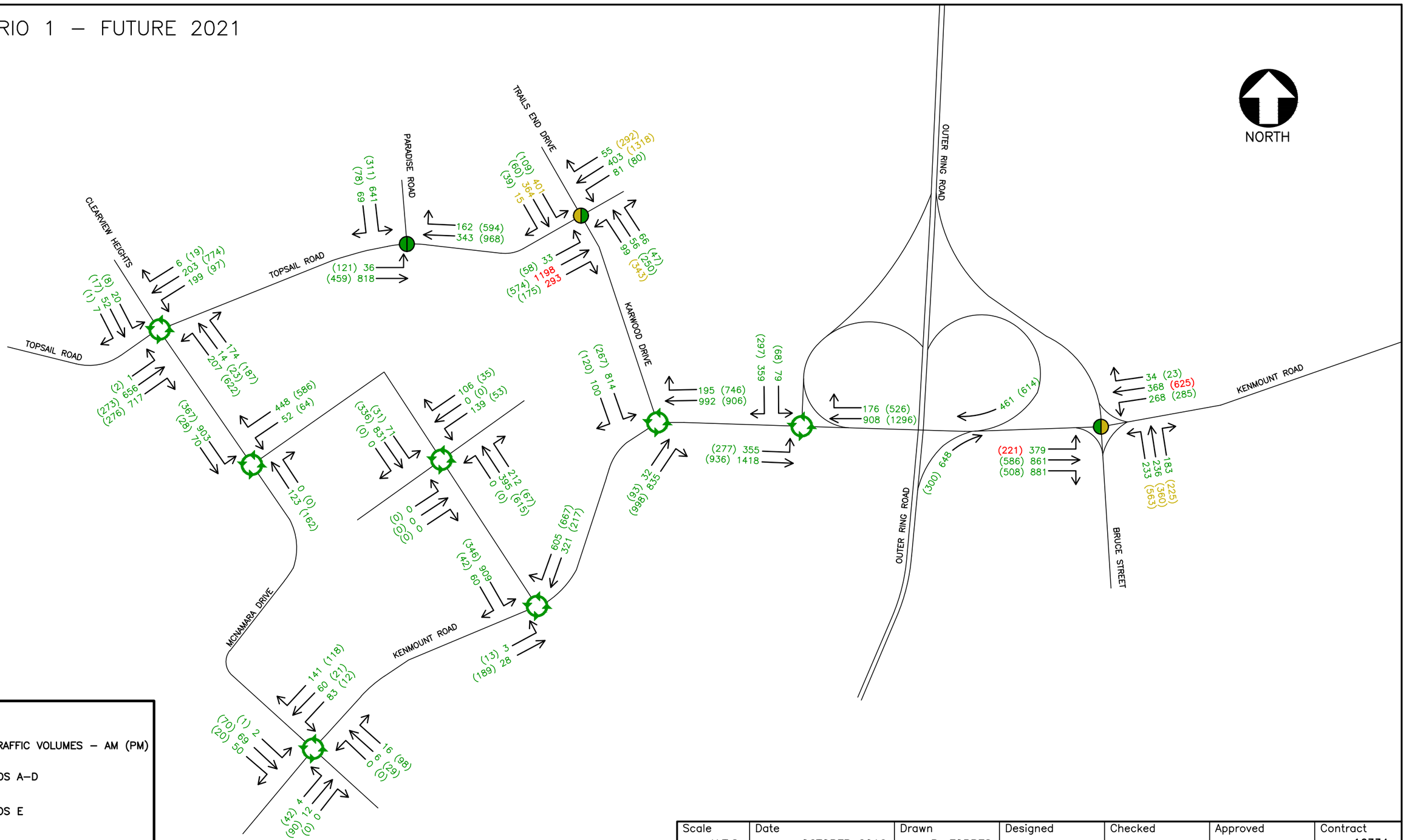
During the PM peak hour, the overall intersection operates at LOS E. The eastbound left-turn and westbound through movements are operating at LOS F. The northbound left-turn and through/right-turn movements operate at LOS E. These four movements are operating at or over capacity.

Poor levels of service at Kenmount Road/Bruce Street will be addressed by converting the signalized intersection to a roundabout by 2026.

Roundabouts

All roundabouts throughout the study network analyzed using Arcady/Junctions 8 software operate with LOS D or better in both the AM and PM peak hours in Scenario 1.

SCENARIO 1 – FUTURE 2021



LEGEND

## (##)	TRAFFIC VOLUMES – AM (PM)
	LOS A–D
	LOS E
	LOS F
	INTERSECTION LOS AM (PM)
	ROUNDABOUT LOS AM (PM)

Scale	Date	Drawn	Designed	Checked	Approved	Contract
N.T.S.	OCTOBER 2016	B. FORBES				16334

HARBOURSIDE Transportation Consultants

KARWOOD MARKET AREA TS

SCENARIO 1 – FUTURE 2021

SKETCH No. CSK - 02

Figure 6 - S1 – Future Conditions (2021) – AM & PM Peak Hour Synchro & Arcady Results

6.2 Scenario 2 – 10-year Projection (2026) Level of Service Analysis

The Scenario 2 Synchro models for the AM and PM peak hours were developed using the design volumes described previously in section 5.3. This scenario is based on a 10-year development horizon. The traffic signal timings were optimized for all signalized intersections throughout the study.

In addition to the roundabouts included in Scenario 1, this scenario models the Kenmount Road/Bruce Street intersection as a roundabout.

The level of service conditions throughout the study area under Scenario 2 (2026) are shown in Figure 7. The results of the analysis show some movements operating at LOS E or F during both the AM and PM peak hour.

Topsail Road/Paradise Road

During the AM peak hour, the intersection operates at acceptable levels of service in the Synchro analysis. The SimTraffic analysis results show the overall intersection operating at LOS E. The SimTraffic results also show the eastbound left-turn and through movements operate at LOS F and the southbound left-turn movement operates at LOS E. The delay in SimTraffic is caused by queues from the Topsail Road/Karwood Drive intersection spilling back into the Topsail Road/Paradise Road intersection.

During the PM peak hour, the intersection operates at acceptable levels of service in both the Synchro and SimTraffic analyses.

Topsail Road/Karwood Drive

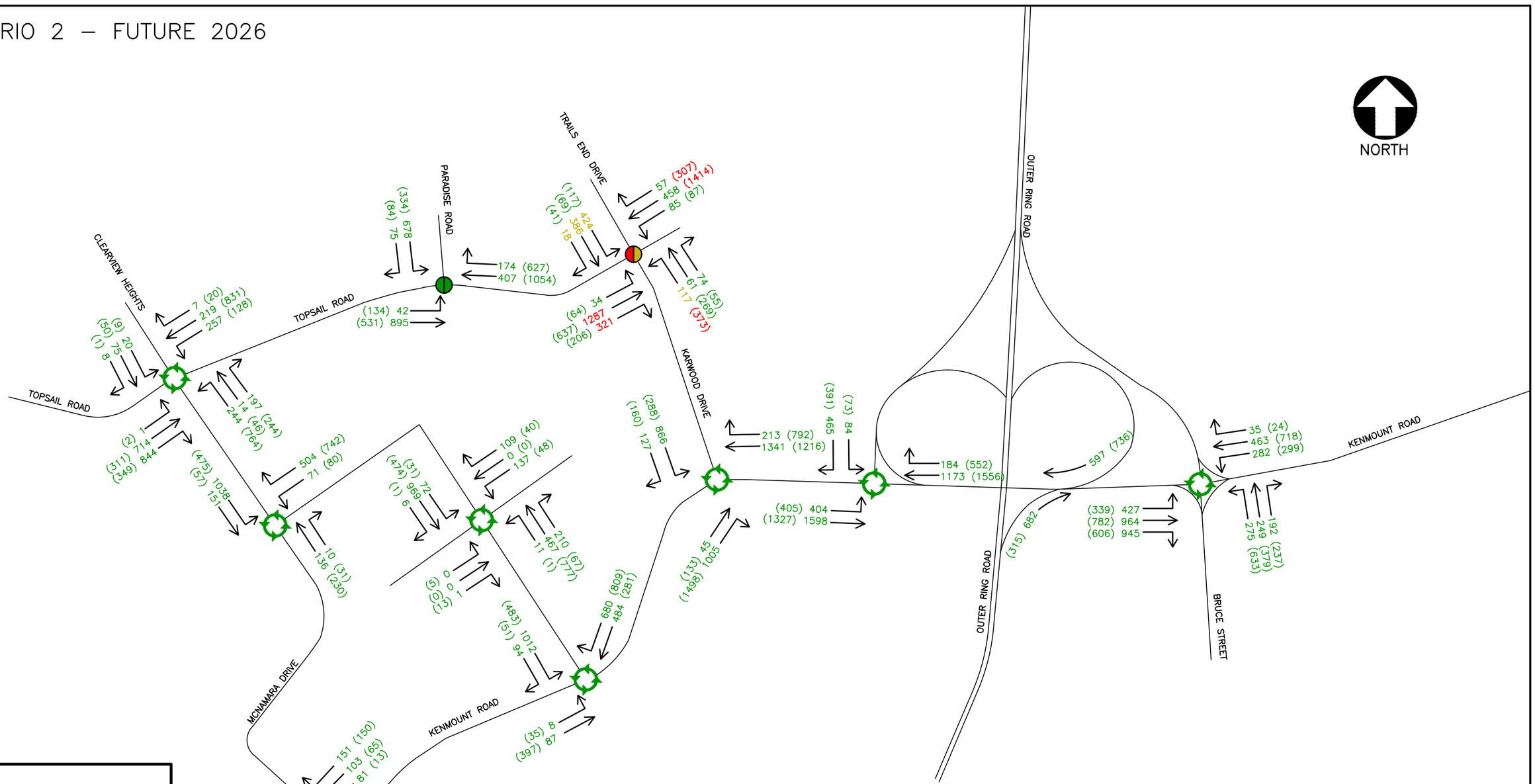
During the AM peak hour, the overall intersection operates at LOS F. The eastbound through/right-turn movement at Topsail Road/Karwood Drive is operating at LOS F and is over capacity. The southbound movements are operating at LOS E and the northbound left-turn movement operates at LOS E. The SimTraffic analysis results indicate that all eastbound movements are operating at LOS F. The southbound movements are operating at LOS F

During the PM peak hour, the overall intersection operates at LOS E. The westbound through/right-turn movement is operating at LOS F and is over capacity. The northbound left-turn movement operates at LOS F. The SimTraffic analysis results show the overall intersection operating at LOS E. All westbound movements at the intersection operating at LOS F and the northbound left-turn movement at LOS E.

Roundabouts

All roundabouts throughout the study network analyzed using Arcady/Junctions 8 operate with LOS D or better in both the AM and PM peak hours in Scenario 2.

SCENARIO 2 – FUTURE 2026



LEGEND

## (##)	TRAFFIC VOLUMES – AM (PM)
	LOS A–D
	LOS E
	LOS F
	INTERSECTION LOS AM (PM)
	ROUNDABOUT LOS AM (PM)

Scale	Date	Drawn	Designed	Checked	Approved	Contract
N.T.S.	OCTOBER 2016	B. FORBES				16334

HARBOURSIDE Transportation Consultants

KARWOOD MARKET AREA TS

SCENARIO 2 – FUTURE 2026

SKETCH No.

CSK - 03

Figure 7 - S2 – Future Conditions (2026) – AM & PM Peak Hour Synchro & Arcady Results

6.3 Scenario 3 – 10-year Projection with Route 2 (2026) Level of Service Analysis

The Scenario 3 Synchro models for the AM and PM peak hours were developed using the design volumes described previously in section 5.3. This scenario is based on a 10-year development horizon with the network connection to the Route 2. The traffic signal timings were optimized for all signalized intersections throughout the study.

The level of service conditions throughout the study area under Scenario 3 with the road network connection to Route 2 are shown in Figure 8. The results of the analysis show some movements operating at LOS E or F during both the AM and PM peak hour.

Topsail Road/Paradise Road

During the AM peak hour, the intersection operates at acceptable levels of service in the Synchro analysis. The SimTraffic analysis results show the overall intersection operating at LOS E. The southbound left-turn movement operates at LOS F and the southbound right-turn movement operates at LOS E. The SimTraffic results indicate that the queues from the eastbound movements at Topsail Road/Karwood previously spilling back into the Topsail Road/Paradise Road intersection, are reduced by the redistribution of traffic patterns caused by the connection to Route 2. However, this is not sufficient enough to restore levels of service to acceptable conditions.

During the PM peak hour, the intersection operates at acceptable levels of service in both the Synchro and SimTraffic analyses.

Topsail Road/Karwood Drive

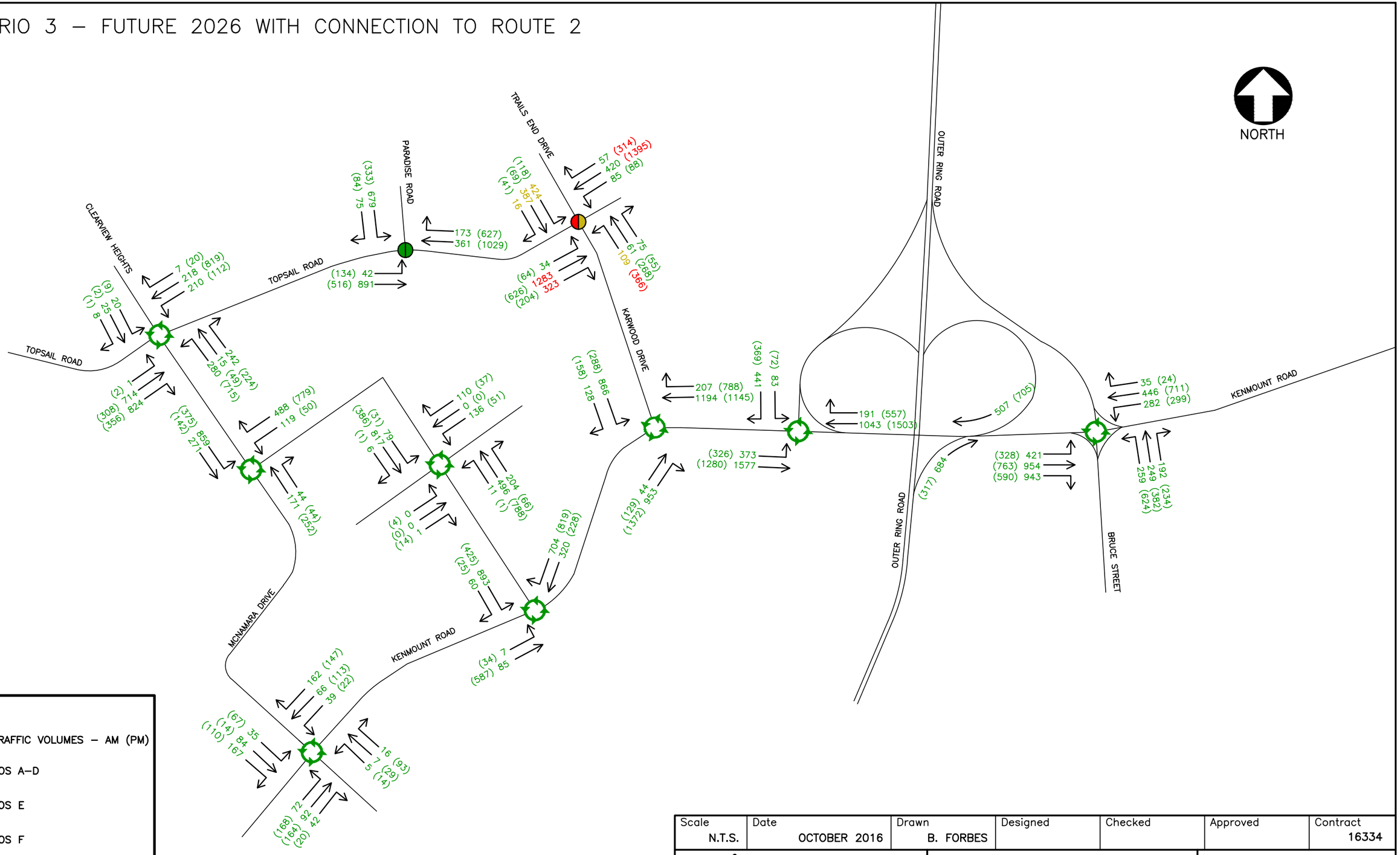
During the AM peak hour, conditions at Topsail Road/Karwood Drive remain similar to those in Scenario 2. The overall intersection operates at LOS F. The eastbound through/right-turn movement operates at LOS F and is over capacity. The southbound movements and the northbound left-turn movement are operating at LOS E. The SimTraffic analysis results indicate that the overall intersection operates at LOS E. All eastbound and southbound movements are operating at LOS F.

During the PM peak hour, the overall intersection operates at LOS E. The northbound left-turn operates at LOS F. The westbound through/right-turn movements operate at LOS F. The SimTraffic analysis results show the overall intersection operating at LOS E. The westbound movement and northbound left-turn movements operate at LOS F.

Roundabouts

All roundabouts throughout the study network analyzed using Arcady/Junctions 8 operate with LOS D or better in both the AM and PM peak hours in Scenario 3.

SCENARIO 3 – FUTURE 2026 WITH CONNECTION TO ROUTE 2



LEGEND

## (##)	TRAFFIC VOLUMES – AM (PM)
	LOS A–D
	LOS E
	LOS F
	INTERSECTION LOS AM (PM)
	ROUNDABOUT LOS AM (PM)

Scale	Date	Drawn	Designed	Checked	Approved	Contract
N.T.S.	OCTOBER 2016	B. FORBES				16334

HARBOURSIDE Transportation Consultants

KARWOOD MARKET AREA TS

SCENARIO 3 – FUTURE 2026 WITH CONNECTION TO ROUTE 2

SKETCH No.

CSK - 04

Figure 8 - S3 – Future Conditions with Connection to Route 2 (2026) – AM & PM Peak Hour Synchro & Arcady Results

6.4 Improvements for the year 2021 & 2026

HTC reviewed previously completed reports for the study area to confirm the improvements that had been recommended and the suggested timeframes for implementation. The studies that were reviewed included:

- Paradise Transportation Study (2011) by Hatch Mott MacDonald,
- Paradise Traffic Improvement Plan (2014) by Hatch Mott MacDonald, and
- Route 2 Traffic Study (2016) by Harbourside Transportation Consultants.

The improvements include a new road from McNamara Drive to Kenmount Road, new roundabouts at Kenmount Road/Route 1 SB Ramps and Kenmount Road/Bruce Street and a connection to the proposed Route 2 Interchange. It should be noted that all three studies had different study horizons, thus the recommended timeframes for implementation differ between the studies. The Transportation Study and Traffic Improvement Plan suggested short (0-5 year), medium (5-10 years) and long (>10 years) term improvements. While the Route 2 Traffic Study recommended improvements for the 2020 and 2030 horizons.

McNamara Drive to Kenmount Road

The construction of a new road from McNamara Drive to Kenmount Road, allowing traffic to by-pass a segment of industrial and commercial development on McNamara Drive was first identified in the Paradise Transportation Study. The new road was recommended as a medium-term improvement in both the Transportation Study and Traffic Improvement Plan. Both these timeframes fall within the 0-5 year (2021) timeframe for the Karwood Market Area Traffic Study. In both studies, the road was recommended as a collector road with a two-lane cross-section.

HTC is recommending that this roadway be built to a temporary 3-lane cross section by 2021 to be eventually upgraded to a 5-lane cross section by the year 2026. Reference Figure 12 for details on the road cross sections that are being proposed.

Roundabout at Kenmount Road/Route 1 SB Ramps

The high-level analysis in the Paradise Transportation Study identified the need for traffic signals or a roundabout as a medium-term improvement at the intersection of Kenmount Road/Route 1 SB Ramps. Providing a roundabout would potentially negate the need to widen Kenmount Road under the existing TCH interchange structure. The Traffic Improvement Plan also identified the need for traffic signals at the Kenmount Road/Route 1 SB Ramps in the short term until a roundabout was installed. The Route 2 Traffic Study identified the need for the roundabout for the 2020 study horizon. These timeframes fall within the 0-5 year horizon (2021) for the Karwood Market Area Traffic Study.

Roundabout at Kenmount Road/Bruce Street

The installation of a roundabout at the Kenmount Road/Bruce Street intersection has been identified as a medium-term improvement in the Paradise Transportation Study and the Paradise Traffic Improvement Plan. The Route 2 Traffic Study identified the need for the roundabout for the 2030 study horizon. Given that improvements to this intersection are shared between the City of Mount Pearl and NLDTW and will require liaison between agencies, conversion to a roundabout by 2021 may be too optimistic. HTC assumed the intersection would be converted to a roundabout for the 5-10 year horizon (2026) for the Karwood Market Area Traffic Study.

Route 2 Connection

Both the Paradise Transportation Study and the Paradise Traffic Improvement Plan have identified the need for a connection to Route 2 as a long-term improvement, while the Route 2 Traffic Study included the connection to Route 2 in the 2020 study horizon. For the Karwood Market Area TS, HTC assumed the connection to Route 2 would occur in the 5-10 year horizon (2026). At the time of this report, there is no clear timeframe for the construction of the interchange on Route 2.

The extension of Kenmount Road to the Route Interchange is an improvement that should be considered for the 2026 horizon.

Existing Congestion

The congestion problems at the intersections of Topsail Road/McNamara Drive and Kenmount Road/McNamara Drive/Bremigens Boulevard will be addressed by upgrading these intersections to single or multi-lane roundabouts. These roundabouts are projected in the 5-year horizon.

Topsail Road/Karwood Drive experiences high levels of delay, however, due to physical constraints, the geometry of the intersection cannot easily be improved or converted to a roundabout. The optimal solution to reduce congestion at this location is to provide alternative routes for traffic. The North/South Octagon Pond connection and the connection to the Route 2 Interchange will serve as a possible alternative route once constructed.

7 Road Network Improvements

7.1 Proposed Roundabouts

HTC has proposed a total of 12 new roundabouts throughout the study area. They are separated into the three categories for the proposed timeframe of implementation: 5-year, 10-year and more than 10 years. The locations of the proposed roundabouts are shown in Figure 9.

Year 2021 (5-year)

- Kenmount Road/Route 1 SB Ramps (Roundabout B)
- Kenmount Road/McNamara Drive Extension (Roundabout C)
- McNamara Drive Extension Internal Roundabout (Roundabout D)
- Kenmount Road/McNamara Drive/Bremigens Blvd (Roundabout E)
- Sgt Donald Lucas Drive/Octagon Pond Connection (Roundabout J)
- McNamara Drive/McNamara Drive Extension (Roundabout K)
- Topsail Road/McNamara Drive/Clearview Heights (Roundabout L)

Year 2026 (10-year)

- Kenmount Road/Bruce Street/Route 1 NB On-Ramp (Roundabout A)
- Kenmount Road Extension/Octagon Pond Connection (Roundabout F)
- Octagon Pond Connection, south of Sgt. Donald Lucas Drive (Roundabout I)

After Year 2026 (>10 years)

- Octagon Pond Connection, north of Kenmount Road Extension (Roundabout G)
- Octagon Pond Connection/Shalloway Place Extension (Roundabout H)

The Town of Paradise should reserve the space required for the construction of the roundabouts to ensure future development does not occur within the required right-of-way. A small amount of preliminary design may be required to establish the land requirements that need to be reserved.

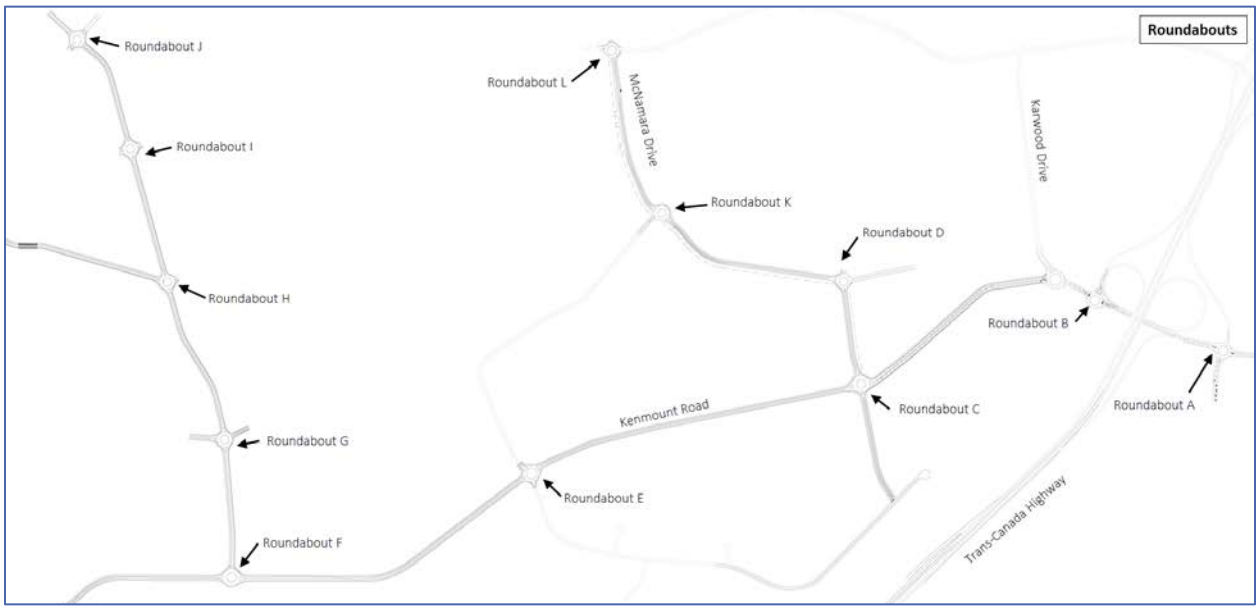


Figure 9 - Proposed Roundabout Locations

7.1.1 Why Roundabouts?

New Construction

While roundabouts are typically more expensive than signalized intersections when retrofitting an intersection, in the case of new construction the costs are comparable. Roundabouts are known to provide more benefits such as increased vehicular and pedestrian safety, reductions in delay and lower emission. As a result, HTC proposed roundabouts for new intersections on the proposed roads which are anticipated to carry high volumes.

Access Management

Roundabouts provide safety benefits by reducing the number of conflict points at an intersection. Roundabout corridors are particularly effective in reducing collisions on roadways with a high number of access points such as Kenmount Road. Providing a median in between two roundabouts eliminates left-turns in and out of access points. The roundabouts allow the left-turning traffic to perform U-turns to access their desired locations as shown in Figure 10.

Given the proposed number of access points on Kenmount Road and the anticipated high volumes along the segment of Kenmount Road that serves as the frontage of the Karwood Market development, a roundabout corridor with a raised median was preferred over the traditional corridors that use signalized intersections and allow left–turns. The roundabout corridor will while maintain efficient traffic flow without limiting access to properties. The segment of Kenmount Road between the Karwood Drive roundabout and the proposed new road (street 4) should be upgraded to a roundabout by 2021.

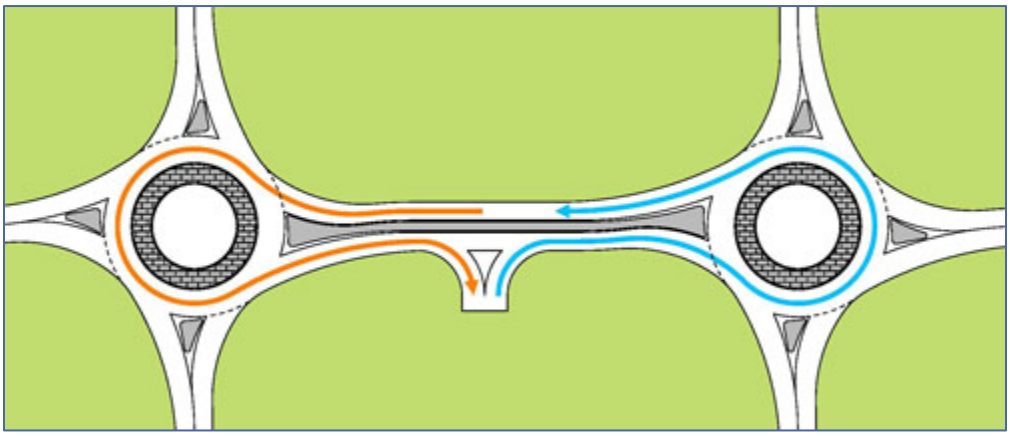


Figure 10 - Access management using roundabout corridors

7.2 Proposed New Roadway Connections

For the proposed developments throughout the study area, additional roadways will be required to provide capacity to the surrounding road networks. These new roadways were broken down into three different timeframes for implementation, 5-year, 10-year and more than 10 years which are shown in Figure 11.

Year 2021 (5-year)

- Street 1 – North/South Octagon Pond Connection
- Street 3 – McNamara Drive Extension (3-lane cross section)
- Street 5 – Kenmount Road Extension to Route 2 Interchange
- Street 7 – McNamara Drive Extension Connection to Kenmount Road (3-lane cross section)

Year 2026 (10-year)

- Street 1 – North/South Octagon Pond Connection
- Street 3 – McNamara Drive Extension (5-lane cross section)
- Street 5 – Kenmount Road Extension to Route 2 Interchange
- Street 7 – McNamara Drive Extension Connection to Kenmount Road (5-lane cross section)

After Year 2026 (>10 years)

- Street 1 – North/South Octagon Pond Connection
- Street 2 – Octagon Pond Connection to Shalloway Place
- Street 4 – Bremigens Boulevard Extension Connection to Kenmount Road
- Street 6 – Bremigens Boulevard Extension

The land required for the right-of-way of the proposed streets should be reserved by the Town of Paradise as soon as possible to ensure future development does not occur where roads are proposed.

7.3 Proposed Improvements to Existing Roadways

The two main corridors through the study area are McNamara Drive and Kenmount Road. These roadways are currently 3-lane and 2-lane roadways, respectively. With the increase in traffic volumes along these corridors and with the proposed new roadways, both of these roadways will require upgrading.

In the 0-5 year timeframe (2021), Kenmount Road should be widened to a 4-lane cross section with a raised median from Karwood Drive to Street 7, and to a 3-lane cross section from Street 7 to the intersection with McNamara Drive and Bremigens Boulevard.

In the 5-10 year timeframe (2026), the existing section of McNamara Drive from Topsail Road to Street 3 should be widened to a 5-lane cross section.

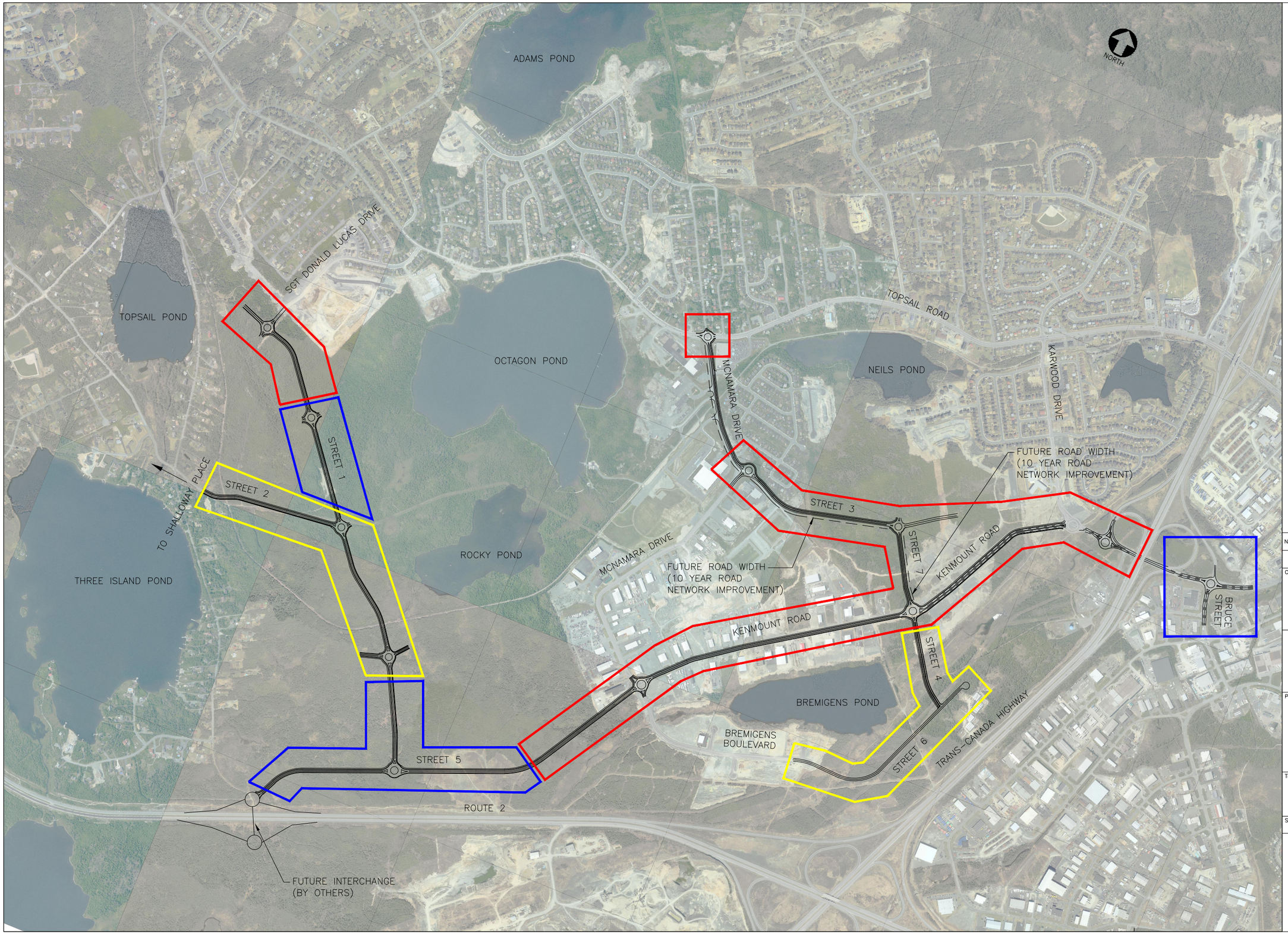


Figure 11 – Road Network Improvement Plan

7.4 Cross Sections

HTC has prepared different cross sections for the new roadways throughout the study area, as well as cross sections for the upgrades of both Kenmount Road and McNamara Drive. The cross sections were determined by the hourly volumes observed in the capacity analysis. The description of the cross sections for each roadway are noted below with diagrams illustrating the same shown in Figure 12. The cross sections with the street plan and profiles of each roadway can also be found in Appendix F.

Street 1 - Octagon Pond North/South Connection & Street 2 – Octagon Pond Connection to Shalloway Place

The proposed cross section for the new Octagon Pond collector road consists of one travel lane in each direction along with a multiuse trail and sidewalk. The cross section for the proposed Street 2 from the Octagon Pond collector road to Shalloway Place is the same as the Octagon Pond collector road.

Street 3 - McNamara Drive Extension & Street 7 - McNamara Drive Extension Connection to Kenmount Road

The new road between McNamara Drive and Kenmount Road will be required by 2021 to accommodate the five-year plan for development in the area. HTC is proposing the new road be constructed initially to a 3-lane interim configuration that will be eventually widened to a five-lane cross section by 2026. The temporary and long term configurations include provisions for a multiuse trail and sidewalk.

The same interim and longer term road cross section will be required on the existing section of McNamara Drive extending from Topsail Road to the roundabout intersection with Street 3.

Street 4 - Bremigens Boulevard Connection to Kenmount Road

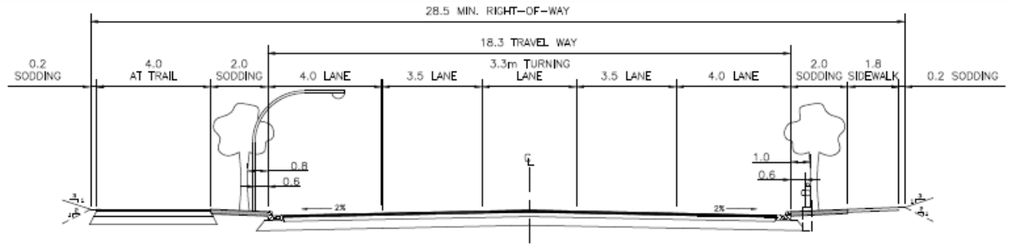
The proposed cross section for the new street between Kenmount Road and Bremigens Boulevard consists of one travel lane in each direction with an auxiliary turning lane in the center. The cross section also includes a multiuse trail.

Street 5 - Kenmount Road Extension to Route 2 Interchange

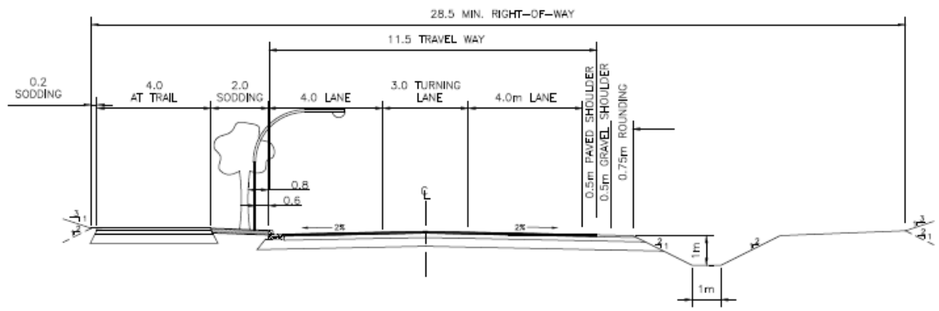
The proposed cross section for the extension of Kenmount Road to the west (2021) consists of one travel lane in each direction with an auxiliary turning lane in the center. The cross section also includes a multiuse trail.

Kenmount Road Upgrade

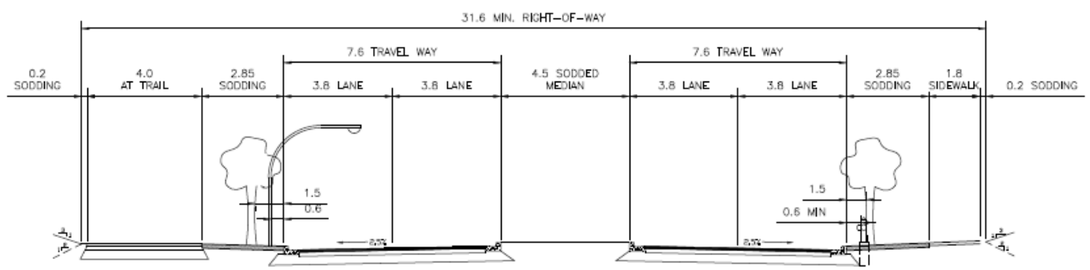
Kenmount Road from the Karwood Drive roundabout to the roundabout intersection with Street 7 (McNamara Drive Extension to Kenmount Road) should be upgraded to a four-lane cross section with a raised median by 2021 to create a roundabout corridor. The remainder of Kenmount Road from the Street 7 to Bremigens Pond/McNamara Drive should be upgraded to a three-lane cross section with a multiuse trail.



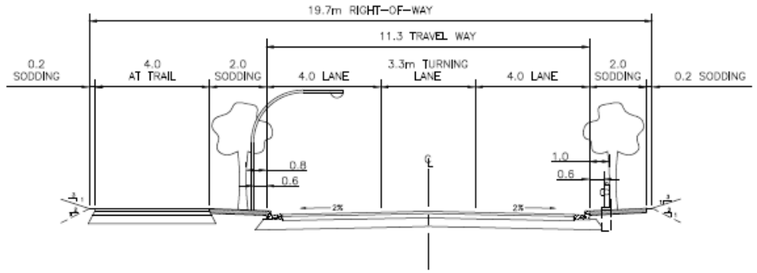
CROSS SECTION — STREET 3, 7 & MCNAMARA DRIVE



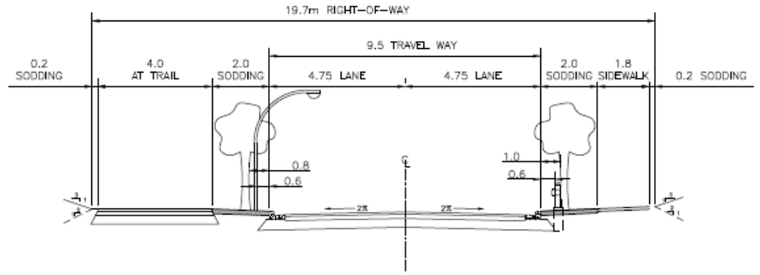
INTERIM CROSS SECTION — STREET 3 & STREET 7



CROSS SECTION — KENMOUNT ROAD — KARWOOD MARKET SECTION



CROSS SECTION — STREET 4, 5 & KENMOUNT ROAD



CROSS SECTION — STREET 1 & 2

Figure 12 - Cross Sections

7.5 Cost Estimates

HTC prepared 'Class D' cost estimates to allocate costs for network improvements. It should be noted that these cost estimates are high level cost estimates and do not reflect balanced earthwork, land acquisition, overhead utility relocation or underground utilities other than storm sewer. The letters associated with each roundabout correspond to the roundabout locations shown in Figure 9.

The total cost for all roadway improvements is $37 million. The costs are broken down by time horizons as shown in Table 6.

Table 6 - Road Network Improvements - Cost Estimates

New Roadways			
Street 1 - North/South Octagon Pond Connection		$	5,200,000
Street 2 - Octagon Pond Connection to Shalloway Place		$	1,800,000
Street 3 - McNamara Drive Extension			
	3-lane cross section	$	4,400,000
	5-lane cross section	$	800,000
Street 4 - Bremigens Boulevard Extension Connection to Kenmount Road		$	1,100,000
Street 5 - Kenmount Road Extension to Route 2 Interchange		$	5,800,000
Street 6 - Bremigens Boulevard Extension		$	1,800,000
Street 7 - McNamara Drive Extension Connection to Kenmount Road			
	3-lane cross section	$	950,000
	5-lane cross section	$	200,000
	Total New Roadway Cost	**$**	**22,050,000**
Road Network Improvements			
1	Kenmount Road (2 lane to 4 lane cross section w/ median)	$	6,500,000
2	McNamara Drive (3 lane to 5 lane cross section)	$	600,000
	Total Road Network Improvements Cost	**$**	**7,100,000**
Roundabouts			
A	Kenmount Road/Bruce Street/Route 1 NB On-Ramp	$	750,000
B	Kenmount Road/Route 1 SB Ramps	$	750,000
C	Kenmount Road/McNamara Drive Extension	$	750,000
D	McNamara Drive Extension Internal Roundabout	$	500,000
E	Kenmount Road/McNamara Drive/Bremigens Blvd	$	500,000
F	Kenmount Road Extension/Octagon Pond Connection	$	500,000
G	Octagon Pond Connection, North of Kenmount Road Extension	$	500,000
H	Octagon Pond Connection/Shalloway Place Extension	$	500,000
I	Octagon Pond Connection, South of Sgt Donald Lucas Drive	$	500,000
J	Sgt Donald Lucas Drive/Octagon Pond Connection	$	500,000
K	McNamara Drive/McNamara Drive Extension	$	500,000
L	Topsail Road/McNamara Drive/Clearview Heights	$	1,600,000
	Total Roundabout Cost	**$**	**7,850,000**

7.6 Improvement Priority Ranking

The road network improvements were assigned a priority ranking for each of the three different timeframes for implementation. The priority rankings are as follows:

- High: Existing infrastructure that is currently nearing or over capacity and requires immediate attention.
- Medium: Improvements required to accommodate development.
- Low: As construction of the developments occurs, these improvements are required to provide access to the developments.

7.6.1 Year 2021 (5-year)

High:
Kenmount Road/Route 1 SB Ramps (Roundabout B)
Topsail Road/McNamara Drive/Clearview Heights (Roundabout L)
Kenmount Road/McNamara Drive/Bremigens Boulevard (Roundabout E)

Medium:
Kenmount Road (2-lane to 4-lane cross section with median)
Street 3 – McNamara Drive Extension – 3-lane cross section
Street 7 – McNamara Drive Extension Connection to Kenmount Road – 3-lane cross section
Kenmount Road/McNamara Drive Extension (Roundabout C)
McNamara Drive Extension Internal Roundabout (Roundabout D)
McNamara Drive/McNamara Drive Extension (Roundabout K)

Low:
Street 5 – Kenmount Road Extension to Route 2 Interchange
Street 1 – North/South Octagon Pond Connection
Sgt Donald Lucas Drive/Octagon Pond Connection (Roundabout J)

7.6.2 Year 2026 (10-year)

High:
Kenmount Road/Bruce Street/Route 1 NB On-Ramp (Roundabout A)

Medium:
McNamara Drive (3-lane to 5-lane cross section)
Street 3 – McNamara Drive Extension – 5-lane cross section
Street 7 – McNamara Drive Extension Connection to Kenmount Road – 5-lane cross section)
Kenmount Road Extension/Octagon Pond Connection (Roundabout F)
Street 5 – Kenmount Road Extension to Route 2 Interchange

Low:
Street 1 – North/South Octagon Pond Connection
Octagon Pond Connection, South of Sgt. Donald Lucas Drive (Roundabout I)

7.6.3 After Year 2026 (>10 years)

Medium:
Street 1 – North/South Octagon Pond Connection
Octagon Pond Connection, North of Kenmount Road Extension (Roundabout G)
Octagon Pond Connection/Shalloway Place Extension (Roundabout H)

Low:
Street 4 – Bremigens Boulevard Extension Connection to Kenmount Road
Street 6 – Bremigens Boulevard Extension
Street 2 – Octagon Pond Connection to Shalloway Place

8 Development Access Review

8.1 Karwood Market

HTC reviewed the proposed development plan for Karwood Market, which is situated on Kenmount Road and is bordered by Karwood Drive to the east and "Street 7" to the west. It should be noted that the Street 7 alignment was located such that its right-of-way is shared equally between the two properties at this location. As a result, the right-of-way will encroach on both properties equally, as shown in Figure 13. Modifications will be required to the Karwood Market development plan to accommodate the proposed roadway.

The Karwood Market proposed plan includes access points to Karwood Drive, Kenmount Road and Street 7, with the majority of the accesses being on Kenmount Road. There are three (3) accesses proposed on the north side and five (5) accesses proposed on the south side of Kenmount Road. Kenmount Road is proposed to have a four-lane cross section with a raised median in this section of Kenmount Road. It is recommended that a fully directional, stop controlled intersection, be included at the middle (main) access location on the north side, as shown in Figure 13 (orange). On the south side of Kenmount Road, it is recommended that the four properties are designed with shared access and cross-property connectivity (purple) to minimize the number of intersections on Kenmount Road.

A temporary roadway has been constructed to the north of the Irving Site with access to Karwood Drive. This roadway has allowed for convenient access for heavy vehicles during the construction of the high-density Market Ridge residential area. It is recommended that once construction of a permanent roadway to the residential area has been completed, that the access to the residential development be removed and that the access to Karwood Drive service only the Karwood Market Development. This access should be monitored to ensure problems do not arise if it becomes a high-volume access.

8.2 Market Ridge

The Market Ridge residential area is located north of the Karwood Market development and includes both medium and high-density dwelling units. This development will connect into the existing residential area via Merganser Avenue to the north and to the proposed roundabout located at the Street 3/Street 7 intersection to the west. The development plan, shown in Figure 13, shows a proposed connection to the Karwood Market development. This connection is not recommended as it may encourage neighbourhood shortcutting, however, room should be provided to allow large vehicles such as snow plows to turn around at the end of the street.

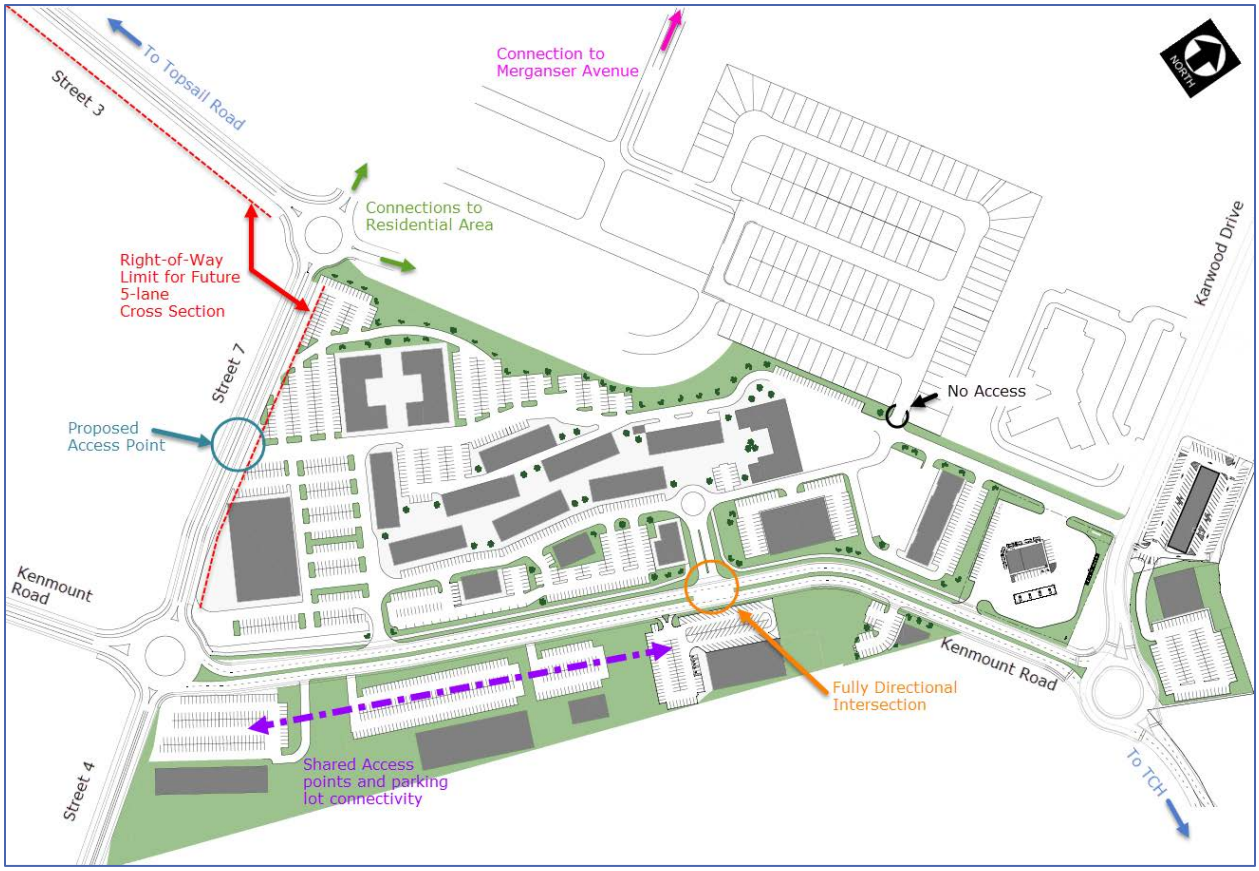


Figure 13 - Karwood Market & Market Ridge Development

8.3 Octagon Pond Development

In January 2009, Fairview Investments completed the "Octagon Pond Plan" which detailed the concept for the Octagon Pond Development (Figure 3). The plan included residential, commercial, mixed use and open space areas. At the time of the plan, the future connection to Route 2 had not been identified and, as a result, was not incorporated in the Octagon Pond development concept plan.

The Town of Paradise completed a new Municipal Plan in 2016 which included a revised "Future Land Use Map" for the Town. In the Octagon Pond Development Area, areas are now zoned as residential, rural, open space, commercial and comprehensive development. The land use map incorporates the proposed connection to Route 2 located in the Octagon Pond Area. Figure 14 shows the future land use map with the conceptual road network developed in this study superimposed on the area.

Initially, the area was primarily intended for residential uses with commercial developments near the intersection of Kenmount Road/Bremigens Boulevard. However, with light industrial uses and the new road network introduced to the area, the development plan must be modified to suit the new scheme. It is recommended that the Octagon Pond development area now include a roadway from Kenmount Road/Bremigens Boulevard intersection to Route 2. This roadway will accommodate frontage to a range of land uses included in the "Comprehensive Development Area", such as commercial and light industrial.

North of the "Comprehensive Development Area", includes low and medium density residential development areas to be accessible through a roundabout corridor (Street 1: North/South Octagon Pond Connection).

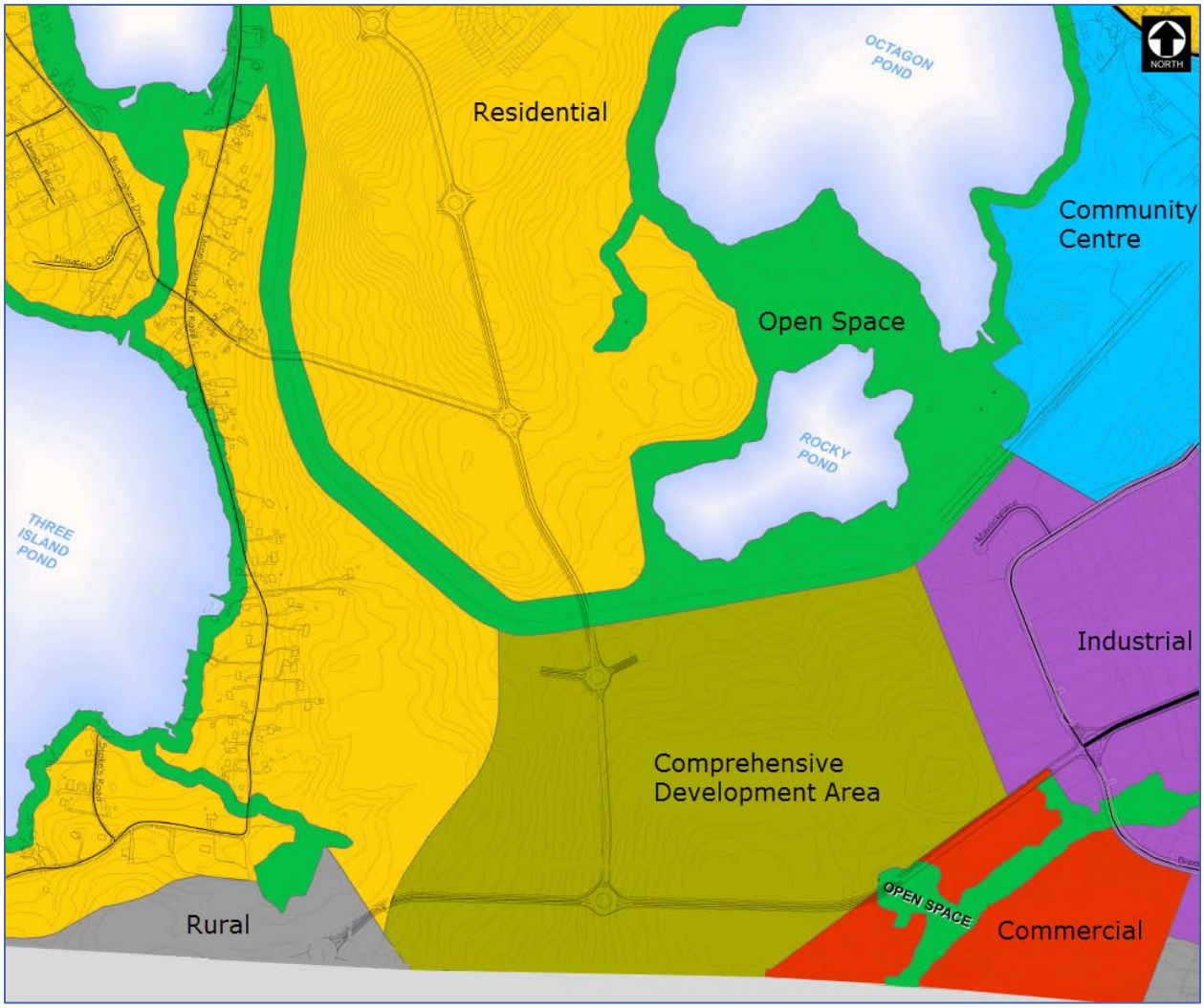


Figure 14 - Octagon Pond Development

9 Active Transportation

9.1 Existing Active Transportation Infrastructure

The Town of Paradise has an extensive system of trails and open spaces. The open space network in the area includes the Newfoundland T'Railway and trail systems around ponds including Octagon Pond and Neil's Pond. The T'Railway provides an east-west connection throughout the study area from Karwood Drive to Three Island Pond Road.

HTC evaluated the presence of sidewalk on roads within the study area and on the outskirts of the study area where the proposed road network will connect into the existing network. Sidewalk is provided on one side of the majority of residential streets in the study area. On McNamara Drive and Kenmount Road, due to the industrial/commercial nature of these major streets, sidewalk has not yet been put in place.

The proposed network will connect to streets including Sgt Donald Lucas Drive and Three Island Pond Road. Sidewalk is provided on both sides of Sgt Donald Lucas Drive and no sidewalk is provided on Three Island Pond Road.

In addition, there is one short section (approximately 285m) of marked on-street bicycle lane on McNamara Drive between the Town Hall and the Rotary Youth and Community Center. This is the only existing bike lane in the Town of Paradise.

9.2 Active Transportation Plan: Network Improvements

The Town of Paradise completed an Active Transportation Plan in 2011, the plan outlines 11 different network improvements that improve both the safety and the walking environment for the residents of the Town of Paradise. The following 6 network improvements are located within or just on the outskirts of the study area.

Topsail Road from McNamara Drive to St. Thomas' Line – Create a safe crossing and walking environment along Topsail Road by providing sidewalks and pedestrian crossing/underpass.

> **Update:** Sidewalk exists on the north side of Topsail Road from McNamara Drive to Glenderek Drive. The rest of the section to St. Thomas Line is currently being widened and is expected to have sidewalk on north side.

Topsail Road from McNamara Drive to Karwood Drive – Improve pedestrian safety along Topsail Road by providing sidewalk.

> **Update:** No sidewalk exists between Karwood Drive and Paradise Road on Topsail Road. Sidewalk is provided on the north side of Topsail Road from Paradise Road to McNamara Drive with a short section on the south side from McNamara Drive to the Sobeys Entrance.

Karwood Drive – Improve safety on school route and provide connection for T'Railway (signed crossing, actuated crossing, pedestrian underpass).

> **Update:** Sidewalk is provided on one side from Topsail Road to Goldfinch Drive/Cloudberry Drive and then on both sides to Kenmount Road. A mid-block signalized crossing exists in front of the Paradise Elementary School. At the T'Railway crossing there are no indications to vehicles of the presence of a trail crossing and no other crosswalks present crossing Karwood Drive.

Pathway from McNamara Drive to Paradise Elementary School – Connect school to recreation facilities and encourage walking to school.

> **Update:** Network improvement not completed. According to the 2016 Municipal Plan, there is no open space land reserved in the area that could facilitate the development of this trail.

Topsail Pond Path – Create a circuit around Topsail Pond.

> **Update:** Network improvement not completed, however, there is open space area reserved around the pond to facilitate the same.

New roadway by soccer fields – Connect school to recreation center by providing sidewalk and a multi-use path.

> **Update:** Network improvement not completed, the road has not been constructed. The new street is proposed for 2021 in this study, the proposed cross section shown in Figure 12 includes a sidewalk and a multiuse trail.

While not included in the network improvements, the Active Transportation Plan also proposed a trail around Rocky Pond located within the study area. The area surrounding the pond is zoned as open space.

The plan also indicates cycling infrastructure should be developed but does not propose bicycle lanes be implemented as part of the network improvements.

9.3 Proposed Active Transportation Infrastructure

HTC has proposed road cross-sections which include a 4.0m active transportation trail on one side and, in some instances, sidewalk on the other side. Figure 13 shows the road network for the study area with existing trails, proposed active transportation trails and sidewalks. The trails are shown in green, AT trails are shown in red and sidewalks are shown in blue. Multiuse trails along the proposed road network are connected and intersect with the T'Railway on the Octagon Pond North/South Connection. Consideration should be given to restricting the T'Railway to non-motorized use only and upgrading it to an active transportation multiuse trail.

The T'Railway and multiuse trails one the major roads can form the basis of a well-connected trail system in the area. When designing lower hierarchy streets multiuse trail connections should be made to existing trail systems around ponds, the T'Railway, schools and adjacent neighborhoods or commercial areas.

Figure 15 - Open Space and Trail Network

9.4 Opportunities to enhance Active Transportation Infrastructure

The 2016 Municipal Plan for the Town of Paradise indicates the need to increase walkability in the Town. Policies in the plan are designed to improve opportunities for Active Transportation. New developments are to support the trail system by providing adequate separation distance and buffers and, when possible, providing connections to it.

The Town strives to achieve a high quality of urban design throughout the Town. For street design, the concept of ***Complete Streets*** is the suggested approach. A Complete Street is a street that is designed for all ages, abilities and modes of travel. A Complete Street is achieved by considering safe and comfortable access for pedestrians, cyclists, the mobility-impaired and transit users as an integral part of the planning process. Unlike the traditional approach of designing roads for motorized vehicles, Complete Streets are designed and operated for all road users.

9.5 Complete Street Cross Sections

HTC designed all new roads in the study area to incorporate the Complete Streets concept. As previously mentioned, all road cross-sections include a 4.0m active transportation trail with a minimum of a 2.0m buffer from the roadway on one side and, in some instances, a 1.8m sidewalk with buffer on the other side.

However, designing a new Complete Street does not increase walkability in itself. In order to increase walkability, there must be connectivity in the street network. HTC ensured the multiuse trails were connected throughout the study area and looked for opportunities to add and/or enhance the active transportation on existing streets in the study area. When designing the remainder of the road network in the area especially in residential neighbourhoods, it should be ensured that active transportation infrastructure is provided that connects to the multiuse trails on major roads.

9.5.1 Safe Crossing Methods

HTC explored different ways to improve pedestrian safety at crossing locations. The following sections identify methods of enhancing safety at intersections and crossing locations such as trail crossings.

Roundabouts

HTC is proposing a number of roundabouts throughout the proposed road network. Roundabouts are known to increase vehicular safety by reducing collisions frequency and severity. Roundabouts also provide safety benefits to cyclists and pedestrians. Roundabouts have fewer conflict points between pedestrians and vehicles than signalized intersections, reducing the likelihood of a collision.

When pedestrians cross at a roundabout, they are faced only with one direction of traffic and a single crossing at a time of only one or two lanes of traffic between crossings. Pedestrians will be accommodated on refuge islands or sidewalk before making their next crossing. Approaching drivers are forced to slow as they approach the roundabout, which enables them to be able to react and stop quickly to yield to pedestrians.

When a cyclist approaches a roundabout, depending on their experience level, they can either proceed through the roundabout as a vehicle, or dismount and proceed through the intersection as a pedestrian. Due to the low speed of approaching/circulating vehicles, a cyclist can often proceed through the intersection within the vehicle stream.

For visually-impaired pedestrians, multi-lane roundabouts can sometimes provide navigation challenges. Relying primarily on auditory cues, multiple lanes of traffic can lead to difficulty in judging whether all vehicles have yielded at the crossing.

Refuge Islands or Medians

Refuge islands or medians (Figure 16) are roadway design elements that allow pedestrians to cross only one direction at a time. Refuge islands or medians should be raised above the roadway, a minimum of 2.0 meters wide and provide an accessible pathway. These are particularly beneficial on multilane roadways where the traffic volumes exceed 10,000 vehicles per day. A raised median is proposed along a section of Kenmount Road.

Figure 16 - Refuge island

Rectangular Rapid-Flashing Beacons

The Town of Paradise has purchased a number of Rectangular Rapid-Flashing Beacons (RRFB). An RRFB, shown in Figure 17, is a user-activated amber LED used in combination with a pedestrian crosswalk sign. When activated by the user, through a pedestrian push button or by pedestrian detection, the device flashes high intensity warning lights in an irregular pattern to indicate to motorists the presence of pedestrians. Ped crossing should be evaluated using the TAC methodology.

Figure 17 - Rectangular Rapid-Flashing Beacon

9.5.2 Crossing Control

Crossing control is already addressed on most of the pedestrian desire lines in the area through the use of roundabouts at intersections. In the event of mid-block pedestrian crossings such as locations where the T'Railway intersects streets, crossing control should be reviewed using the TAC methodology.

The Pedestrian Crossing Control Guide published by TAC, provides guidelines on the use of devices for pedestrian crossing control. The guide provides a decision support tool to assist with in the decision-making process when establishing the need to control traffic to enable pedestrians to cross and when selecting the type of application most suitable to the location.

Sites for pedestrian control must meet the minimum requirements of 15 Equivalent Adult Units (EAUs) per hour and 1,500 vehicles per day. Hourly pedestrian volumes are converted to EAUs to account for pedestrian age and physical ability.

Without pedestrian counts and only projected traffic volumes during peak hours it is difficult to evaluate the type of crossing control that will be needed at key crossing locations. In addition, the selection of the treatment is also dependent on other factors such as speed limit and number of lanes. HTC recommends performing counts and evaluating locations using the Pedestrian Crossing Control Guide during the development timeframe. It should be noted that providing unwarranted measures will not necessarily improve pedestrian safety and can, in some instances, have a negative impact on vehicle operations.

9.5.3 Other Consideration to enhance Active Transportation

Lighting

Lighting should be provided along sidewalks and trails. Research has shown that street lighting can increase trail use. Pedestrian lighting should be evenly spaced, consistent in height and provided adequate light coverage.

Trailheads and Signage

Lack of proper signage and trailheads have been identified to hamper the user's ability to find and access trails. While residents may be able to find their way, lack of signage can deter tourism and new users. A standard design should be developed for trailheads to ensure they are clearly visible for both trail users and motorists.

The Town of Paradise should develop a signage and wayfinding system with uniform design. Appropriate entrance signage should be provided at trailheads, at a minimum, indicating to users the layout of the trail system, connections to other trails, and the location of amenities and services. Wayfinding signs should also be installed at all locations where trails and other linkages meet.

Well-designed signage directs trail users to trails and also informs motorists that users may be crossing streets. Off-site directional sign posts can be located on the side of the road indicating the presence of an upcoming trailhead.

A number of trails systems exist or are proposed within the study area and are managed by different authorities such as the Town and the Grand Concourse Authority. Signage systems, if developed separately for different trail systems or by different authorities, should complement each other and provide consistent information.

Amenities

To encourage active transportation, rest areas with benches, picnic tables, litter cans, drinking fountains and restrooms could be provided. These amenities support increased frequency and duration of walking.

Bicycle Parking

The areas surrounding the proposed roundabouts will be designed as small commercial hubs with shops and convenience stores. To encourage bicycle use to these areas, it is important that bicycle parking be provided at the locations. Bicycle racks should be provided close to the entrance that it serves without impeding pedestrian flow in and out of the building.

10 Summary/Conclusions/Recommendations

Harbourside Transportation Consultants (HTC) was retained by the Town of Paradise to prepare a Traffic Study for the Karwood Market and Octagon Pond areas of the Town of Paradise. The study considered development projections to the years 2021 and 2026 and improvements that will be required to facilitate the same.

The study area for this project focused on intersections along Topsail Road between McNamara Drive and Karwood Drive and along Kenmount Road from McNamara Drive to Bruce Street. Traffic counts were collected during the morning (AM) and afternoon (PM) peak traffic periods on the dates and locations noted in Section 1.4.

HTC constructed 4 different Synchro models for the study area. The scenarios included:

- Scenario 0 – Existing Conditions (2016): A scenario reflecting the existing conditions in the study area.
- Scenario 1 – 5-year Projection (2021): A projection of normal growth to the year 2021 with the 5-year development horizon projected on the study network.
- Scenario 2 – 10-year Projection (2026): A projection of normal growth to the year 2026 with the 10-year development horizon projected on the study network.
- Scenario 3 – 10-year Projection with connection to Route 2 (2026): A projection of normal growth to the year 2026 with the 10-year development horizon. The road network was modified to include a roadway connection to the Route 2 Interchange.

The analysis of the existing conditions, Scenario 0, within the study area shows a number of problems during both the AM and PM peak hours. The more predominant problems relate to Topsail Road/Karwood Drive, Kenmount Road/Bremigens Boulevard and Kenmount Road/Route 1 Southbound Ramp in both the AM and PM peak hours. These intersections experienced LOS E or F on a number of approaches.

The intersection of Topsail Road/Karwood Drive experiences high levels of delay, however, due to physical constraints, the geometry of the intersection cannot be improved or converted to a roundabout. The optimal solution to reduce congestion at this location is to provide alternative routes for traffic travelling along Topsail Road and Karwood Drive.

The intersections of Topsail Road/McNamara Drive/Clearview Heights, Kenmount Road/McNamara Drive/Bremigens Blvd and Kenmount Road/Route 1 Southbound Ramps should be converted to roundabouts to reduce congestion. These intersections are modelled as roundabouts in future scenarios.

HTC updated the conceptual road network, to reflect the updated Land Use Plan for the Town of Paradise and the projected developments plans for the Karwood Market and Octagon Pond Areas. The road network includes seven (7) new roadways and connections throughout the study network. The updated conceptual road network includes:

- A main north/south collector road for the Octagon Pond Development Area,
- A connection between the Octagon Pond road and Shalloway Place to the west of the study area,
- A proposed new road between Kenmount Road and McNamara Drive,
- An extension of Bremigens Boulevard to the east,
- A connection between Kenmount Road and the extension of Bremigens Boulevard, and
- An extension of Kenmount Road towards the proposed Route 2 Interchange.

The trip generation rates for the development projections in this study were based on information obtained from the 9th edition of the Institute of Transportation Engineers (ITE) *Trip Generation Manual*; 13 different land use codes were used. The new development in the study area is expected to generate 1,211 trips in the AM peak hour (725 in/486 out) and 1,104 trips in the PM peak (491 in/613 out) in the 0-5 year horizon and 2,050 trips in the AM peak hour (1,283 in/767 out) and 2,401 trips in the PM peak (1,025 in/1,376 out) in the 5-10 year horizon. These trips include reductions for internal captures and for pass-by trips for the commercial development Karwood Market Area.

The site-generated traffic was distributed to the existing road network using 2025 VISUM models that were adjusted for the Paradise study area. HTC used the models to complete a number of select project zone analyses, the details of which have been noted in Section 5.2.

Over the next five years, the study area for this project is expected to experience significant growth. New road connections and intersection upgrading will be required. This scenario includes the new road connection from McNamara Drive to Kenmount Road and the extension of Kenmount Road towards the Octagon Pond area. This scenario also reflects a road network with 7 roundabouts, both new and existing. The results of the Scenario 1 analysis show all roundabouts operating with LOS D or better. Two signalized intersections throughout the study area, Karwood Drive/Topsail Road and Kenmount Road/Bruce Street/Route 1 NB, experience LOS E or F on a number of approaches during both the AM and PM peak hours. The intersection of Kenmount Road/Bruce Street/Route 1 NB should be converted to a roundabout to deal with congestion problems. This intersection was modelled as a roundabout in the 10-year horizon scenarios.

The results of the Scenario 2 analysis, which include the 10-year horizon for the projected development and the same road network connections as Scenario 1, show very similar results. In both the AM and PM peak hours, the intersection at Topsail Road/Karwood Drive has movements experiencing LOS E or LOS F. Queues at the Topsail Road/Karwood Drive intersection extend to the Topsail Road/Paradise Road intersection causing delays in the eastbound direction at Topsail Road/Paradise Road. All other study intersections operate at LOS D or better.

The results of the Scenario 3 analysis, which includes the same road network and intersection configurations as Scenario 2 but incorporate a connection to the Route 2 interchange, show very similar results as Scenario 2. In both the AM and PM peak hours, the intersection at Topsail Road/Karwood Drive have movements experiencing LOS E or LOS F. The connection to Route 2 slightly reduces the traffic volumes on Topsail Road, however, the queues at the Topsail Road/Karwood Drive intersection continue to affect the Topsail Road/Paradise Road intersection. All other study intersections operate at LOS D or better.

HTC has proposed a total of 12 new roundabouts, seven (7) new roadways and upgrades to two (2) of the existing roadways, Kenmount Road and McNamara Drive. The land required for the right-of-way of the proposed roundabouts and streets should be reserved by the Town of Paradise, as soon as possible, to ensure future development does not occur where roundabouts and roads are proposed. These road network improvements were broken down into three different timeframes for implementation, 5-year, 10-year and more than 10 years as shown in Table 7.

HTC prepared cross sections for the new roadways throughout the study area as well as cross sections for the upgrades of both Kenmount Road and McNamara Drive. All cross sections feature a 4.0m wide multi-use trail and a 1.85 m sidewalk both with buffers of at least 2.0m from the roadway. The multiuse trail

system is well connected throughout the study are and connects to the T'Railway along the Octagon Pond North/South Connection. The proposed multiuse trail system will form the basis for a well-connected trail system in the area.

The network improvements from the Town's Active Transportation Plan located within the study area were identified. One of the network improvements is included as a recommendation of this study, the new roadway by the soccer fields is anticipated for 2021 and will feature a multiuse trail and sidewalk as per the Active Transportation Plan.

The recommended intersection and road network improvements required to accommodate the traffic expected to be generated in the Karwood Market and Octagon Pond Development Areas over the 5 year and 10-year development horizons are listed in Table 5 noted below. HTC has also noted a number of other improvements that will be required in the 10 year plus timeframe. The letters associated with each roundabout correspond to the roundabout locations shown in Figure 9. The total cost for all roadway improvements is $37 million. Improvements were assigned a priority ranking of high, medium or low.

Table 7 - Road Network Improvements

5-year Network Improvements			Cost	Priority
B	Kenmount Road/Route 1 SB Ramps	$	750,000	High
C	Kenmount Road/McNamara Drive Extension	$	750,000	Medium
D	McNamara Drive Extension Internal Roundabout	$	500,000	Medium
E	Kenmount Road/McNamara Drive/Bremigens Blvd	$	500,000	High
J	Sgt Donald Lucas Drive/Octagon Pond Connection	$	500,000	Low
K	McNamara Drive/McNamara Drive Extension	$	500,000	Medium
L	Topsail Road/McNamara Drive/Clearview Heights	$	1,600,000	High
	Total 5-year Roundabouts Cost	**$**	**5,100,000**	
Street 1 - North/South Octagon Pond Connection (20% Complete)		$	1,040,000	Low
Street 3 - McNamara Drive Extension - 3-lane cross section		$	4,400,000	Medium
Street 5 - Kenmount Road Extension to Route 2 Interchange (30% complete)		$	1,740,000	Low
Street 7 - McNamara Drive Extension Connection to Kenmount Road - 3-lane cross section		$	950,000	Medium
	Total 5-year New Roadways Cost	**$**	**8,130,000**	
Kenmount Road (2 lane to 4 lane cross section w/ median)		$	6,500,000	Medium
	Total 5-year Road Improvement Cost	**$**	**6,500,000**	
	Total 5-year Network Improvement Cost	**$**	**19,730,000**	

10-year Network Improvements			Cost	Priority
A	Kenmount Road/Bruce Street/Route 1 NB On-Ramp	$	750,000	High
F	Kenmount Road Extension/Octagon Pond Connection	$	500,000	Medium
I	Octagon Pond Connection, South of Sgt Donald Lucas Drive	$	500,000	Low
	Total 10-year Roundabouts Cost	**$**	**1,750,000**	
Street 1 - North/South Octagon Pond Connection (60% Complete)		$	2,080,000	Low
Street 3 - McNamara Drive Extension - 5-lane cross section		$	800,000	Medium
Street 5 - Kenmount Road Extension to Route 2 Interchange (100% complete)		$	4,060,000	Medium
Street 7 - McNamara Drive Extension Connection to Kenmount Road - 5-lane cross section		$	200,000	Medium
	Total 10-year New Roadways Cost	**$**	**7,140,000**	
McNamara Drive (3 lane to 5 lane cross section)		$	600,000	Medium
	Total 10-year Road Improvement Cost	**$**	**600,000**	
	Total 10-year Network Improvement Cost	**$**	**9,490,000**	

>10-year Network Improvements			Cost	Priority
G	Octagon Pond Connection, North of Kenmount Road Extension	$	500,000	Medium
H	Octagon Pond Connection/Shalloway Place Extension	$	500,000	Medium
	Total >10-year Roundabouts Cost	**$**	**1,000,000**	
Street 1 - North/South Octagon Pond Connection (100% Complete)		$	2,080,000	Medium
Street 2 - Octagon Pond Connection to Shalloway Place		$	1,800,000	Low
Street 4 - Bremigens Boulevard Extension Connection to Kenmount Road		$	1,100,000	Low
Street 6 - Bremigens Boulevard Extension		$	1,800,000	Low
	Total >10-year New Roadways Cost	**$**	**6,780,000**	
	Total >10-year Network Improvement Cost	**$**	**7,780,000**	

McCarthy Subdivision, Paradise, NL

Traffic Impact Assessment

Status: Draft Report

Date: July 11, 2022

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Project Name: McCarthy Subdivision Traffic Impact Assessment

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Prepared for:

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Table of Contents

List of Appendices

List of Figures

List of Tables

1 Introduction

Pinnacle Engineering retained Harbourside Transportation Consultants to conduct a Traffic Impact Assessment for a residential development referred to as the McCarthy Subdivision located on Lanark Drive in Paradise, NL. Figure 1 illustrates the site location.

The study assesses current and future background traffic conditions within the study area, estimates the traffic generated by the development site, assesses the impacts of the site-generated traffic on the surrounding road network and identifies improvements required to accommodate the site generated traffic.

Figure 1: Site Location

2 Study Area

2.1 Road Network

The roadways of interest within the study area include:

- **Paradise Road:** a collector roadway[1] that runs from Topsail Road to St. Thomas Line. Paradise Road has a three-lane urban cross section with sidewalks on one or both sides of the roadway. Paradise Road has a posted speed limit of 50 km/hr.
- **St. Thomas Line**: a collector roadway that runs from Paradise Road north to the adjacent community of Portugal Cove-St. Philip's. St. Thomas Line has a three-lane urban cross section with sidewalks on one side of the roadway between Paradise Road and Ridgewood Drive. North of Ridgewood Drive Paradise Road has a two-lane rural cross section. St. Thomas Line has a posted speed limit of 50 km/hr.
- **Lanark Drive:** a collector roadway that runs from St. Thomas Line along Adams Pond. Segments of Lanark Drive are constructed as development occurs, when completed the roadway will form a loop around Adams Pond. Lanark Drive has a two-lane cross section with sidewalks on both sides of the roadway. Lanark Drive has a speed limit of 40 km/h.
- **Starlight Drive:** a local roadway that runs from Paradise Road to Rembrant Boulevard. Starlight Drive has a two-lane cross section with sidewalks on one side of the roadway. Starlight Drive has a speed limit of 40 km/h.
- **Rembrant Boulevard:** a local roadway that runs from Starlight Drive to Archibald Drive. Rembrant Boulevard has a two-lane cross section with sidewalks on one side of the roadway. Rembrant Boulevard has a speed limit of 40 km/h.

2.2 Intersections

The intersections assessed in this study include:

- **St. Thomas Line and Lanark Drive:** unsignalized three-leg intersection with stop control on the Lanark Drive approach; and
- **Paradise Road and Starlight Drive:** unsignalized three-leg intersection with stop control on the Starlight Drive approach. There is a westbound left turn lane on Paradise Road at the intersection.

[1] Development Regulations – Appendix F: Street Classification, Town of Paradise, September 2020.

3 Existing Traffic Operations

3.1 Traffic Volumes

Turning movement counts were collected at the study area intersections using Miovision 'Scout' video data collection devices. The turning movement counts recorded traffic data during the morning (AM) peak period (7:00 and 9:00 AM), mid-day peak period (11:00 AM and 1:00 PM) and afternoon (PM) peak period (4:00 and 6:00 PM) in June 2022. Motor vehicle and pedestrian volumes were reported in 15-minute intervals.

Figure 2 illustrates the existing base year weekday AM and PM peak hour traffic volumes at the study area intersections. Appendix A contains the traffic count data.

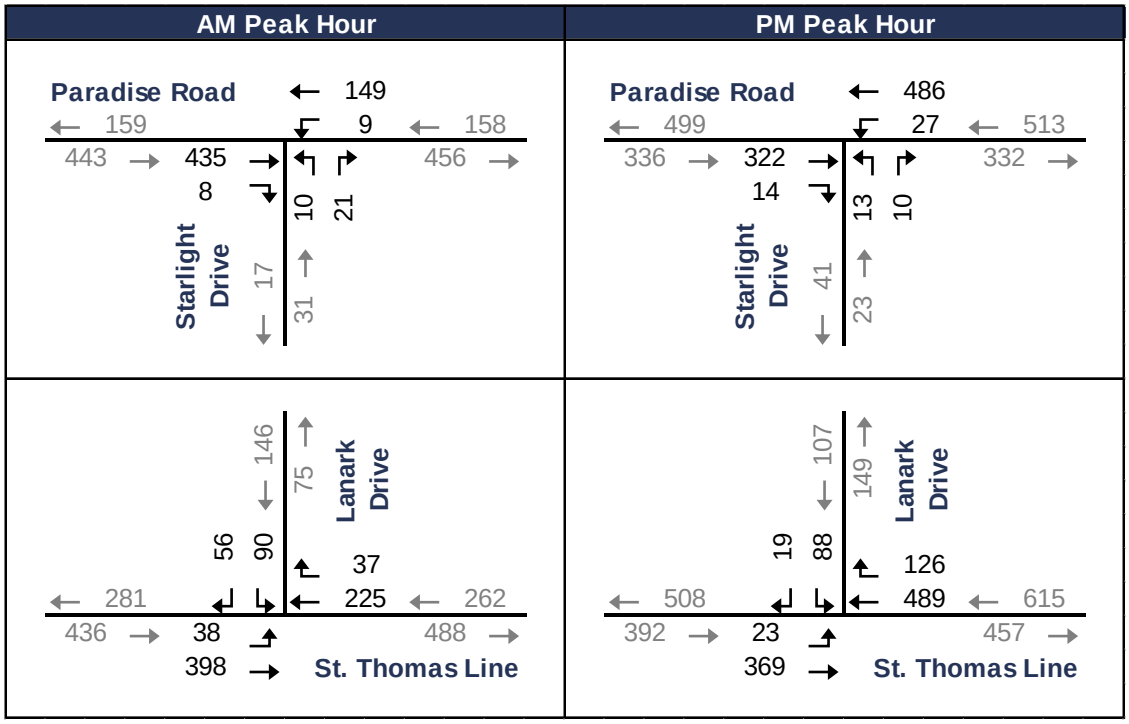


Figure 2: Existing Traffic Volumes

3.2 Existing Operations

Traffic operations at the study area intersections were evaluated using Synchro 11 and Highway Capacity Manual (HCM) 6th edition procedures. The intersection analysis considered the following measures of performance:

- Level of service (LOS) for each turning movement. LOS is a measure that describes the performance or efficiency of traffic flow based on the average control delay per vehicle. Control delay is delay attributable to the presence of traffic

control and conflicting traffic. LOS is reported on a scale of A to F, where A represent the highest possible rating and LOS F represents the worst rating where the level of congestion is considered unacceptable and remedial measures are typically implemented where feasible. Table 1 summarizes the delay criteria for LOS ratings at signalized and unsignalized intersections.

- The volume-to-capacity (v/c) ratio for each turning movement; and
- The 95th percentile queue lengths for each turning movement.

Table 1: Level of Service Criteria

LOS	Description	Signalized Delay	Unsignalized Delay
A	No congestion; most vehicles do not stop.	≤ 10 s/veh	≤ 10 s/veh
B	Very light congestion; some vehicles stop.	10-20 s/veh	10-15 s/veh
C	Light congestion; most vehicles stop.	20-35 s/veh	15-25 s/veh
D	Minor congestion; no long-standing queues.	35-55 s/veh	25-35 s/veh
E	Congestion; long-standing queues are formed.	55-80 s/veh	35-50 s/veh
F	Severe congestion; demand exceeds capacity.	≥ 80 s/veh	≥ 50 s/veh

The following criteria indicate critical conditions:

- LOS for an individual or shared movement exceeds LOS “D”;
- The v/c ratio for an individual or shared movement exceeds 0.85; or
- The 95th percentile length for an individual movement exceeds the available queue storage.

Mitigation measures may need to be considered for movements in critical conditions.

Existing operations at the study intersections were evaluated using the existing lane configuration, traffic control and traffic volumes (Figure 2). Table 2 and Table 3 summarize the results of the analysis for the AM and PM peak hours. No critical movements are identified; operations at both study intersections are considered acceptable. Appendix B contains the supporting detailed Synchro reports.

The Paradise Road & Starlight Drive intersection operates with minimal delay and queuing, and v/c ratios well within capacity during the AM and PM peak hours.

The St. Thomas Line & Lanark Drive intersection operates with minimal delay and queuing, and v/c ratios well within capacity during the AM peak hour. During the PM peak hour, LOS D or minor congestion is observed on the Lanark Drive approach (stop-controlled). No significant or long-standing queues are formed and the v/c ratios well within capacity during the PM peak hours.

Table 2: Existing Operations, AM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	435	8	443	9	149	158	10	21	31	632
	Delay	0.0	0.0	0.0	8.5	0.0	0.5	12.2		12.2	0.7
	LOS	A	A	A	A	A	A	B		B	A
	v/c	0.00	0.00		0.01	0.00		0.06			
	95th% Q	0.0	0.0		0.0	0.0		1.5			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	38	398	436	225	37	262	90	56	146	844
	Delay	8.1	0.0	0.7	0.0	0.0	0.0	22.4		22.4	4.2
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.04	0.00		0.00	0.00		0.47			
	95th% Q	0.8	0.0		0.0	0.0		18.2			

Table 3: Existing Operations, PM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	322	14	336	27	486	513	13	10	23	872
	Delay	0.0	0.0	0.0	8.1	0.0	0.4	15.1		15.1	0.6
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.00	0.00		0.02	0.00		0.06			
	95th% Q	0.0	0.0		0.8	0.0		1.5			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	23	369	392	489	126	615	88	19	107	1114
	Delay	9.0	0.0	0.5	0.0	0.0	0.0	26.4		26.4	2.7
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.03	0.00		0.00	0.00		0.40			
	95th% Q	0.8	0.0		0.0	0.0		14.4			

4 Development Concept

4.1 Development Description

The development site is located in the Lanark Drive area between Quantum Drive and Starlight Drive. The development proposal for the McCarthy Subdivision includes 70 single-family detached units.

The subdivision's road network will:

- Extend Lanark Drive to the north, from Quantum Drive and connecting to the existing segment of Lanark Drive near Tudor Avenue;
- Extend Rembrant Boulevard between Quantum Drive and Starlight Drive;
- Include one new cul-de-sac local roadway accessed from Lanark Drive (currently referred to as Street 'A');
- Include one new cul-de-sac local roadway accessed from Rembrant Boulevard (currently referred to as Street 'B'); and
- Include one new local roadway which will form a crescent shape between Rembrant Boulevard and Street 'B' (currently referred to as Street 'C').

Figure 3 illustrates the concept plan.

Figure 3: Site Concept Plan

4.2 Access Review

Until Lanark Drive is further extended to complete a loop around Adams Pond, it is anticipated that the proposed subdivision will be accessed primarily from St. Thomas Line via Lanark Drive and from Paradise Road via Starlight Drive. While access to Paradise Road will also be available via Archibald Drive and Acharya Drive, these are less direct routes and for the purposes of this study, the primary access points are considered to be existing intersections of Paradise Road & Starlight Drive and St. Thomas Line & Lanark Drive.

Available sight distance at these intersections was reviewed to confirm that the minimum stopping sight distance and turning sight distance requirements of the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads[2] are met. The minimum sight distance requirements for a two-lane roadway with a design speed of 50 km/h are:

- Minimum stopping sight distance = 65 metres
- Minimum turning sight distance – left-turn from stop = 105 metres
- Minimum turning sight distance – right-turn from stop = 95 metres

Minimum stopping and turning sight distance requirements are met in both directions at the intersections of Paradise Road & Starlight Drive and St. Thomas Line & Lanark Drive.

4.3 Site Plan Review

The site plan has not been reviewed in detail with respect to adherence to the Town of Paradise guidelines for curb radii, street centreline radii, etc. as this is typically completed as part of the Town's review process. For the most part, the proposed road network is the 'natural' extension of both Lanark Drive and Rembrant Boulevard. No issues are noted with the four internal intersections.

- Lanark Drive & Street 'A';
- Rembrant Boulevard & Street 'B';
- Rembrant Boulevard & Street 'C'; and
- Street 'B' & Street 'C'.

The sight distance at internal intersections between two low-volume local roadways should meet the TAC minimum stopping sight distance requirement of 65 metres for a design speed of 50 km/h.

[2] Geometric Design Guide for Canadian Roads, Transportation Association of Canada, June 2017.

4.4 Trip Generation

The Institute of Transportation Engineers (ITE) Trip Generation Manual[3] was used to estimate the site's vehicle trip generation. Land use code 210 Single-Family Detached Housing, General Urban/Suburban was used. Table 4 summarizes the trip generation rates for the land use code.

Table 4: Trip Generation Rates

Land Use	AM Peak Hour			PM Peak Hour		
	Rate	Entering	Exiting	Rate	Entering	Exiting
210 Single-Family Detached Housing	0.70	26%	74%	0.94	63%	37%
Note: Rates are in vehicles per hour (vph)/unit						

Table 5 summarizes the estimated trip generation for the subdivision. The development is forecast to generate approximate 49 vehicle trips during the AM peak hour (41 trips entering and 25 trips exiting) and approximately 66 vehicle trips during the PM peak hour (41 trips entering and 25 trips exiting).

Table 5: Estimated Trip Generation

Land Use	Units	AM Peak Hour			PM Peak Hour		
		Total	Entering	Exiting	Total	Entering	Exiting
210 Single-Family Detached	70	49	13	36	66	41	25
Note: Trips generated are in vehicles per hour (vph).							

4.5 Trip Distribution and Assignment

The site generated vehicle trips were distributed to the road network based on existing travel patterns observed in the turning movement counts.

The site generated vehicle trips were assigned to the two access points based on the following assumptions:

- 60 percent of site-generated traffic will access the site via Lanark Drive; and
- 40 percent of site-generated traffic will access the site via Starlight Drive.

Table 6 summarizes the trip distribution assumptions.

[3] Trip Generation Manual, 11th Edition, Institute of Transportation Engineers, September 2021

Table 6: Trip Distribution

Origin/ Destination	Route	Trip Distribution			
		AM		PM	
East	Paradise Road via Starlight Drive	60%	25%	70%	25%
	St. Thomas Line via Lanark Drive		35%		45%
West	Paradise Road via Starlight Drive	40%	15%	30%	15%
	St. Thomas Line via Lanark Drive		25%		15%
Total		100%	100%	100%	100%

Figure 4 illustrates the site generated traffic volumes for the weekday AM and PM peak hours. Appendix C contains the detailed traffic forecasts for the development application.

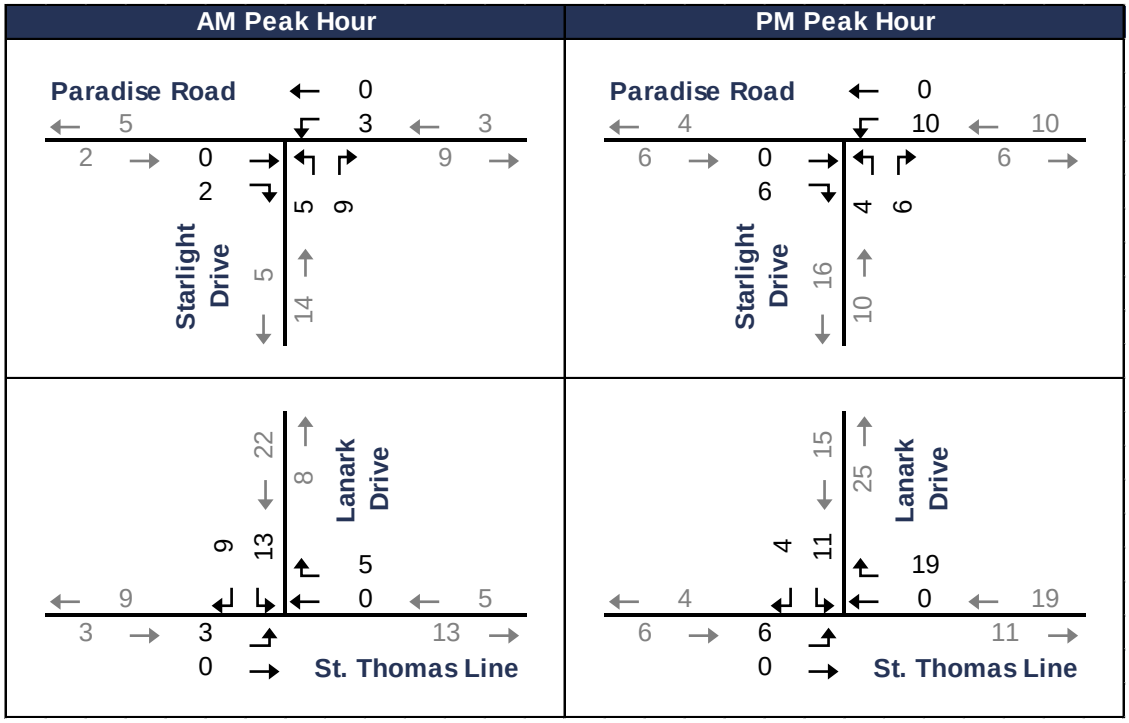


Figure 4: Site-Generated Traffic Volumes

5 Future Traffic Operations

One horizon year, five-years from the date of the study for the full build-out (Year 2027) has been assessed to estimate the impact of background traffic growth and the development.

5.1 Background Operations

The forecast background traffic volumes will consist of:

- Background traffic growth: the increase in non-site traffic is estimated to be 1.0% percent per year; and
- Traffic generated by adjacent developments:
  - Adams Pond Subdivision[4]: A 147-unit subdivision extending Lanark Drive and Rembrant Boulevard between Starlight Drive and Archibald Drive. The development is expected to generate 104 vehicle trips in the AM peak hour (26 trips entering, 78 trips exiting) and 138 vehicle trips in the PM peak hour (87 trips entering, 51 trips exiting). Primary access to the development will be from Paradise Road at Starlight Drive and Archibald Drive.

Figure 5 illustrates the future background traffic volumes for the weekday AM and PM peak hours.

[4] Adams Pond Subdivision Traffic Impact Assessment, Harbourside Transportation Consultants, February 2021.

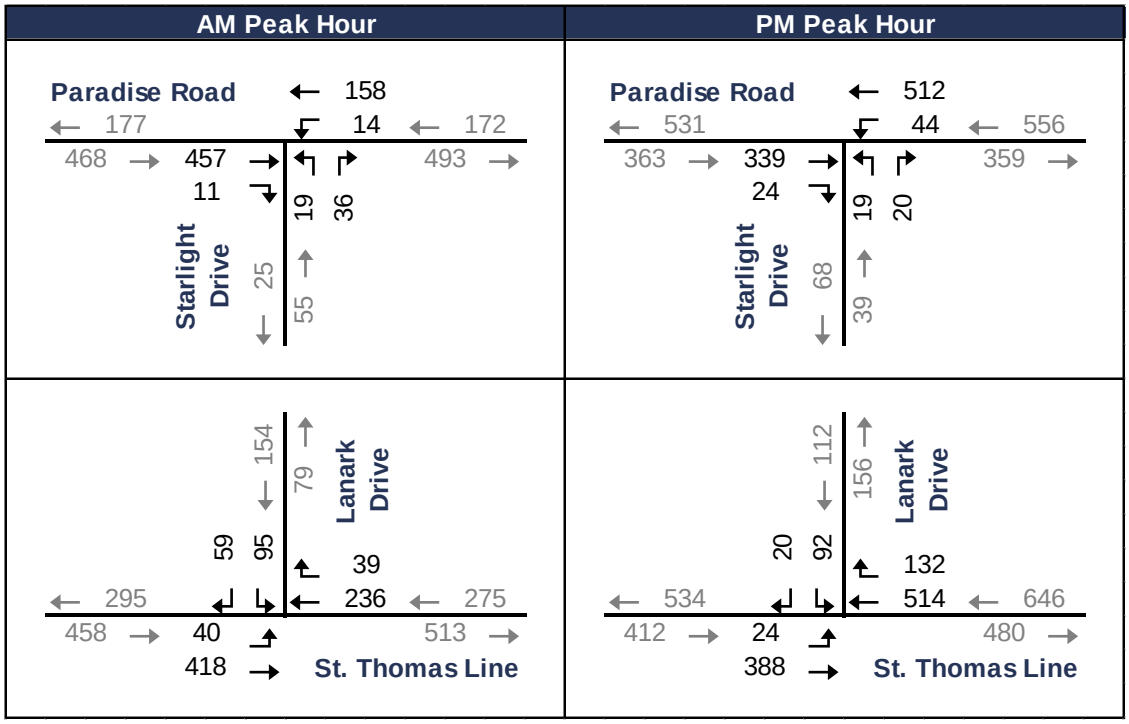


Figure 5: Background Traffic Volumes

Future background operations at the study intersections were evaluated using the same methodology used for existing conditions. No changes to existing traffic control and lane configurations are assumed.

Table 7 and Table 8 summarize the results of the analysis for the AM and PM peak hours. No critical movements are identified; operations at both study intersections are considered acceptable. The impacts of background traffic growth and adjacent developments are:

- Negligible increases in delay (approximately 1.0 second/vehicle or less) and queueing (less than 1 vehicle) are expected at Paradise Road & Starlight Drive; and
- Minor increases in delay (approximately 3.5 seconds/vehicle or less) and queueing (less than 1 vehicle) are expected at St. Thomas Line & Lanark Drive.

Appendix C contains the supporting detailed Synchro reports.

Table 7: Background Operations, AM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	457	11	468	14	158	172	19	36	55	695
	Delay	0.0	0.0	0.0	8.5	0.0	0.7	13.1		13.1	1.2
	LOS	A	A	A	A	A	A	B		B	A
	v/c	0.00	0.00		0.01	0.00		0.11			
	95th% Q	0.0	0.0		0.0	0.0		3.0			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	40	418	458	236	39	275	95	59	154	887
	Delay	8.2	0.0	0.7	0.0	0.0	0.0	25.4		25.4	4.8
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.04	0.00		0.00	0.00		0.52			
	95th% Q	0.8	0.0		0.0	0.0		22.0			

Table 8: Background Operations, PM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	339	24	363	44	512	556	19	20	39	958
	Delay	0.0	0.0	0.0	8.2	0.0	0.7	16.2		16.2	1.1
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.00	0.00		0.04	0.00		0.12			
	95th% Q	0.0	0.0		0.8	0.0		3.0			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	24	388	412	514	132	646	92	20	112	1170
	Delay	9.1	0.0	0.5	0.0	0.0	0.0	29.8		29.8	3.0
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.03	0.00		0.00	0.00		0.45			
	95th% Q	0.8	0.0		0.0	0.0		16.7			

5.2 Total Operations

The forecast total traffic volumes will consist of:

- The future background traffic volumes (background traffic growth and adjacent developments); and
- Traffic generated by the McCarthy Subdivision.

Figure 6 illustrates the future total traffic volumes for the weekday AM and PM peak hours.

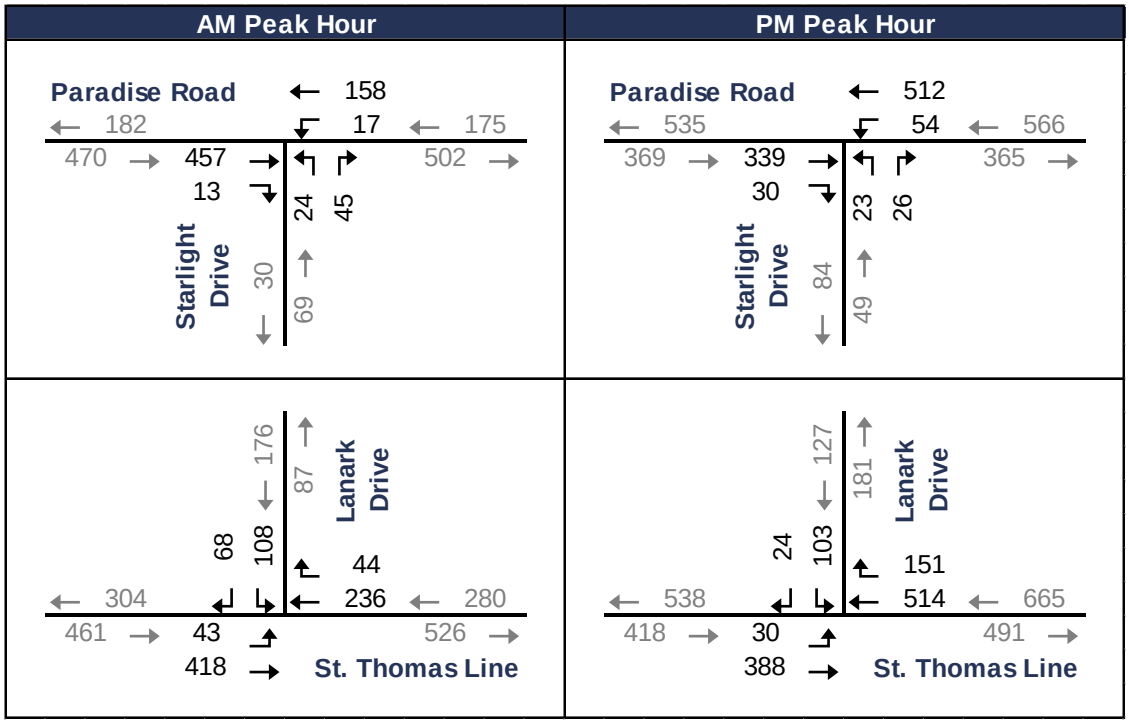


Figure 6: Total Traffic Volumes

Future total operations at the study intersections were evaluated using the same methodology used for existing and future background conditions. No changes to existing traffic control and lane configurations are assumed.

Table 9 and Table 10 summarize the results of the analysis for the AM and PM peak hours. No critical movements are identified; operations at both study intersections are considered acceptable. The impacts of site-generated traffic are:

- Negligible increases in delay (less than 1.0 second/vehicle) and queueing (less than 1 vehicle) are expected at Paradise Road & Starlight Drive; and
- Minor increases in delay (approximately 5.0 seconds/vehicle or less) and queueing (approximately 1 vehicle) are expected at St. Thomas Line & Lanark Drive.

Appendix D contains the supporting detailed Synchro reports.

Table 9: Total Operations, AM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	457	13	470	17	158	175	24	45	69	714
	Delay	0.0	0.0	0.0	8.6	0.0	0.8	13.4		13.4	1.5
	LOS	A	A	A	A	A	A	B		B	A
	v/c	0.00	0.00		0.02	0.00		0.14			
	95th% Q	0.0	0.0		0.8	0.0		3.8			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	43	418	461	236	44	280	108	68	176	917
	Delay	8.2	0.0	0.8	0.0	0.0	0.0	29.5		29.5	6.1
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.04	0.00		0.00	0.00		0.61			
	95th% Q	0.8	0.0		0.0	0.0		28.9			

Table 10: Total Operations, PM Peak Hour

Intersection	Measure	Paradise Road			Paradise Road			Starlight Drive			Intersection
		EB-T	EB-R	Approach	WB-L	WB-T	Approach	NB-L	NB-R	Approach	
1: Paradise Road & Starlight Drive	Volume	339	30	369	54	512	566	23	26	49	984
	Delay	0.0	0.0	0.0	8.3	0.0	0.8	16.8		16.8	1.3
	LOS	A	A	A	A	A	A	C		C	A
	v/c	0.00	0.00		0.05	0.00		0.15			
	95th% Q	0.0	0.0		1.5	0.0		3.8			
Intersection	Measure	St. Thomas Line			St. Thomas Line			Lanark Drive			Intersection
		EB-L	EB-T	Approach	WB-T	WB-R	Approach	SB-L	SB-R	Approach	
2: St. Thomas Line & Lanark Drive	Volume	30	388	418	514	151	665	103	24	127	1210
	Delay	9.2	0.0	0.7	0.0	0.0	0.0	34.8		34.8	3.9
	LOS	A	A	A	A	A	A	D		D	A
	v/c	0.04	0.00		0.00	0.00		0.54			
	95th% Q	0.8	0.0		0.0	0.0		22.0			

6 Remedial Measures

6.1 Traffic Signal Warrant

The Transportation Association of Canada (TAC) Traffic Signal and Pedestrian Head Warrant Handbook[5] provides guidance on the assessment of the need for traffic control signals at intersections. The procedure uses a "cumulative factors methodology" to identify if traffic control signals are warranted based on factors such as geometry, operating parameters, local demographics and pedestrian and vehicular volumes and conflicts. To warrant the installation of a traffic control signal, an intersection must score a minimum of 100 cumulative warrant points.

The traffic signal warrant analysis was completed for the intersection of St. Thomas Line & Lanark Drive using existing traffic volumes. The signal warrant is not satisfied (36 cumulative warrant points); no improvements to the existing form of stop control are recommended. Appendix E contains the warrant analysis.

6.2 Left Turn Lane Warrant

The Ministry of Transportation of Ontario (MTO) Supplement for the TAC Geometric Design Guide for Canadian Roads[6] provides guidance on the assessment of the need for left turn lanes at unsignalized intersections. The methodology uses a series of nomographs to identify if a left turn lane is warranted based on factors such as design speed, advancing volumes, left turn volume as a percentage of advancing volumes and opposing volumes.

The left turn lane warrant analysis was completed for the eastbound direction on St. Thomas Line using the future total traffic volumes.

Figure 2 illustrates the left turn warrant analysis for the AM peak hour, where the left turning volume represents approximately 10% of advancing volumes. A left turn lane with a minimum storage length of 15 metres is warranted; it should be noted that the result falls approximately on the warrant line indicating that the threshold is narrowly met.

Figure 8 illustrates the left turn warrant analysis for the PM peak hour, where the left turning volume represents approximately 7% of advancing volumes. A left turn lane with a minimum storage length of 15 metres is warranted.

[5] TAC Traffic Signal and Pedestrian Head Warrant Handbook, June 2014.
[6] MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads, Appendix 9 for Chapter 9 Intersections, June 2017.

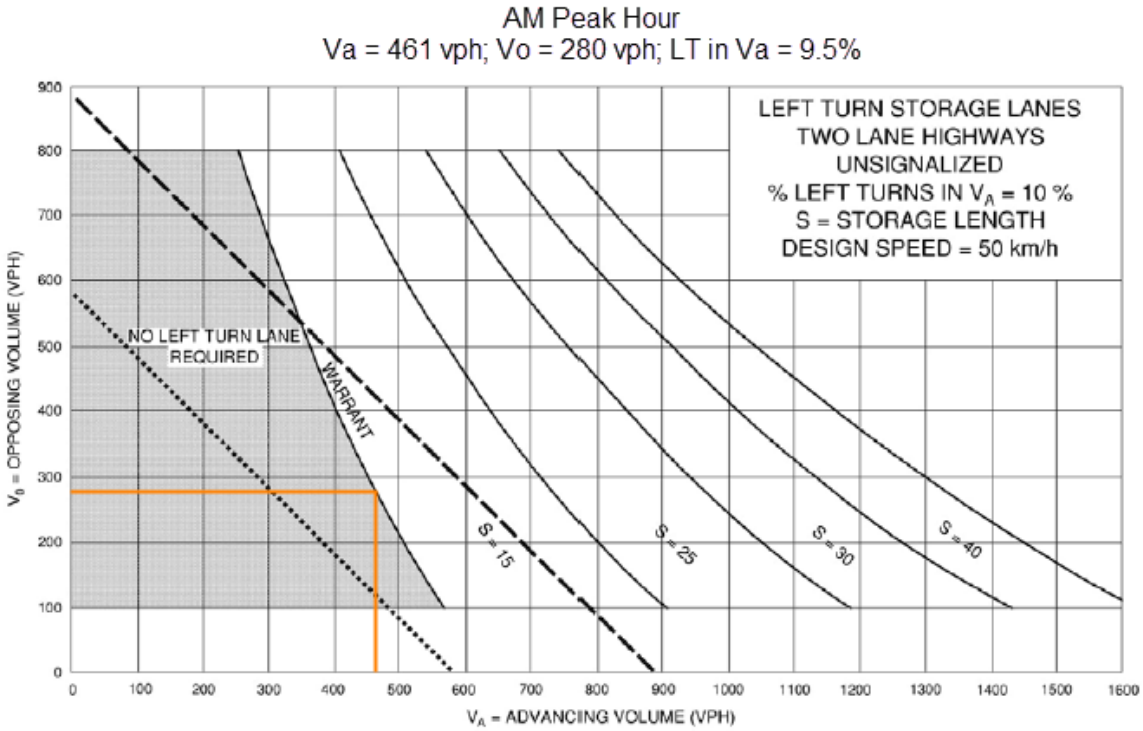


Figure 7: Left Turn Lane Warrant, St. Thomas Line AM Peak Hour

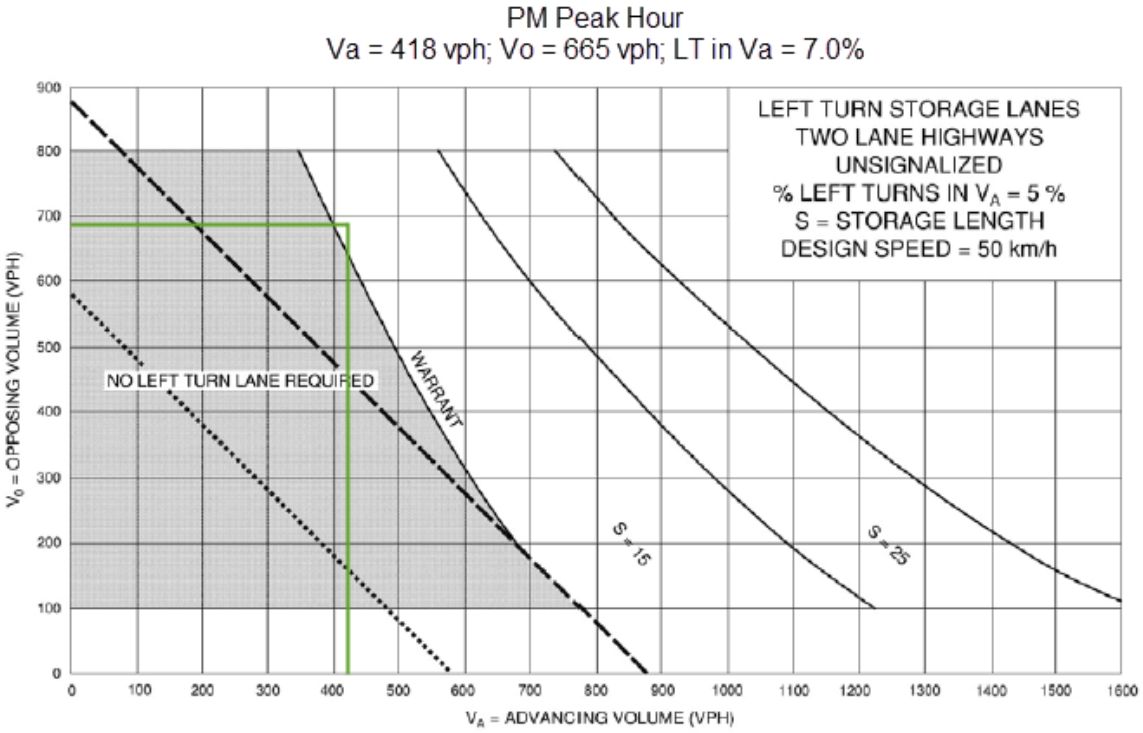


Figure 8: Left Turn Lane Warrant, St. Thomas Line PM Peak Hour

A storage lane could be accommodated within the existing pavement width on St. Thomas Line. Due to the close proximity of Sullivans Road on the opposing side of St. Thomas Line, however, the storage lane would extend across the Sullivans Road approach and vehicles queued in the lane would temporarily block left turns into and out of Sullivans Road. There is also an existing crosswalk in this area. Figure 9 illustrates the existing configuration of the Lanark Drive and Sullivans Road intersections on St. Thomas Line.

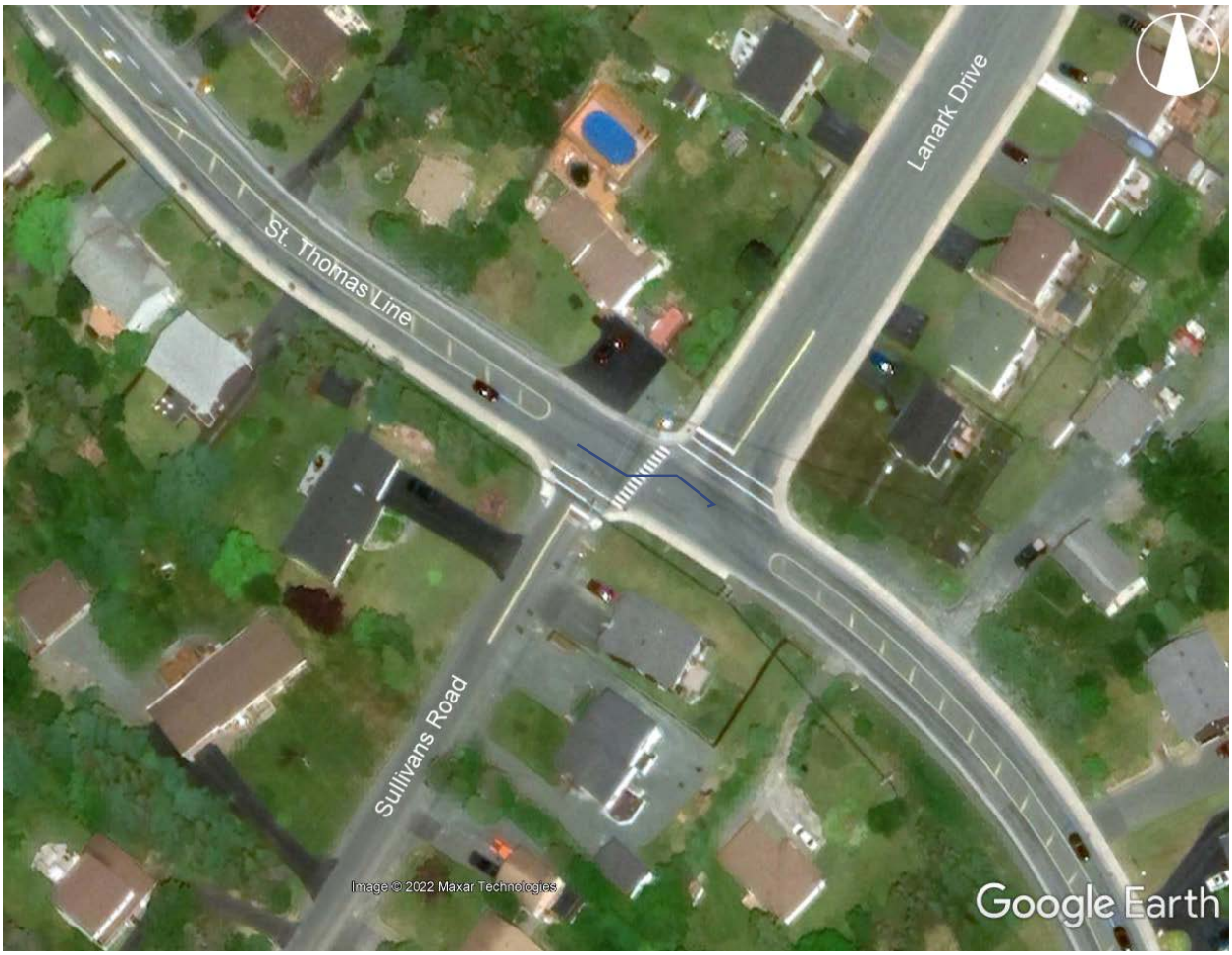


Figure 9: St. Thomas Line & Lanark Drive

While the crosswalk could be relocated either to the west side of Sullivans Road, or to the east side of Lanark Drive, neither of these scenarios is ideal. The left turn volume from Lanark Drive to St. Thomas Line is significantly higher than the right turn volume and moving the crosswalk to the east of Lanark would unnecessarily introduce more vehicle-pedestrian conflicts. There is an existing driveway directly across from the existing pedestrian lowback on the west side of Sullivans Road which would require pushing the crossing point even further to the west. Because the pedestrian ‘desire line’ is anticipated

to be between the north and south sides of St. Thomas Line at Lanark Drive, pedestrians are more likely to continue crossing at the established crossing point.

Furthermore, it is likely that vehicles are already queuing in the available space in the median area on St. Thomas Line to turn left to either Lanark Drive of Sullivan's Road. The traffic analysis indicates that future left turn queues at Lanark Drive are not expected to exceed a couple of vehicles with average delay of less than 10 seconds, and given the low volumes anticipated to be generated by less than 15 single-family homes on Sullivans Road, no operational or safety concerns are expected to arise from this configuration.

Considering these factors, it is recommended that the existing intersection configuration be maintained unless the Town is aware, or becomes aware, of operational issues at this location.

7 Conclusion

Pinnacle Engineering retained Harbourside Transportation Consultants to conduct a Traffic Impact Assessment for a residential development referred to as the McCarthy Subdivision located in Paradise, NL.

The study assesses current and future background traffic conditions within the study area, estimates the traffic generated by the development site, assesses the impacts of the site-generated traffic on the surrounding road network and identifies improvements required to accommodate the site generated traffic.

The development site is located in the Lanark Drive area between Quantum Drive and Starlight Drive. The development proposal for the McCarthy Subdivision includes 70 single-family detached units.

The subdivision's road network will:

- Extend Lanark Drive from Quantum Drive to the north connecting to the existing segment of Lanark Drive near Tudor Avenue;
- Extend Rembrant Boulevard between Quantum Drive and Starlight Drive;
- Include one new cul-de-sac local roadway accessed from Lanark Drive (currently referred to as Street 'A');
- Include one new cul-de-sac local roadway accessed from Rembrant Boulevard (currently referred to as Street 'B'); and
- Include on new local roadway which will form a crescent shape between Rembrant Boulevard and Street 'B' (currently referred to as Street 'C').

Until Lanark Drive is further extended to complete a loop around Adams Pond, it is anticipated that the proposed subdivision will be accessed primarily from St. Thomas Line via Lanark Drive and from Paradise Road via Starlight Drive. While access to Paradise Road will also be available via Archibald Drive and Acharya Drive, these are less direct routes and for the purposes of this study, the primary access points are considered to be existing intersections of Paradise Road & Starlight Drive and St. Thomas Line & Lanark Drive. Minimum stopping and turning sight distance requirements are met in both directions at these intersections.

Based on the investigations carried out, it is concluded that:

- **Existing Traffic Operations:** No capacity issues are identified at the two intersections; traffic operations are considered acceptable.
- **Site-Generated Traffic:** The development is forecast to generate approximate 49 vehicle trips during the AM peak hour (41 trips entering and 25 trips exiting) and approximately 66 vehicle trips during the PM peak hour (41 trips entering and 25 trips exiting).
- **5-year Background Traffic Operations:** No capacity issues are forecast at the intersections with the addition of generalized traffic growth and the adjacent Adams Pond Subdivision.
- **5-year Total Traffic Operations:** No capacity issues of concern result from the addition of site-generated traffic. The existing and 5-year background horizon intersection delays are only slightly exacerbated.
- **Remedial Measures:** The forecast future traffic volumes at the intersection of St. Thomas Line & Lanark Drive do not warrant traffic signals; no improvements to the existing form of stop control are recommended. An eastbound left turn lane with a minimum storage length of 15 metres was found to be warranted on St. Thomas Line. This issue is discussed in detail in Section 6.2 and, considering a number of factors, it is recommended that the existing configuration at the intersection of St. Thomas Line and Lanark Drive/Sullivans Road be maintained unless the Town is aware, or becomes aware, of any operational issues at this location.

Appendix A: Traffic Data

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

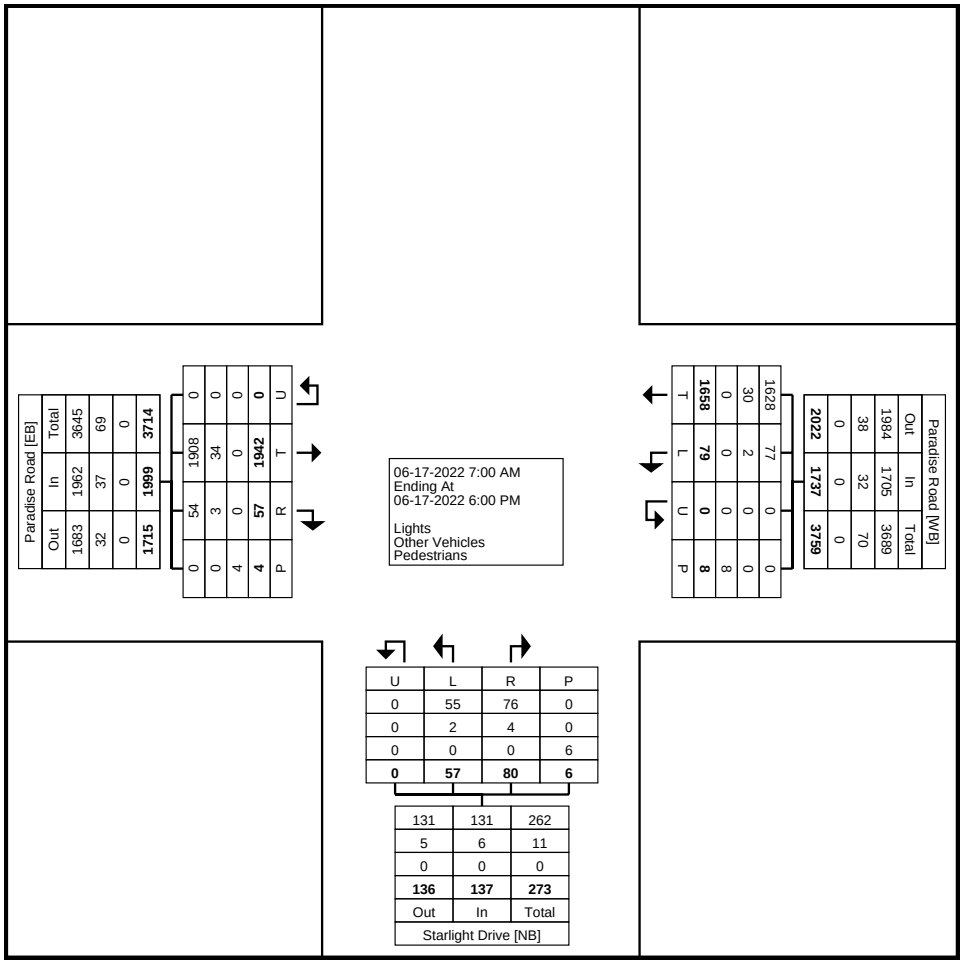
Turning Movement Data

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
7:00 AM	70	0	0	0	70	0	19	0	0	19	1	5	0	0	6	95
7:15 AM	102	1	0	0	103	1	23	0	2	24	2	3	0	0	5	132
7:30 AM	133	1	0	0	134	2	25	0	1	27	2	2	0	1	4	165
7:45 AM	83	2	0	0	85	5	44	0	0	49	3	7	0	0	10	144
Hourly Total	388	4	0	0	392	8	111	0	3	119	8	17	0	1	25	536
8:00 AM	117	2	0	0	119	2	35	0	0	37	1	3	0	0	4	160
8:15 AM	102	3	0	0	105	0	45	0	5	45	4	9	0	0	13	163
8:30 AM	87	1	0	0	88	1	41	0	0	42	4	3	0	0	7	137
8:45 AM	89	2	0	0	91	0	47	0	0	47	2	1	0	0	3	141
Hourly Total	395	8	0	0	403	3	168	0	5	171	11	16	0	0	27	601
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11:00 AM	68	2	0	0	70	2	44	0	0	46	1	5	0	0	6	122
11:15 AM	56	2	0	0	58	3	62	0	0	65	0	5	0	1	5	128
11:30 AM	77	1	0	0	78	0	66	0	0	66	2	1	0	0	3	147
11:45 AM	82	3	0	1	85	2	61	0	0	63	4	2	0	1	6	154
Hourly Total	283	8	0	1	291	7	233	0	0	240	7	13	0	2	20	551
12:00 PM	72	3	0	0	75	3	55	0	0	58	2	3	0	0	5	138
12:15 PM	73	5	0	0	78	3	47	0	0	50	0	4	0	0	4	132
12:30 PM	56	0	0	1	56	3	65	0	0	68	6	5	0	1	11	135
12:45 PM	70	4	0	0	74	2	60	0	0	62	1	1	0	0	2	138
Hourly Total	271	12	0	1	283	11	227	0	0	238	9	13	0	1	22	543
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	72	5	0	0	77	3	102	0	0	105	5	2	0	0	7	189
4:15 PM	67	3	0	0	70	8	119	0	0	127	4	4	0	0	8	205
4:30 PM	79	3	0	0	82	7	117	0	0	124	2	2	0	0	4	210
4:45 PM	79	3	0	0	82	8	117	0	0	125	3	0	0	0	3	210
Hourly Total	297	14	0	0	311	26	455	0	0	481	14	8	0	0	22	814
5:00 PM	77	6	0	0	83	3	123	0	0	126	4	7	0	0	11	220
5:15 PM	87	2	0	2	89	9	129	0	0	138	4	1	0	2	5	232
5:30 PM	77	3	0	0	80	6	113	0	0	119	0	3	0	0	3	202
5:45 PM	67	0	0	0	67	6	99	0	0	105	0	2	0	0	2	174
Hourly Total	308	11	0	2	319	24	464	0	0	488	8	13	0	2	21	828
Grand Total	1942	57	0	4	1999	79	1658	0	8	1737	57	80	0	6	137	3873
Approach %	97.1	2.9	0.0	-	-	4.5	95.5	0.0	-	-	41.6	58.4	0.0	-	-	-
Total %	50.1	1.5	0.0	-	51.6	2.0	42.8	0.0	-	44.8	1.5	2.1	0.0	-	3.5	-
Lights	1908	54	0	-	1962	77	1628	0	-	1705	55	76	0	-	131	3798

% Lights	98.2	94.7	-	-	98.1	97.5	98.2	-	-	98.2	96.5	95.0	-	-	95.6	98.1
Other Vehicles	34	3	0	-	37	2	30	0	-	32	2	4	0	-	6	75
% Other Vehicles	1.8	5.3	-	-	1.9	2.5	1.8	-	-	1.8	3.5	5.0	-	-	4.4	1.9
Pedestrians	-	-	-	4	-	-	-	-	8	-	-	-	-	6	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	100.0	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Data Plot

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

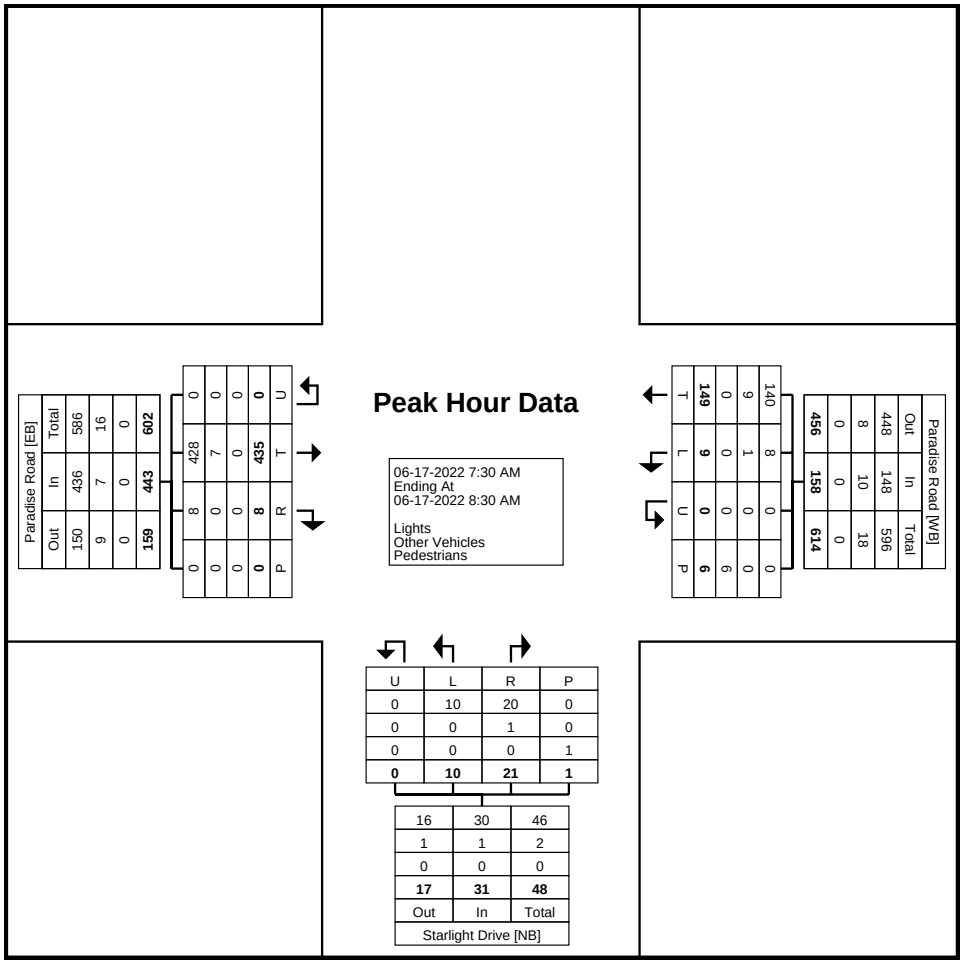
Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

Turning Movement Peak Hour Data (7:30 AM)

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
7:30 AM	133	1	0	0	134	2	25	0	1	27	2	2	0	1	4	165
7:45 AM	83	2	0	0	85	5	44	0	0	49	3	7	0	0	10	144
8:00 AM	117	2	0	0	119	2	35	0	0	37	1	3	0	0	4	160
8:15 AM	102	3	0	0	105	0	45	0	5	45	4	9	0	0	13	163
Total	435	8	0	0	443	9	149	0	6	158	10	21	0	1	31	632
Approach %	98.2	1.8	0.0	-	-	5.7	94.3	0.0	-	-	32.3	67.7	0.0	-	-	-
Total %	68.8	1.3	0.0	-	70.1	1.4	23.6	0.0	-	25.0	1.6	3.3	0.0	-	4.9	-
PHF	0.818	0.667	0.000	-	0.826	0.450	0.828	0.000	-	0.806	0.625	0.583	0.000	-	0.596	0.958
Lights	428	8	0	-	436	8	140	0	-	148	10	20	0	-	30	614
% Lights	98.4	100.0	-	-	98.4	88.9	94.0	-	-	93.7	100.0	95.2	-	-	96.8	97.2
Other Vehicles	7	0	0	-	7	1	9	0	-	10	0	1	0	-	1	18
% Other Vehicles	1.6	0.0	-	-	1.6	11.1	6.0	-	-	6.3	0.0	4.8	-	-	3.2	2.8
Pedestrians	-	-	-	0	-	-	-	-	6	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	100.0	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Peak Hour Data Plot (7:30 AM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

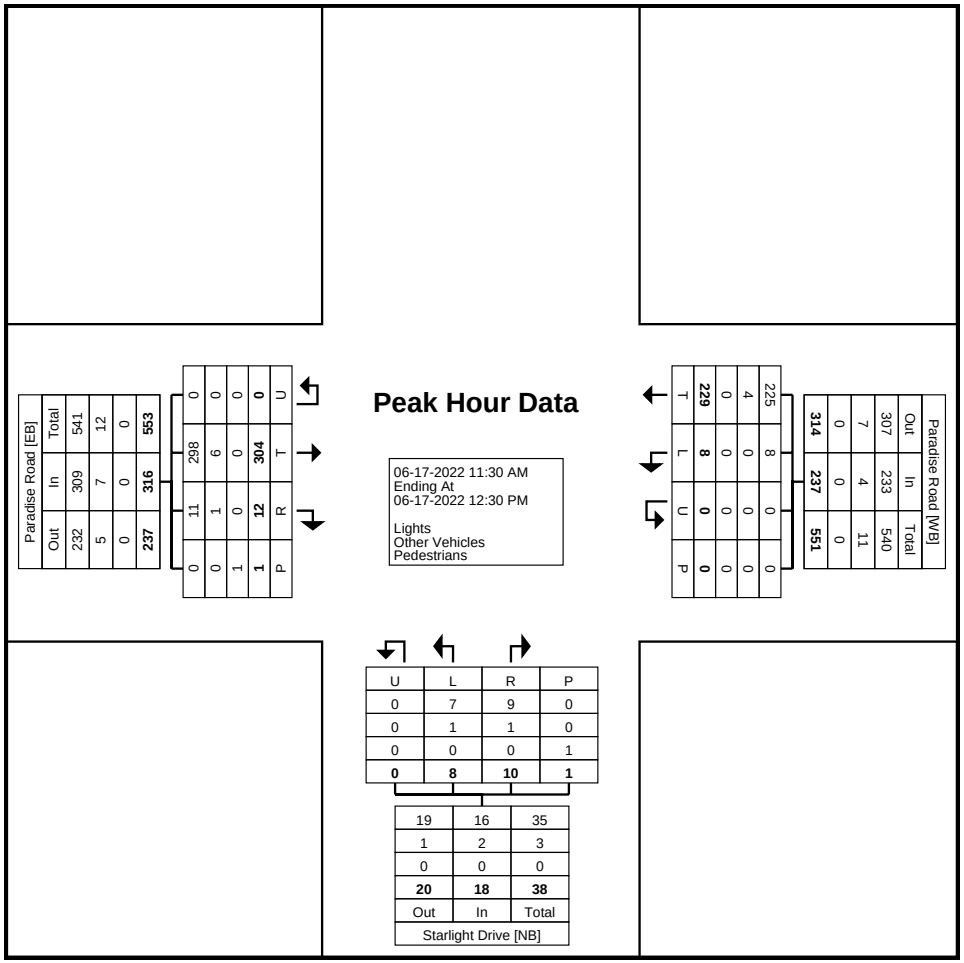
Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

Turning Movement Peak Hour Data (11:30 AM)

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
11:30 AM	77	1	0	0	78	0	66	0	0	66	2	1	0	0	3	147
11:45 AM	82	3	0	1	85	2	61	0	0	63	4	2	0	1	6	154
12:00 PM	72	3	0	0	75	3	55	0	0	58	2	3	0	0	5	138
12:15 PM	73	5	0	0	78	3	47	0	0	50	0	4	0	0	4	132
Total	304	12	0	1	316	8	229	0	0	237	8	10	0	1	18	571
Approach %	96.2	3.8	0.0	-	-	3.4	96.6	0.0	-	-	44.4	55.6	0.0	-	-	-
Total %	53.2	2.1	0.0	-	55.3	1.4	40.1	0.0	-	41.5	1.4	1.8	0.0	-	3.2	-
PHF	0.927	0.600	0.000	-	0.929	0.667	0.867	0.000	-	0.898	0.500	0.625	0.000	-	0.750	0.927
Lights	298	11	0	-	309	8	225	0	-	233	7	9	0	-	16	558
% Lights	98.0	91.7	-	-	97.8	100.0	98.3	-	-	98.3	87.5	90.0	-	-	88.9	97.7
Other Vehicles	6	1	0	-	7	0	4	0	-	4	1	1	0	-	2	13
% Other Vehicles	2.0	8.3	-	-	2.2	0.0	1.7	-	-	1.7	12.5	10.0	-	-	11.1	2.3
Pedestrians	-	-	-	1	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Peak Hour Data Plot (11:30 AM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

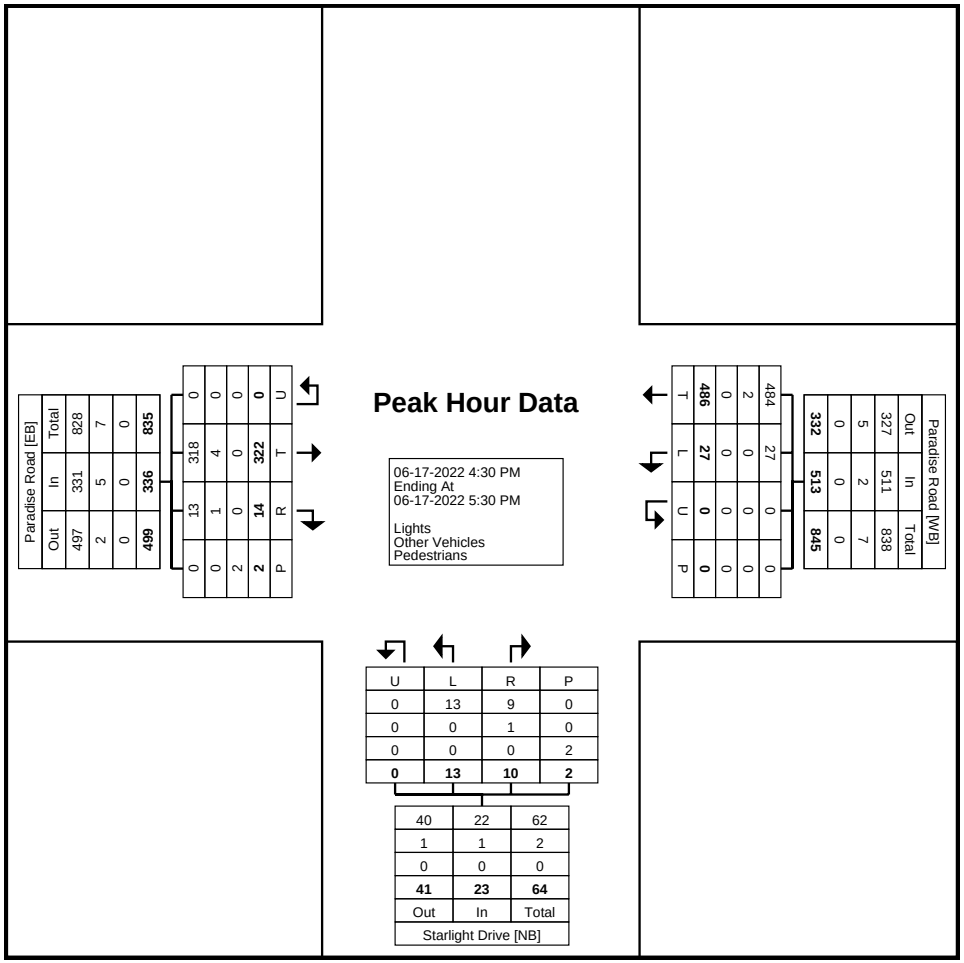
Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022

Turning Movement Peak Hour Data (4:30 PM)

Start Time	Paradise Road Eastbound					Paradise Road Westbound					Starlight Drive Northbound					
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
4:30 PM	79	3	0	0	82	7	117	0	0	124	2	2	0	0	4	210
4:45 PM	79	3	0	0	82	8	117	0	0	125	3	0	0	0	3	210
5:00 PM	77	6	0	0	83	3	123	0	0	126	4	7	0	0	11	220
5:15 PM	87	2	0	2	89	9	129	0	0	138	4	1	0	2	5	232
Total	322	14	0	2	336	27	486	0	0	513	13	10	0	2	23	872
Approach %	95.8	4.2	0.0	-	-	5.3	94.7	0.0	-	-	56.5	43.5	0.0	-	-	-
Total %	36.9	1.6	0.0	-	38.5	3.1	55.7	0.0	-	58.8	1.5	1.1	0.0	-	2.6	-
PHF	0.925	0.583	0.000	-	0.944	0.750	0.942	0.000	-	0.929	0.813	0.357	0.000	-	0.523	0.940
Lights	318	13	0	-	331	27	484	0	-	511	13	9	0	-	22	864
% Lights	98.8	92.9	-	-	98.5	100.0	99.6	-	-	99.6	100.0	90.0	-	-	95.7	99.1
Other Vehicles	4	1	0	-	5	0	2	0	-	2	0	1	0	-	1	8
% Other Vehicles	1.2	7.1	-	-	1.5	0.0	0.4	-	-	0.4	0.0	10.0	-	-	4.3	0.9
Pedestrians	-	-	-	2	-	-	-	-	0	-	-	-	-	2	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: Paradise Road & Starlight Drive
Site Code:
Start Date: 06-17-2022



Turning Movement Peak Hour Data Plot (4:30 PM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

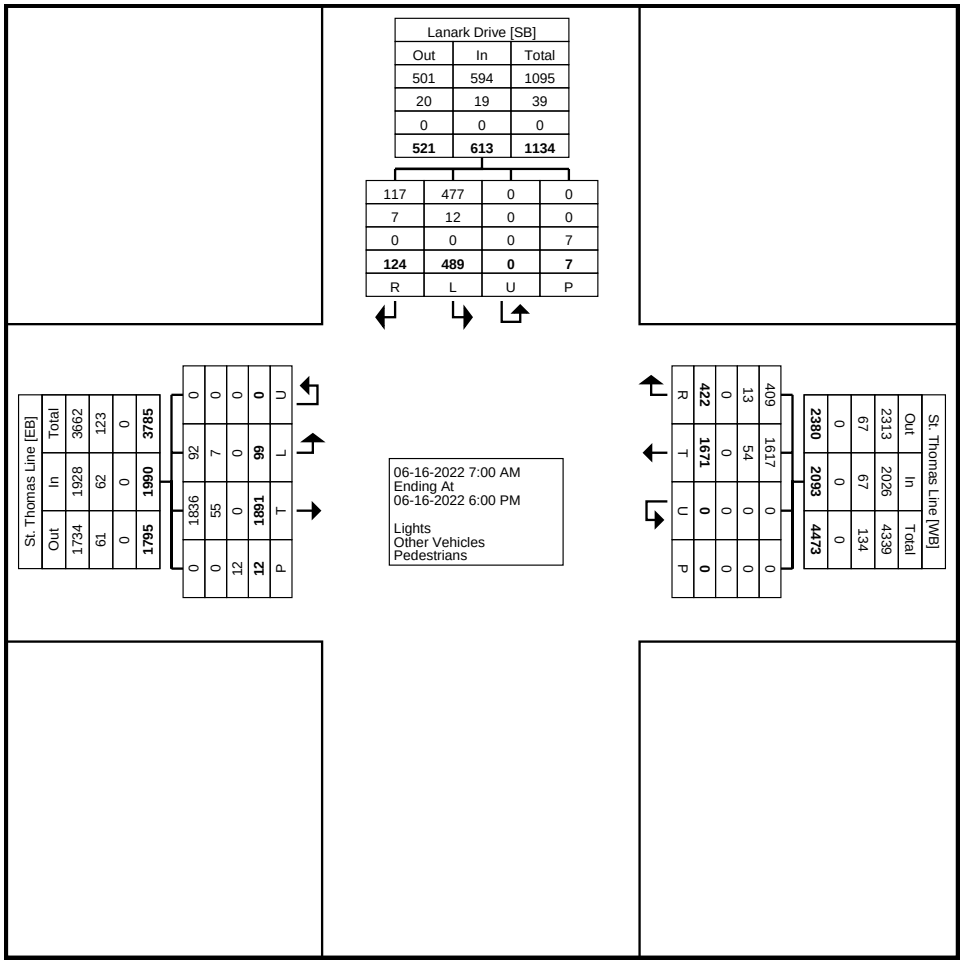
Turning Movement Data

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
7:00 AM	0	35	0	0	35	20	7	0	0	27	15	1	0	0	16	78
7:15 AM	1	77	0	0	78	27	8	0	0	35	28	0	0	0	28	141
7:30 AM	0	106	0	0	106	42	8	0	0	50	21	7	0	0	28	184
7:45 AM	0	89	0	0	89	41	10	0	0	51	35	4	0	0	39	179
Hourly Total	1	307	0	0	308	130	33	0	0	163	99	12	0	0	111	582
8:00 AM	4	91	0	0	95	39	11	0	0	50	26	5	0	0	31	176
8:15 AM	5	106	0	1	111	63	6	0	0	69	26	13	0	2	39	219
8:30 AM	11	120	0	2	131	70	8	0	0	78	25	22	0	0	47	256
8:45 AM	18	81	0	0	99	53	12	0	0	65	13	16	0	0	29	193
Hourly Total	38	398	0	3	436	225	37	0	0	262	90	56	0	2	146	844
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11:00 AM	1	49	0	0	50	49	15	0	0	64	13	1	0	0	14	128
11:15 AM	3	42	0	0	45	30	9	0	0	39	17	1	0	0	18	102
11:30 AM	1	45	0	0	46	32	15	0	0	47	14	2	0	0	16	109
11:45 AM	4	68	0	0	72	62	15	0	0	77	15	0	0	0	15	164
Hourly Total	9	204	0	0	213	173	54	0	0	227	59	4	0	0	63	503
12:00 PM	1	56	0	0	57	52	17	0	0	69	11	1	0	0	12	138
12:15 PM	2	52	0	0	54	68	8	0	0	76	19	0	0	0	19	149
12:30 PM	1	69	0	0	70	72	27	0	0	99	24	3	0	0	27	196
12:45 PM	3	56	0	0	59	63	14	0	0	77	23	6	0	1	29	165
Hourly Total	7	233	0	0	240	255	66	0	0	321	77	10	0	1	87	648
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	2	88	0	1	90	91	26	0	0	117	18	5	0	1	23	230
4:15 PM	6	94	0	3	100	98	30	0	0	128	16	6	0	2	22	250
4:30 PM	7	90	0	1	97	122	30	0	0	152	21	5	0	0	26	275
4:45 PM	4	90	0	1	94	131	39	0	0	170	17	4	0	0	21	285
Hourly Total	19	362	0	6	381	442	125	0	0	567	72	20	0	3	92	1040
5:00 PM	8	90	0	1	98	148	26	0	0	174	16	5	0	0	21	293
5:15 PM	4	79	0	1	83	109	31	0	0	140	30	4	0	1	34	257
5:30 PM	7	110	0	0	117	101	30	0	0	131	25	6	0	0	31	279
5:45 PM	6	108	0	1	114	88	20	0	0	108	21	7	0	0	28	250
Hourly Total	25	387	0	3	412	446	107	0	0	553	92	22	0	1	114	1079
Grand Total	99	1891	0	12	1990	1671	422	0	0	2093	489	124	0	7	613	4696
Approach %	5.0	95.0	0.0	-	-	79.8	20.2	0.0	-	-	79.8	20.2	0.0	-	-	-
Total %	2.1	40.3	0.0	-	42.4	35.6	9.0	0.0	-	44.6	10.4	2.6	0.0	-	13.1	-
Lights	92	1836	0	-	1928	1617	409	0	-	2026	477	117	0	-	594	4548

% Lights	92.9	97.1	-	-	96.9	96.8	96.9	-	-	96.8	97.5	94.4	-	-	96.9	96.8
Other Vehicles	7	55	0	-	62	54	13	0	-	67	12	7	0	-	19	148
% Other Vehicles	7.1	2.9	-	-	3.1	3.2	3.1	-	-	3.2	2.5	5.6	-	-	3.1	3.2
Pedestrians	-	-	-	12	-	-	-	-	0	-	-	-	-	7	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Data Plot

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

Turning Movement Peak Hour Data (8:00 AM)

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
8:00 AM	4	91	0	0	95	39	11	0	0	50	26	5	0	0	31	176
8:15 AM	5	106	0	1	111	63	6	0	0	69	26	13	0	2	39	219
8:30 AM	11	120	0	2	131	70	8	0	0	78	25	22	0	0	47	256
8:45 AM	18	81	0	0	99	53	12	0	0	65	13	16	0	0	29	193
Total	38	398	0	3	436	225	37	0	0	262	90	56	0	2	146	844
Approach %	8.7	91.3	0.0	-	-	85.9	14.1	0.0	-	-	61.6	38.4	0.0	-	-	-
Total %	4.5	47.2	0.0	-	51.7	26.7	4.4	0.0	-	31.0	10.7	6.6	0.0	-	17.3	-
PHF	0.528	0.829	0.000	-	0.832	0.804	0.771	0.000	-	0.840	0.865	0.636	0.000	-	0.777	0.824
Lights	35	376	0	-	411	203	35	0	-	238	83	53	0	-	136	785
% Lights	92.1	94.5	-	-	94.3	90.2	94.6	-	-	90.8	92.2	94.6	-	-	93.2	93.0
Other Vehicles	3	22	0	-	25	22	2	0	-	24	7	3	0	-	10	59
% Other Vehicles	7.9	5.5	-	-	5.7	9.8	5.4	-	-	9.2	7.8	5.4	-	-	6.8	7.0
Pedestrians	-	-	-	3	-	-	-	-	0	-	-	-	-	2	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
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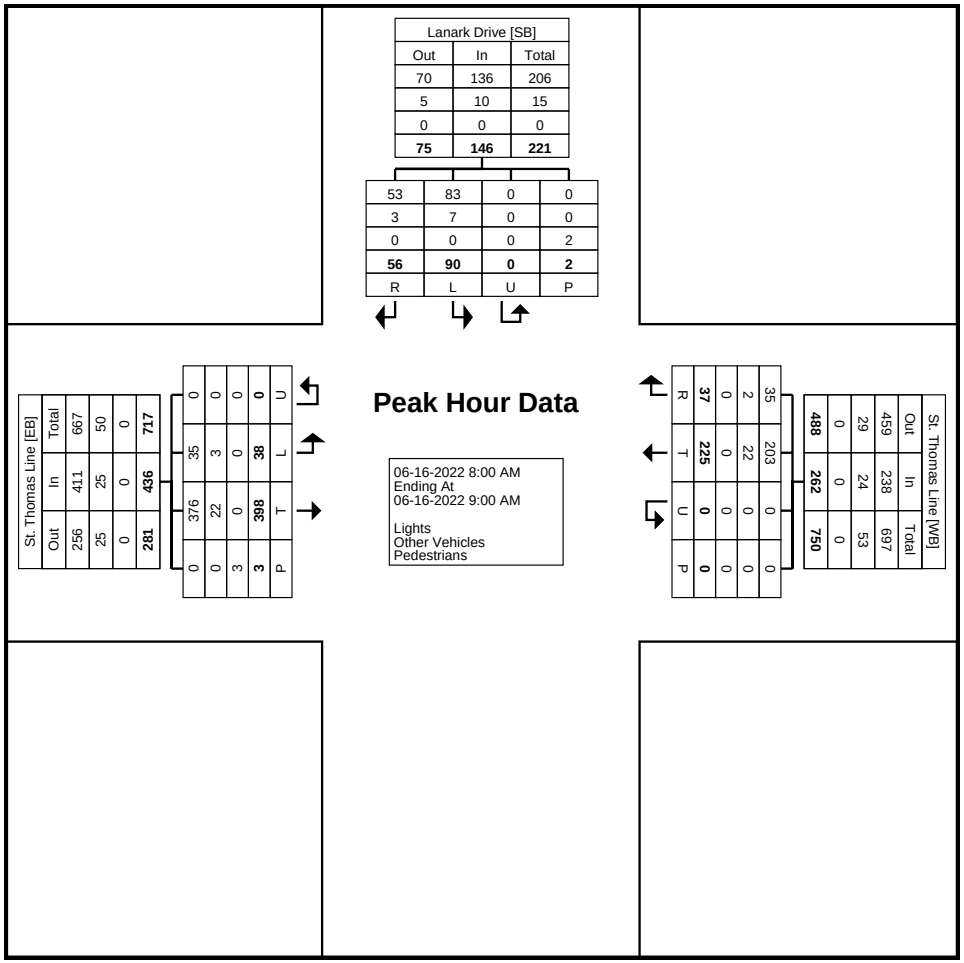
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Peak Hour Data Plot (8:00 AM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

Turning Movement Peak Hour Data (12:00 PM)

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
12:00 PM	1	56	0	0	57	52	17	0	0	69	11	1	0	0	12	138
12:15 PM	2	52	0	0	54	68	8	0	0	76	19	0	0	0	19	149
12:30 PM	1	69	0	0	70	72	27	0	0	99	24	3	0	0	27	196
12:45 PM	3	56	0	0	59	63	14	0	0	77	23	6	0	1	29	165
Total	7	233	0	0	240	255	66	0	0	321	77	10	0	1	87	648
Approach %	2.9	97.1	0.0	-	-	79.4	20.6	0.0	-	-	88.5	11.5	0.0	-	-	-
Total %	1.1	36.0	0.0	-	37.0	39.4	10.2	0.0	-	49.5	11.9	1.5	0.0	-	13.4	-
PHF	0.583	0.844	0.000	-	0.857	0.885	0.611	0.000	-	0.811	0.802	0.417	0.000	-	0.750	0.827
Lights	7	230	0	-	237	250	64	0	-	314	77	9	0	-	86	637
% Lights	100.0	98.7	-	-	98.8	98.0	97.0	-	-	97.8	100.0	90.0	-	-	98.9	98.3
Other Vehicles	0	3	0	-	3	5	2	0	-	7	0	1	0	-	1	11
% Other Vehicles	0.0	1.3	-	-	1.3	2.0	3.0	-	-	2.2	0.0	10.0	-	-	1.1	1.7
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
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Suite 200
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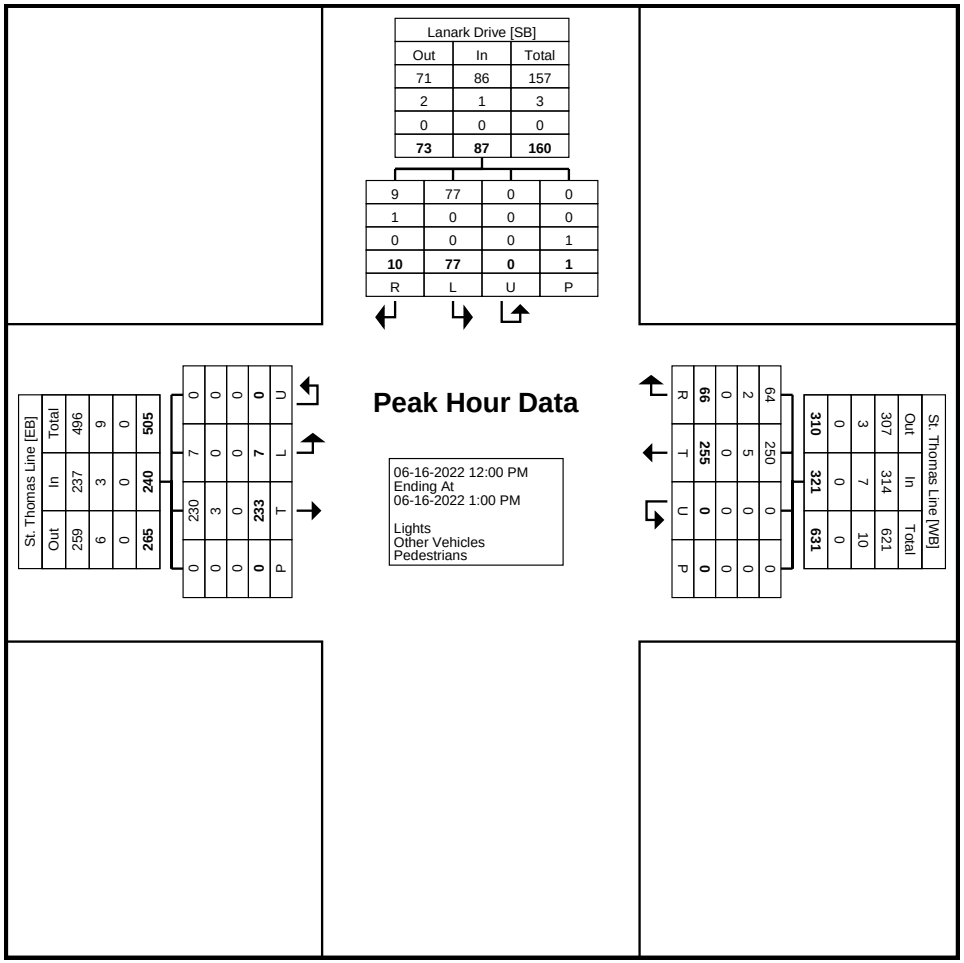
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Peak Hour Data Plot (12:00 PM)

Harbourside Transportation Consultants
219 Waverley Road
Suite 200
Dartmouth, Nova Scotia, Canada B2X 2C3
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022

Turning Movement Peak Hour Data (4:45 PM)

Start Time	St. Thomas Line Eastbound					St. Thomas Line Westbound					Lanark Drive Southbound					
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Int. Total
4:45 PM	4	90	0	1	94	131	39	0	0	170	17	4	0	0	21	285
5:00 PM	8	90	0	1	98	148	26	0	0	174	16	5	0	0	21	293
5:15 PM	4	79	0	1	83	109	31	0	0	140	30	4	0	1	34	257
5:30 PM	7	110	0	0	117	101	30	0	0	131	25	6	0	0	31	279
Total	23	369	0	3	392	489	126	0	0	615	88	19	0	1	107	1114
Approach %	5.9	94.1	0.0	-	-	79.5	20.5	0.0	-	-	82.2	17.8	0.0	-	-	-
Total %	2.1	33.1	0.0	-	35.2	43.9	11.3	0.0	-	55.2	7.9	1.7	0.0	-	9.6	-
PHF	0.719	0.839	0.000	-	0.838	0.826	0.808	0.000	-	0.884	0.733	0.792	0.000	-	0.787	0.951
Lights	22	360	0	-	382	485	126	0	-	611	87	19	0	-	106	1099
% Lights	95.7	97.6	-	-	97.4	99.2	100.0	-	-	99.3	98.9	100.0	-	-	99.1	98.7
Other Vehicles	1	9	0	-	10	4	0	0	-	4	1	0	0	-	1	15
% Other Vehicles	4.3	2.4	-	-	2.6	0.8	0.0	-	-	0.7	1.1	0.0	-	-	0.9	1.3
Pedestrians	-	-	-	3	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Harbourside Transportation Consultants
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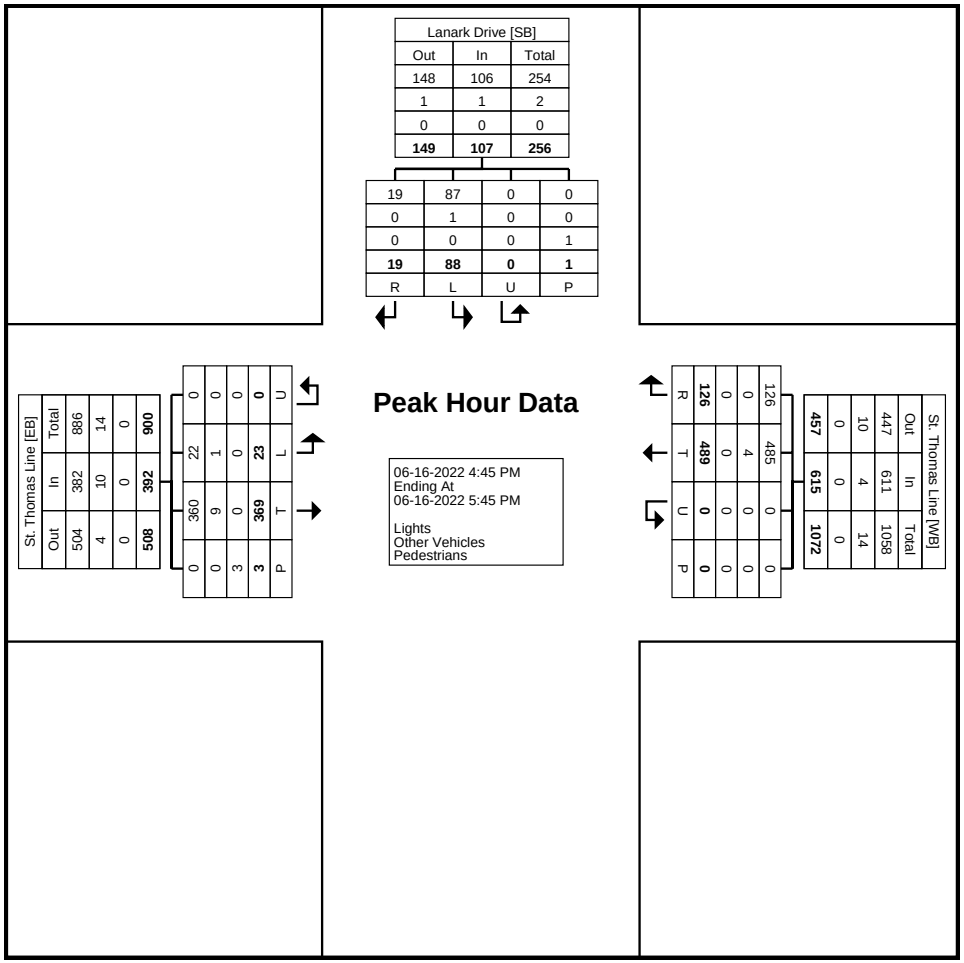
905-405-4696

Count Name: St. Thomas Line & Lanark Drive
Site Code:
Start Date: 06-16-2022



Turning Movement Peak Hour Data Plot (4:45 PM)

Appendix B: Existing Operations Synchro Reports

Intersection	
Int Delay, s/veh	0.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	435	8	9	149	10	21
Future Vol, veh/h	435	8	9	149	10	21
Conflicting Peds, #/hr	0	1	1	0	0	6
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	11	6	2	5
Mvmt Flow	453	8	9	155	10	22

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	462	0	631	464
Stage 1	-	-	-	-	458	-
Stage 2	-	-	-	-	173	-
Critical Hdwy	-	-	4.21	-	6.42	6.25
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.299	-	3.518	3.345
Pot Cap-1 Maneuver	-	-	1053	-	445	592
Stage 1	-	-	-	-	637	-
Stage 2	-	-	-	-	857	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1052	-	441	588
Mov Cap-2 Maneuver	-	-	-	-	441	-
Stage 1	-	-	-	-	636	-
Stage 2	-	-	-	-	849	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	12.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	531	-	-	1052	-
HCM Lane V/C Ratio	0.061	-	-	0.009	-
HCM Control Delay (s)	12.2	-	-	8.5	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Intersection	
Int Delay, s/veh	4.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	38	398	225	37	90	56
Future Vol, veh/h	38	398	225	37	90	56
Conflicting Peds, #/hr	2	0	0	2	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	8	6	10	5	8	5
Mvmt Flow	46	485	274	45	110	68

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	321	0	-	0	876	302
Stage 1	-	-	-	-	299	-
Stage 2	-	-	-	-	577	-
Critical Hdwy	4.18	-	-	-	6.48	6.25
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	2.272	-	-	-	3.572	3.345
Pot Cap-1 Maneuver	1206	-	-	-	312	731
Stage 1	-	-	-	-	739	-
Stage 2	-	-	-	-	550	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1203	-	-	-	295	727
Mov Cap-2 Maneuver	-	-	-	-	295	-
Stage 1	-	-	-	-	699	-
Stage 2	-	-	-	-	549	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	22.4
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1203	-	-	-	382
HCM Lane V/C Ratio	0.039	-	-	-	0.466
HCM Control Delay (s)	8.1	0	-	-	22.4
HCM Lane LOS	A	A	-	-	C
HCM 95th %tile Q(veh)	0.1	-	-	-	2.4

Intersection	
Int Delay, s/veh	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	322	14	27	486	13	10
Future Vol, veh/h	322	14	27	486	13	10
Conflicting Peds, #/hr	0	2	2	0	2	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	7	2	2	2	10
Mvmt Flow	343	15	29	517	14	11

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	360	0	930	353
Stage 1	-	-	-	-	353	-
Stage 2	-	-	-	-	577	-
Critical Hdwy	-	-	4.12	-	6.42	6.3
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.39
Pot Cap-1 Maneuver	-	-	1199	-	297	673
Stage 1	-	-	-	-	711	-
Stage 2	-	-	-	-	562	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1196	-	289	671
Mov Cap-2 Maneuver	-	-	-	-	289	-
Stage 1	-	-	-	-	710	-
Stage 2	-	-	-	-	547	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	15
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	384	-	-	1196	-
HCM Lane V/C Ratio	0.064	-	-	0.024	-
HCM Control Delay (s)	15	-	-	8.1	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.1	-

Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	23	369	489	126	88	19
Future Vol, veh/h	23	369	489	126	88	19
Conflicting Peds, #/hr	1	0	0	1	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	2	2	2	2	2
Mvmt Flow	24	388	515	133	93	20

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	649	0	-	0	1019	586
Stage 1	-	-	-	-	583	-
Stage 2	-	-	-	-	436	-
Critical Hdwy	4.14	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.236	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	927	-	-	-	263	510
Stage 1	-	-	-	-	558	-
Stage 2	-	-	-	-	652	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	926	-	-	-	254	508
Mov Cap-2 Maneuver	-	-	-	-	254	-
Stage 1	-	-	-	-	539	-
Stage 2	-	-	-	-	651	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	26.4
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	926	-	-	-	279
HCM Lane V/C Ratio	0.026	-	-	-	0.404
HCM Control Delay (s)	9	0	-	-	26.4
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	1.9

Appendix C: 5-Year Background Operations Synchro Reports

Intersection	
Int Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	457	11	14	158	19	36
Future Vol, veh/h	457	11	14	158	19	36
Conflicting Peds, #/hr	0	1	1	0	0	6
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	11	6	2	5
Mvmt Flow	476	11	15	165	20	38

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	488	0	678	489
Stage 1	-	-	-	-	483	-
Stage 2	-	-	-	-	195	-
Critical Hdwy	-	-	4.21	-	6.42	6.25
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.299	-	3.518	3.345
Pot Cap-1 Maneuver	-	-	1030	-	418	573
Stage 1	-	-	-	-	620	-
Stage 2	-	-	-	-	838	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1029	-	411	569
Mov Cap-2 Maneuver	-	-	-	-	411	-
Stage 1	-	-	-	-	619	-
Stage 2	-	-	-	-	825	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	13.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	502	-	-	1029	-
HCM Lane V/C Ratio	0.114	-	-	0.014	-
HCM Control Delay (s)	13.1	-	-	8.5	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	40	418	236	39	95	59
Future Vol, veh/h	40	418	236	39	95	59
Conflicting Peds, #/hr	2	0	0	2	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	8	6	10	5	8	5
Mvmt Flow	49	510	288	48	116	72

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	338	0	-	0	922	317
Stage 1	-	-	-	-	314	-
Stage 2	-	-	-	-	608	-
Critical Hdwy	4.18	-	-	-	6.48	6.25
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	2.272	-	-	-	3.572	3.345
Pot Cap-1 Maneuver	1188	-	-	-	293	717
Stage 1	-	-	-	-	727	-
Stage 2	-	-	-	-	532	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1185	-	-	-	275	713
Mov Cap-2 Maneuver	-	-	-	-	275	-
Stage 1	-	-	-	-	683	-
Stage 2	-	-	-	-	531	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	25.4
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1185	-	-	-	360
HCM Lane V/C Ratio	0.041	-	-	-	0.522
HCM Control Delay (s)	8.2	0	-	-	25.4
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	2.9

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	339	24	44	512	19	20
Future Vol, veh/h	339	24	44	512	19	20
Conflicting Peds, #/hr	0	2	2	0	2	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	7	2	2	2	10
Mvmt Flow	361	26	47	545	20	21

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	389	0	1017	376
Stage 1	-	-	-	-	376	-
Stage 2	-	-	-	-	641	-
Critical Hdwy	-	-	4.12	-	6.42	6.3
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.39
Pot Cap-1 Maneuver	-	-	1170	-	263	653
Stage 1	-	-	-	-	694	-
Stage 2	-	-	-	-	525	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1167	-	251	651
Mov Cap-2 Maneuver	-	-	-	-	251	-
Stage 1	-	-	-	-	693	-
Stage 2	-	-	-	-	503	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	16.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	366	-	-	1167	-
HCM Lane V/C Ratio	0.113	-	-	0.04	-
HCM Control Delay (s)	16.1	-	-	8.2	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.4	-	-	0.1	-

Intersection	
Int Delay, s/veh	3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	24	388	514	132	92	20
Future Vol, veh/h	24	388	514	132	92	20
Conflicting Peds, #/hr	1	0	0	1	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	2	2	2	2	2
Mvmt Flow	25	408	541	139	97	21

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	681	0	-	0	1070	615
Stage 1	-	-	-	-	612	-
Stage 2	-	-	-	-	458	-
Critical Hdwy	4.14	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.236	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	902	-	-	-	245	491
Stage 1	-	-	-	-	541	-
Stage 2	-	-	-	-	637	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	901	-	-	-	236	489
Mov Cap-2 Maneuver	-	-	-	-	236	-
Stage 1	-	-	-	-	521	-
Stage 2	-	-	-	-	636	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	29.8
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	901	-	-	-	260
HCM Lane V/C Ratio	0.028	-	-	-	0.453
HCM Control Delay (s)	9.1	0	-	-	29.8
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	2.2

Appendix D: 5-Year Total Operations Synchro Reports

Intersection	
Int Delay, s/veh	1.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	457	13	17	158	24	45
Future Vol, veh/h	457	13	17	158	24	45
Conflicting Peds, #/hr	0	1	1	0	0	6
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	2	2	11	6	2	5
Mvmt Flow	476	14	18	165	25	47

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	491	0	685	490
Stage 1	-	-	-	-	484	-
Stage 2	-	-	-	-	201	-
Critical Hdwy	-	-	4.21	-	6.42	6.25
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.299	-	3.518	3.345
Pot Cap-1 Maneuver	-	-	1027	-	414	572
Stage 1	-	-	-	-	620	-
Stage 2	-	-	-	-	833	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1026	-	406	568
Mov Cap-2 Maneuver	-	-	-	-	406	-
Stage 1	-	-	-	-	619	-
Stage 2	-	-	-	-	818	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	13.4
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	499	-	-	1026	-
HCM Lane V/C Ratio	0.144	-	-	0.017	-
HCM Control Delay (s)	13.4	-	-	8.6	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.5	-	-	0.1	-

Intersection	
Int Delay, s/veh	6.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	43	418	236	44	108	68
Future Vol, veh/h	43	418	236	44	108	68
Conflicting Peds, #/hr	2	0	0	2	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	8	6	10	5	8	5
Mvmt Flow	52	510	288	54	132	83

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	344	0	-	0	931	320
Stage 1	-	-	-	-	317	-
Stage 2	-	-	-	-	614	-
Critical Hdwy	4.18	-	-	-	6.48	6.25
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	2.272	-	-	-	3.572	3.345
Pot Cap-1 Maneuver	1182	-	-	-	289	714
Stage 1	-	-	-	-	725	-
Stage 2	-	-	-	-	529	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1179	-	-	-	270	710
Mov Cap-2 Maneuver	-	-	-	-	270	-
Stage 1	-	-	-	-	679	-
Stage 2	-	-	-	-	528	-

Approach	EB	WB	SB
HCM Control Delay, s	0.8	0	29.5
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1179	-	-	-	355
HCM Lane V/C Ratio	0.044	-	-	-	0.605
HCM Control Delay (s)	8.2	0	-	-	29.5
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	3.8

Intersection	
Int Delay, s/veh	1.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	339	30	54	512	23	26
Future Vol, veh/h	339	30	54	512	23	26
Conflicting Peds, #/hr	0	2	2	0	2	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	25	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	7	2	2	2	10
Mvmt Flow	361	32	57	545	24	28

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	395	0	1040	379
Stage 1	-	-	-	-	379	-
Stage 2	-	-	-	-	661	-
Critical Hdwy	-	-	4.12	-	6.42	6.3
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.39
Pot Cap-1 Maneuver	-	-	1164	-	255	651
Stage 1	-	-	-	-	692	-
Stage 2	-	-	-	-	514	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1161	-	241	649
Mov Cap-2 Maneuver	-	-	-	-	241	-
Stage 1	-	-	-	-	691	-
Stage 2	-	-	-	-	488	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	16.6
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	362	-	-	1161	-
HCM Lane V/C Ratio	0.144	-	-	0.049	-
HCM Control Delay (s)	16.6	-	-	8.3	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	0.5	-	-	0.2	-

Intersection	
Int Delay, s/veh	3.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	30	388	514	151	103	24
Future Vol, veh/h	30	388	514	151	103	24
Conflicting Peds, #/hr	1	0	0	1	0	3
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	4	2	2	2	2	2
Mvmt Flow	32	408	541	159	108	25

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	701	0	-	0	1094	625
Stage 1	-	-	-	-	622	-
Stage 2	-	-	-	-	472	-
Critical Hdwy	4.14	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.236	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	887	-	-	-	237	485
Stage 1	-	-	-	-	535	-
Stage 2	-	-	-	-	628	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	886	-	-	-	225	483
Mov Cap-2 Maneuver	-	-	-	-	225	-
Stage 1	-	-	-	-	509	-
Stage 2	-	-	-	-	627	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	34.8
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	886	-	-	-	250
HCM Lane V/C Ratio	0.036	-	-	-	0.535
HCM Control Delay (s)	9.2	0	-	-	34.8
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	2.9

Appendix E: Traffic Signal Warrant

Town of Paradise - Traffic Signal & Pedestrian Signal Head Warrant Analysis

Main Street (name)	**St Thomas Line**	**Direction (EW or NS)**	**EW**	**Road Authority:**	**Town of Paradise**
Side Street (name)	**Lanark Drive**	**Direction (EW or NS)**	**NS**	**City:**	**Paradise, NL**
Quadrant / Int #		**Comments**	**Enter Comments about the analysis here.**	**Analysis Date:**	**2022 Jul 06, Wed**
				Count Date:	**2022 Jun 16, Thu**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**			**Date Entry Format:**	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	RT Channelization (y/n)	UpStream Signal (m)	# of Thru Lanes	LT Phase Type	RTOR Allowed (y/n)	Actuated Thru Phase
St Thomas Line	WB					1		n	650	1	perm	y	n
St Thomas Line	EB		1					n	2,000	1	perm	y	n
Lanark Drive	NB							n	2,000	0	perm	y	n
Lanark Drive	SB				1			n	2,000	1	perm	y	n

Are the Lanark Drive SB right turns significantly impeded by through movements? (y/n)	n
Are the St Thomas Line WB right turns significantly impeded by through movements? (y/n)	n
	y
	y

Saturation Flow Rates (if not default) (vphpl)		**Default Saturation Flow Rates (vphpl)**
Left Turn		1,650
Through		1,800
Right Turn		1,500

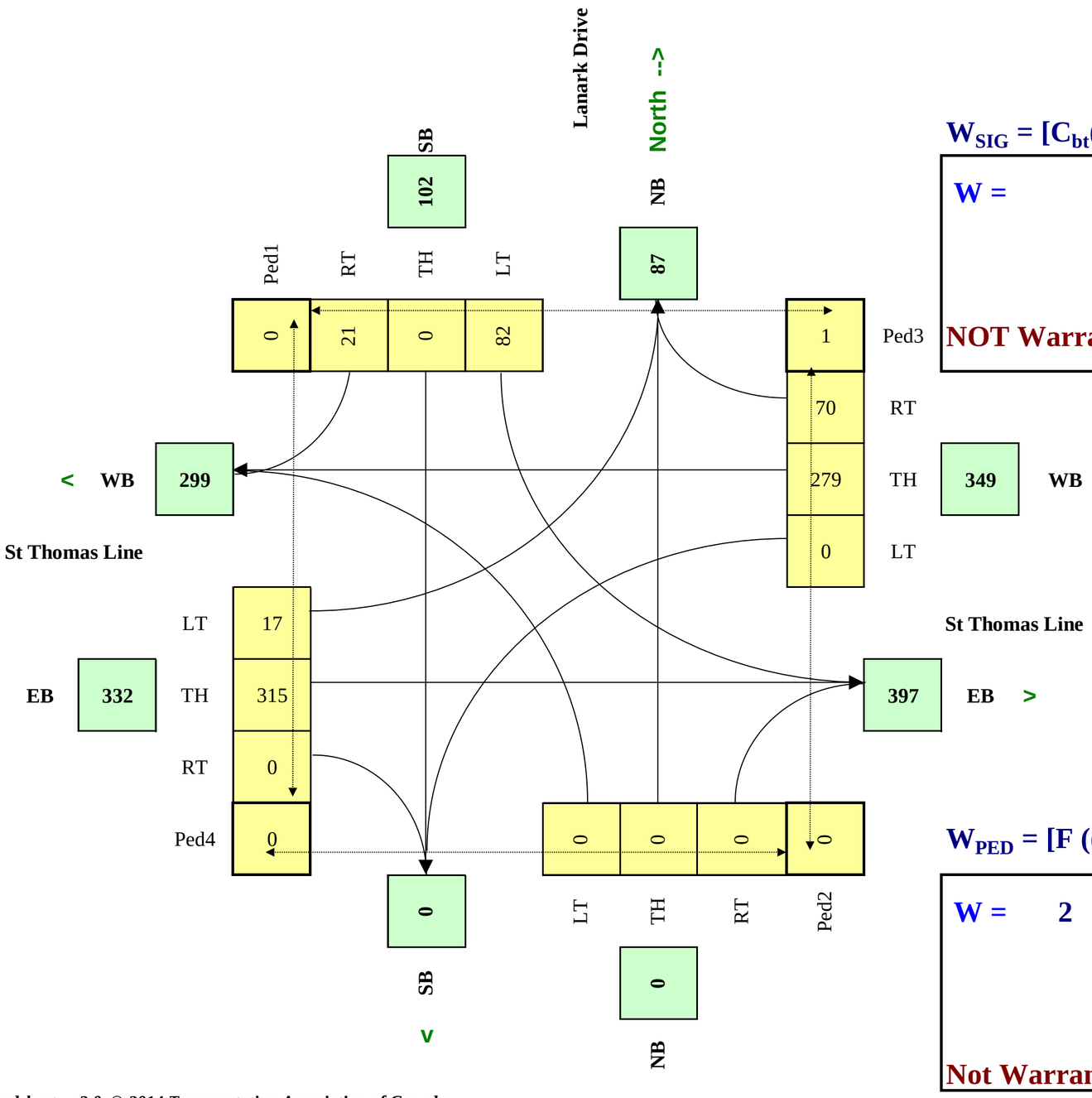
Demographics		
Elem. School/Mobility Challenged	(y/n)	y
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	y
Metro Area Population	(#)	22,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
St Thomas Line	EW	50	3.0%	n	
Lanark Drive	NS		3.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1 NS**	**Ped2 NS**	**Ped3 EW**	**Ped4 EW**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**W Side**	**E Side**	**N Side**	**S Side**
7:00 - 8:00				99		12		130	33	1	307		0	0	0	0
				90		56		225	37	38	398		0	0	2	0
				59		4		173	54	9	204		0	0	0	0
				77		10		255	66	7	233		0	0	1	0
				72		20		442	125	19	362		0	0	3	0
				92		22		446	107	25	387		0	0	1	0
Total (6-hour peak)	**0**	**0**	**0**	**489**	**0**	**124**	**0**	**1,671**	**422**	**99**	**1,891**	**0**	**0**	**0**	**7**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**82**	**0**	**21**	**0**	**279**	**70**	**17**	**315**	**0**	**0**	**0**	**1**	**0**
Actual Pedestrian Crossing Distance (m)													20.0	14.0	14.0	14.0

Average 6-hour Peak Turning Movements



$W_{SIG} = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$

W =	36	36	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

$W_{PED} = [F\,((Xped_m)d_m/K_2) + (Xped_s)d_s/K_3)]$

W = 2

Not Warranted - Ped Vol<25(avg)