Traffic Impact Study & Parking Justification Report
River Road East Apartment Development, Town of Wasaga Beach

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June 2017
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REGISTERED PROFESSIONAL ENGINEER
June 29/17
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PROVINCE OF ONTARIO

Executive Summary

This Traffic Impact / Parking Justification Study (TIPS) has reviewed the traffic impacts and parking requirements associated with developing a residential development in the Town of Wasaga Beach. Bremont Homes Corporation proposes to develop a 50-unit 4-storey condominium apartment totaling 1368.86 m^2 at 60-90 River Road East. This TIPS has been prepared to support the applications for an Official Plan Amendment, Zoning Amendment and Site Plan Approval for the subject development.

Traffic impacts have been assessed at the intersection of River Road East / Beck Street, as well as the proposed Site Access. Traffic impacts have been assessed for horizon years 2024 and 2029. Forecasted traffic volumes have also included growth in background traffic in this area.

Based on the analysis completed, the following primary conclusions and recommendations are made in this study:

- The proposed development is forecast to generate about 15 vehicles per hour (vph) in the a.m. peak hour and 19 vph in the p.m. peak hour.
- A southbound left-turn lane with a 15 m storage length is warranted at the River Road East / Beck Street intersection under existing (2017) traffic conditions. Under 2024 and 2029 background the warranted storage for this southbound left-turn lane increases to 25 m. The proposed development will not have any impact on these warrant requirements, since it does not contribute to this traffic movement and contributes only a relatively small volume of traffic into the intersection.
- A northbound left-turn lane is not warranted at the River Road East / Beck Street intersection through horizon period 2029, since the forecasted volume of left-turning vehicles is too low to meet the warrant requirements.
- Right-turn lanes or tapers are not warranted at the intersection of River Road East / Beck Street through horizon year 2029.
- The traffic movement from the west leg of Beck Street onto River Road East (i.e., access from the proposed development) is forecasted to operate with a Level of Service (LOS) F by horizon year 2029, with a delay of 78 seconds and a volume/capacity (v/c) ratio of 0.15, during the p.m. peak hour period. While this delay is considered significant, the reserve capacity for this movement indicates that sufficient gaps are available to allow for acceptable operations.
- The traffic movement from the east leg of Beck Street onto River Road East is forecasted to operate with a LOS F by horizon year 2029, with a delay of 67 seconds and a v/c ratio of 0.50, during the p.m. peak hour period. While this delay is considered significant, the reserve capacity for this movement indicates that sufficient gaps are available to allow for acceptable operations.
- No traffic queuing issues were identified at the intersection of River Road East / Beck Street, based on the queuing analysis completed.

- The desirable turning sight distance, as well as the minimum stopping sight distance at the River Road East / Beck Street intersection meets the guidelines of the Ministry of Transportation and of the Town. The west leg of Beck Street essentially functions as a short driveway to the developments (i.e., proposed apartment development and Pier 24), with minor traffic volumes, and therefore does not justify the need for daylight triangles. The geometrics at this intersection adequately support all traffic movements, without modification.
- River Road East (two-lane facility) provides sufficient link capacity to beyond horizon year 2029, although operations at intersections along the corridor should be optimized (e.g., through the addition of turning lanes, where required, to maintain traffic mobility.
- The shoulders have been paved along both sides of River Road East, providing a pedestrian and cyclist connection along the roadway in this area. A concrete sidewalk is also proposed on the River Road East right-of-way, along the frontage of the development, with the apartment connected to this sidewalk via internal walkways.
- The location of the proposed development is relatively close to the existing, and planned, recreational and commercial areas in the Town. Therefore there is a high potential for active transportation modes of travel to be utilized, in lieu of auto modes.
- The Active Transportation Plan for the Town of Wasaga Beach (Meridian Planning Consultants Inc., August 2008) proposed a potential "Nancy Island Recreational Trail Loop" that would connect Nancy Island on the Nottawasaga River to both sides of the River via proposed pedestrian bridge crossings at the existing dead-end sections of Beck Street and 2nd Street. This potential connection has not been programmed and therefore its implementation is indeterminate at this time.
- The Town's existing transit system (Wasaga Beach Transit) currently services River Road East, with a bus stop located at Main Street, which adequately services the proposed development.
- The proposed amount of parking (57 spaces) does not meet the Town's Zoning By-law requirements, however, based on site specific considerations this parking supply is considered to be sufficient to meet the demands of the residents and visitors of the apartment building.

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1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) has been retained by Bremont Homes Corporation (Bremont Homes) to prepare a Traffic Impact / Parking Justification Study (TIPS) in support of a proposed residential condominium apartment development in the Town of Wasaga Beach (Town).

It has been requested that Bremont Homes submit a TIPS as part of their overall submission to the Town for Official Plan Amendment, Zoning By-law Amendment and Site Plan Approval, which are required in order to permit the proposed development to proceed. This TIPS will support the planning level approvals by demonstrating how the subject lands can be serviced with transportation infrastructure and identifying impacts on the broader transportation network.

1.1 Site Description

The development location is shown in Figure 1 below. Bremont Homes proposed to develop a 1.593 acre parcel of land located at 60-90 River Road East in the Town of Wasaga Beach and County of Simcoe. The property currently lies within the Official Plan land use designation “Tourism Accommodation”, with a CA-14 Zoning (Accommodation Commercial Zone). It is proposed that the site be designated residential with a R4 (Apartments) zoning.

To the northwest, the property is bounded by the Nottawasaga River. Approximately 300 m northwest of the proposed development is Beach Area 1 of Wasaga Beach

To the southeast, the property is bounded by River Road East.

To the northeast, the property is bounded by a single family residential unit; immediately northeast of this unit is an existing tourist accommodation development (Pinecrest Cabins & Cottages).

To the southwest, the property is bounded by Beck Street, which currently provides access to an existing residential development (Pier 24 Condominiums).

A total of 50 residential condominium apartment units (consisting of one and two bedroom units) have been proposed on the site in a 4-storey building. The total area of the proposed apartment building is 1,368.86 m^2 (14,734.28 ft^2). There is one proposed access to the apartment development on Beck Street (the west leg of the Beck Street / River Road East intersection). There are a total of 57 parking spaces proposed for the development, consisting of 40 underground spaces (in a parking garage beneath the apartment building) and 17 surface spaces. A Site Plan has been prepared for the development by ISM Architects, and is shown in Figure 2.

Figure 1 – Site Location

LEGAL DESCRIPTION

LOTS 60 & 90, RIVER ROAD EAST, TOWN OF WASAGA BEACH
REGISTERED PLAN 648

COMBINED SITE INFORMATION

SITE ZONING	R4 (APARTMENTS)	
SITE AREA	6446.65 m² (1.593 ACRES)	
BUILDING AREA	1368.86 m² (14,734.28 sq. ft.)	
STANDARDS	REQUIRED BY-LAW	PROVIDED
LOT AREA (135m2/ UNIT)	835 m² MIN.	6446.65 m²
LOT FRONTAGE	30.0 m MIN.	106.11 m
FRONT YARD, (SOUTH)	6.0 m MIN.	10.5 m
SIDE YARD, (EAST)	6.0 m MIN.	6.0 m
SIDE YARD, (WEST)	6.0 m MIN.	19.78 m
REAR YARD (NORTH)	6.0 m MIN.	22.90 m
LOT COVERAGE (MAX. % OF SITE AREA)	MAX. 35%	21.5%
LANDSCAPED OPEN SPACE	MIN. 35%	4404.56m² (68.32%)
HT. OF MAIN BUILDINGS	12.0 m	-- m
PARKING & DRIVEWAY AREA		683.23m² (10.59%)
AISLE WIDTH	6 m MIN.	6 m
AREA OF FRONT YARD		--
AREA OF FRONT YARD LANDSCAPED		
NUMBER OF PARKING SPACES	88 SPACES (@1.75 SPACES /UNIT)	57 SPACES
NUMBER OF APT. UNITS		50

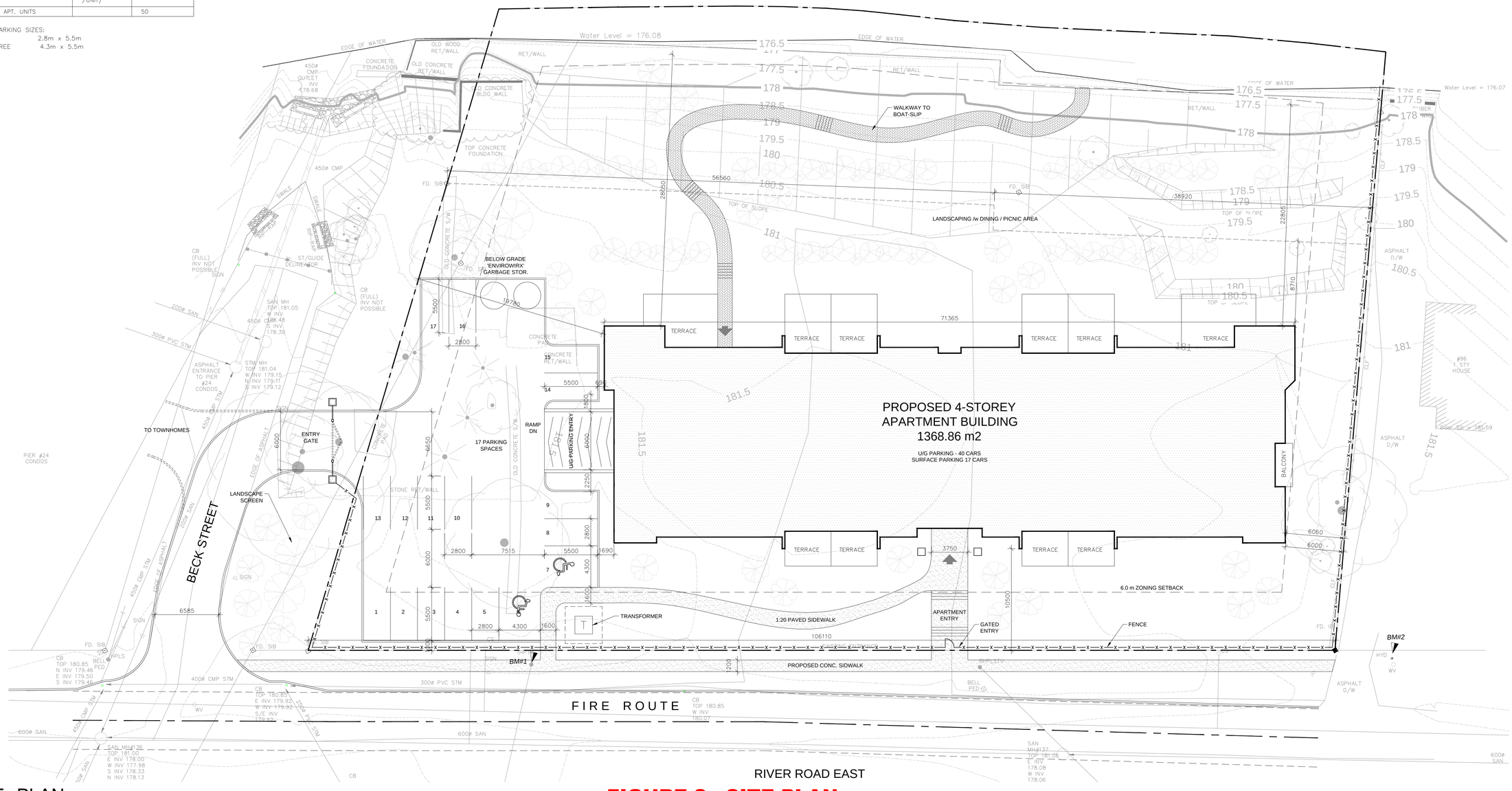
MINIMUM PARKING SIZES:
STANDARD 2.8m x 5.5m
BARRIER-FREE 4.3m x 5.5m

FLOOR AREAS

	GFA	SFA
U/G PARKING	1368.86 m2	--
FIRST FLOOR	1368.86 m2	1124.88 m
SECOND FLOOR	1368.86 m2	1230.21 m2
THIRD FLOOR	1368.86 m2	1230.21 m2
FOURTH FLOOR	1368.86 m2	1230.21 m2
AMENITY ROOFTOP	148.13 m2	--
TOTAL (NO ROOFTOP)	6844.30 m2	4815.51 m2

KEY PLAN

NOTTAWASAGA RIVER



SITE PLAN 1:250

FIGURE 2 - SITE PLAN

ISM ARCHITECTS
174 Bayfield Street
Barrie, ON L4M 3B5
T: 705.726.2342
E: ian@ismarchitects.ca

No.	ISSUE/ REVISION	DATE
1.	ISSUE FOR CLIENT REVIEW	FEB 24/17
2.	CLIENT CHANGES	MAR 10/17
3.	CLIENT CHANGES	MAR 14/17
4.	REZONING	MAR 17/17
5.	REVS'D FOR MODULARITY	JUN 13/17
6.	GFA'S/ ISSUE FOR REVIEW	JUN 16/17

STAMP
ONTARIO ASSOCIATION OF ARCHITECTS
IAN S. MALCOLM
LICENCE 2853

DO NOT SCALE DRAWINGS.
THE CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS AND REPORT ALL ERRORS AND OMISSIONS TO THE ARCHITECT BEFORE PROCEEDING WITH THE WORK.

DETAIL No. WHERE DETAILED
SHEET No. WHERE DETAILED

ORIENTATION

CLIENT
BREMONT HOMES CORP.
4908 HWY 7
WOODBRIDGE, ON
L4L 1S8
T: 905.266.1851

PROJECT
BREMONT APARTMENTS
48 UNIT 4-STOREY
60-90 RIVER ROAD, WASAGA BEACH, ON

PROJECT INFORMATION
PROJECT No.: 173914
DRAWN BY: MN
CHECKED BY: ISM
DATE: 21.06.2017
SCALE: AS NOTED

DRAWING
SITE PLAN

DRAWING No.
A100

173914 RIVER ROAD WASAGA SP7

1.2 Background Information

The following documents have been reviewed as background for this TIS:

- The Town of Wasaga Beach Downtown Development Master Plan (FORREC Limited et al., March 2017).
- Town of Wasaga Beach 2012 Transportation Study Update (Ainley Group, January 2013).
- Active Transportation Plan for the Town of Wasaga Beach (Meridian Planning Consultants Inc., August 2008).
- Official Plan of the Town of Wasaga Beach, Office Consolidation February 2016.
- Town of Wasaga Beach Comprehensive Zoning By-law 2003-60, Office Consolidation February 2016.
- Town of Wasaga Beach Engineering Standards (Town of Wasaga Beach, March 2015).
- Town of Wasaga Beach Road Needs Study 2013 (C.C. Tatham & Associates Limited, September 2013).

2.0 Existing Conditions

2.1 Study Area Road Network

The Study Area includes the transportation facilities linking the proposed development to the adjacent road network. The following intersection has been included in this study:

- River Road East / Beck Street.

The proposed development access on Beck Street will be located approximately 28.5 m northwest of River Road East, opposite the access to the townhome development southwest of the site (Pier 24 Condominiums).

The Proposed Site Access is assumed to be stop-controlled at its intersection with Beck Street. The Access will consist of one inbound and one outbound lane, and will be a gated entry. It will be 7.3 m wide, and is the only vehicular access proposed for the development.

River Road East is a two-lane arterial road in the vicinity of the proposed development and is under the jurisdiction of the Town of Wasaga Beach. River Road East runs northeast-southwest in the Study Area; however for the purposes of this current study it has been assumed that River Road East runs north-south. The posted speed limit on River Road East is 50 km/h.

Beck Street is a two-lane local road in the vicinity of the proposed development. It is classified as a collector road between Main Street and River Road West (southeast of the Study Area). Beck Street runs northwest-southeast in the Study Area; however for the purposes of this current study it has been assumed that Beck Street runs east-west. The speed limit on Beck Street is not posted on Beck Street and therefore is assumed to be 50 km/h.

The intersection of Beck Street / River Road East is a four-leg intersection with stop-sign controls on both of the Beck Street approaches, with traffic on River Road East running freely through the intersection. All movements are permitted at each leg of the intersection (i.e., left-through-right movements). The west leg of Beck Street is slightly offset from the east leg of Beck Street at the intersection (approximately 15 m). Considering the proximity of the two legs of Beck Street to each other, this study has conservatively analyzed traffic operations at this intersection as a cross intersection.

2.2 Other Developments and Proposed Road Improvements

The Town of Wasaga Beach Downtown Development Master Plan (FORREC Limited et al., March 2017) indicates several proposed future street network changes. Some of the proposed changes include additional road linkages between Beck Street with Main Street and River Road East, as well as a linkage between River Road East and the

northern limit of Laidlaw Street. Also proposed is a roundabout at the intersection of Main Street and Beck Street, and a Master Plan for the redevelopment of Main Street. Given the preliminary nature of these Master Plan studies, it is assumed in this current study that any road network adjustments made in the vicinity of the proposed development will occur beyond the horizon periods considered.

No other new developments or proposed road network improvements have been identified in the Study Area within the time period considered in this study. In addition it is assumed that ongoing development in these areas is adequately captured by the traffic growth rates used in traffic forecasting.

3.0 Background Traffic Forecasts

3.1 Study Horizon Periods

Considering the scope of the proposed development, as well as the assumption that the development will be fully built-out and occupied by 2019, the following study horizons (cumulatively) are considered appropriate for consideration of traffic impacts:

- Horizon Year 2017 – Existing Conditions
  - Existing background traffic conditions, taking into consideration peak seasonal traffic volumes.
- Horizon Year 2024 – Five Year Horizon (i.e., 5 years post build-out)
  - Addition of background traffic growth; and
  - Addition of full development traffic (50 apartment units).
- Horizon Year 2029 – Ten Year Horizon (i.e., 10 years post build-out)
  - Addition of background traffic growth.

3.2 Phasing of Development

As noted previously, it has been assumed that the proposed development will be fully built-out and occupied by 2019.

3.3 Time Periods for Traffic Analysis

The time periods selected for traffic analysis are based on the type of development proposed. The peak traffic periods considered in this study, for residential development impacts, include the a.m. peak hour and p.m. peak hour of the adjacent roadways. Both peak hours are considered for weekday conditions.

3.4 Seasonal Adjustments for Traffic Volumes

The study area is affected by seasonal traffic fluctuations, due to Wasaga Beach being a major recreational area, attracting significant volumes of day-use tourists and seasonal residents. A Turning Movement Count (TMC) was obtained at the River Road East / Beck Street intersection on June 15, 2017 by Ontario Traffic Incorporated (OTI), which is included in Appendix A. As noted in the *Town of Wasaga 2012 Transportation Study* Update (Ainley Group, January 2013), the June weekday count is considered to represent average traffic conditions. Since traffic volumes in July and August are typically higher in Wasaga Beach, the traffic volumes obtained in the June 15th TMC have been increased by 10% in order to account for peak seasonal conditions.

3.5 Traffic Growth Factors

Based on the traffic forecasts in the *Town of Wasaga Beach Road Needs Study 2013* (C.C. Tatham & Associates Ltd., September 2013), it is forecast that the traffic on River Road East between 2012 and 2032 will grow by 3.32% per annum (compounded) between 2012 and 2032. Similarly, it is forecast that the traffic on Beck Street between 2012 and 2032 will grow by 1.19% per annum (compounded) between 2012 and 2032. These growth rates, as determined from the Town's Road Needs Study, have been used to forecast future background traffic for the various horizon periods considered in this study. Since the traffic on the west leg of Beck Street (providing access to the proposed development) will be fully accounted for once the forecasted trip generation from the proposed development is added to the road network, no growth factor has been applied to traffic going to/from the west leg of Beck Street.

The forecasted growth factors in this study are considered to be significant and take into account the development growth in this area, as well as traffic growth from external areas that may travel through this area.

3.6 Forecast Background Traffic

The existing traffic volumes (weekday a.m. and p.m. peak hours, increased by 10% to account for seasonal variation) are summarized on Figure 3 below. The forecast future background traffic volumes (weekday a.m. and p.m. peak hours), for horizon years 2024 and 2029, are summarized on Figure 4 and Figure 5 below, respectively.

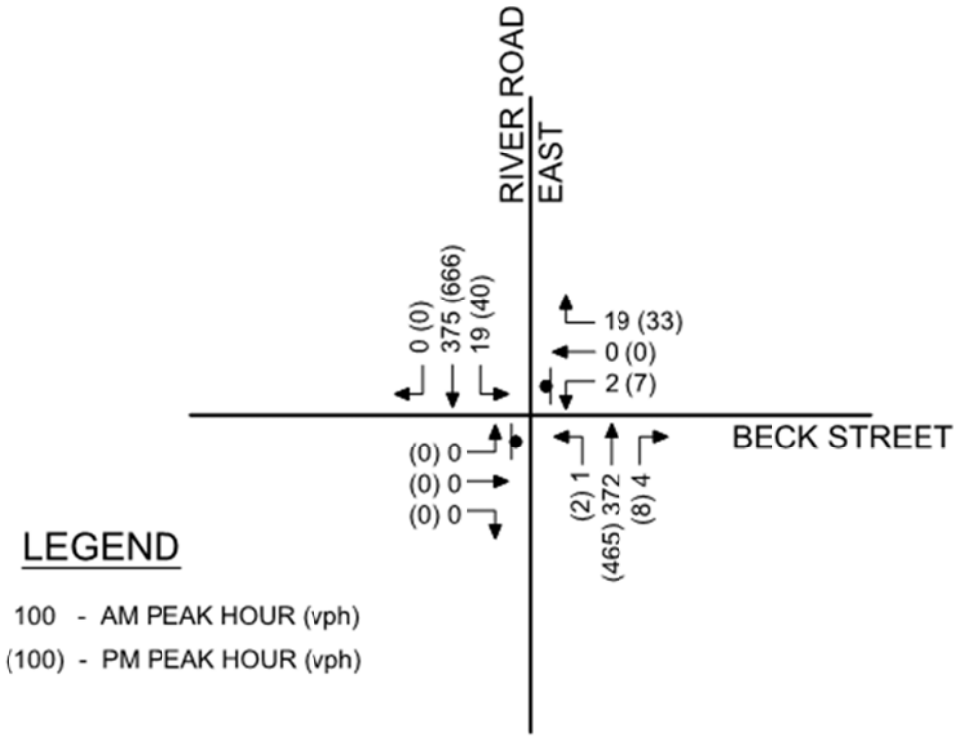


Figure 3 – Existing (2017) Traffic Volumes

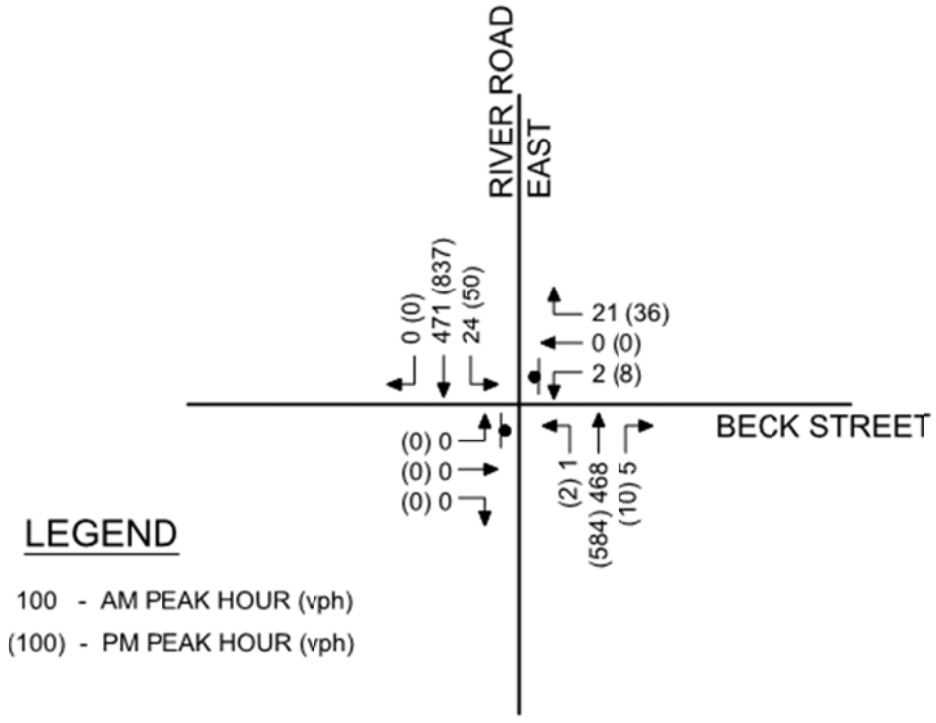


Figure 4 – 2024 Background Traffic Volumes

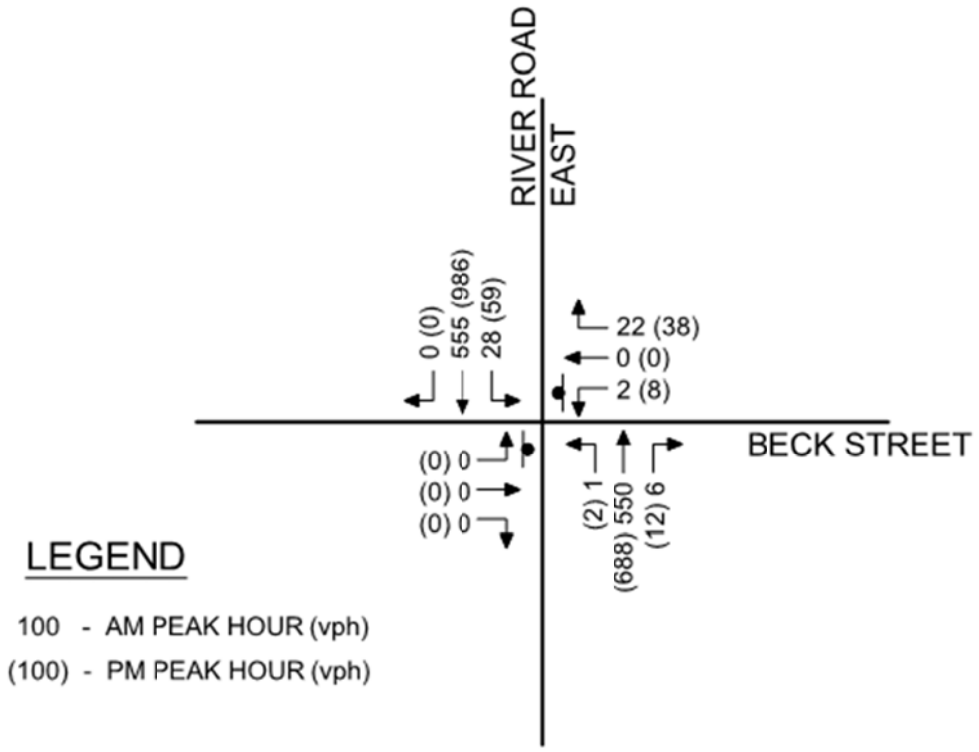


Figure 5 – 2029 Background Traffic Volumes

4.0 Development and Total Traffic Forecasts

4.1 Development Traffic Generation

Site generated traffic volumes from the proposed development have been estimated based on trip rate information contained in the *Trip Generation Manual 9th Edition* (Institute of Transportation Engineers [ITE], 2012), as summarized in the following table:

Table 4.1 – Forecast Trip Generation from Proposed Development – Full Build-out

Land Use	ITE Code	a.m. Peak Hour (vph)		p.m. Peak Hour (vph)	
		In	Out	In	Out
Mid-Rise Apartment (50 units)	223	5	10	11	8

As shown in Table 4.1, the total new trip generation (two-way) for the proposed development is forecasted to be 15 vehicles per hour (vph) in the a.m. peak hour and 19 vph in the p.m. peak hour.

The trip generation from the proposed development has conservatively been based on a Mid-Rise Apartment land use. However, the target market for this development is primarily recreational/seasonal users, as promoted through the amenities provided (e.g., boat slips in the development and close proximity to the adjacent beach areas). The ITE trip generation rates for Recreational Homes (Code 260) is only about 53% of the Mid-Rise Apartment rate in the a.m. peak hour and about 66% of the p.m. peak hour rate. In addition, Bremont Homes estimates that maximum occupancy of these recreational homes may only be 70% at any particular time. These statistics appear to be confirmed by the low peak hour traffic currently being generated by the adjacent Pier 24 Condominium development, which offer similar amenities.

4.2 Trip Distribution

The forecast development traffic has been distributed over the road network according to the logical routing of vehicles to adjacent collector and arterial roads and origin / destination considerations. River Road East provides the arterial road function in the Study Area. In order for drivers to access the majority of commercial and recreational areas in the Town, the most logical route would be to travel to/from the south via River Road East or to/from the east via Beck Street (to get to Main Street). The logical routing for drivers travelling to/from the larger population centres (such as Toronto, Barrie, and Collingwood) would also be to travel south along River Road East or east via Beck Street. Thus, the majority of traffic from the proposed development has been distributed based on these assumptions.

Table 4.2 below summarizes the trip distributions used in this study.

Table 4.2 – Trip Distribution of Traffic from Proposed Development

Road	Direction	a.m. Peak Hour		p.m. Peak Hour	
		To	From	To	From
River Road East	North	20%	20%	20%	20%
	South	50%	50%	50%	50%
Beck Street	East	30%	30%	30%	30%

The forecast turning movement volumes from the proposed development are shown on Figure 6 below.

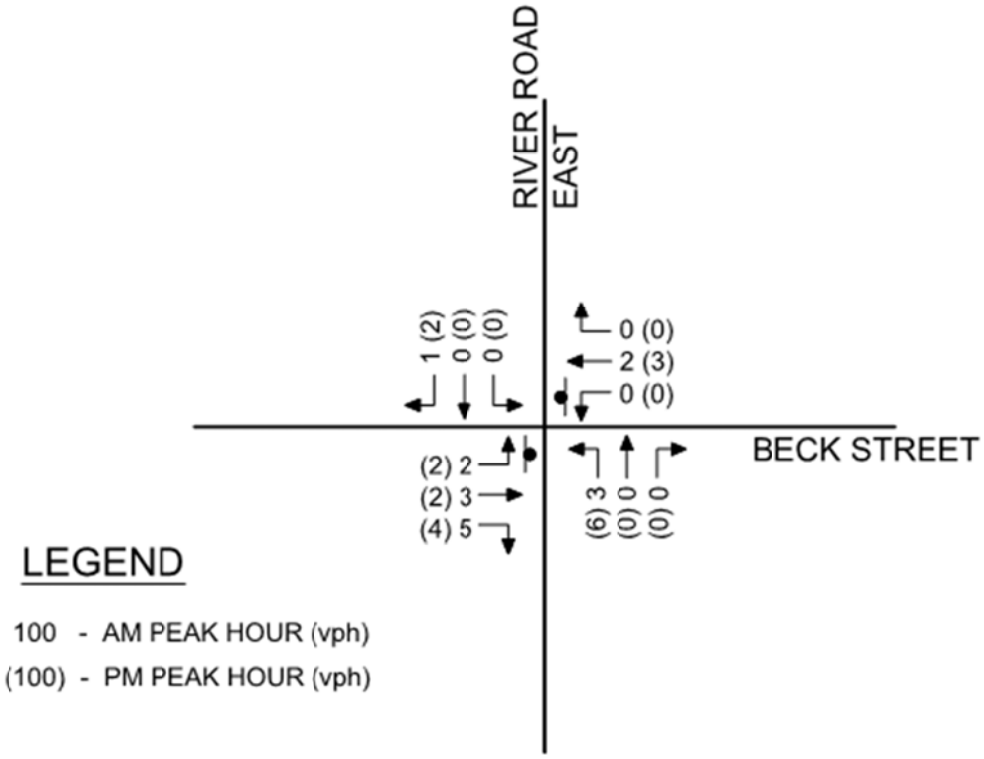


Figure 6 – Forecast Development Traffic Volumes

4.3 Forecast Total Traffic

The development traffic is added to the background traffic (plus growth in background traffic) in order to obtain the forecasted total turning movement volumes. The forecasted total traffic volumes (weekday a.m. and p.m. peak hours) are summarized on Figure 7and Figure 8, for horizon years 2024 and 2029, respectively.

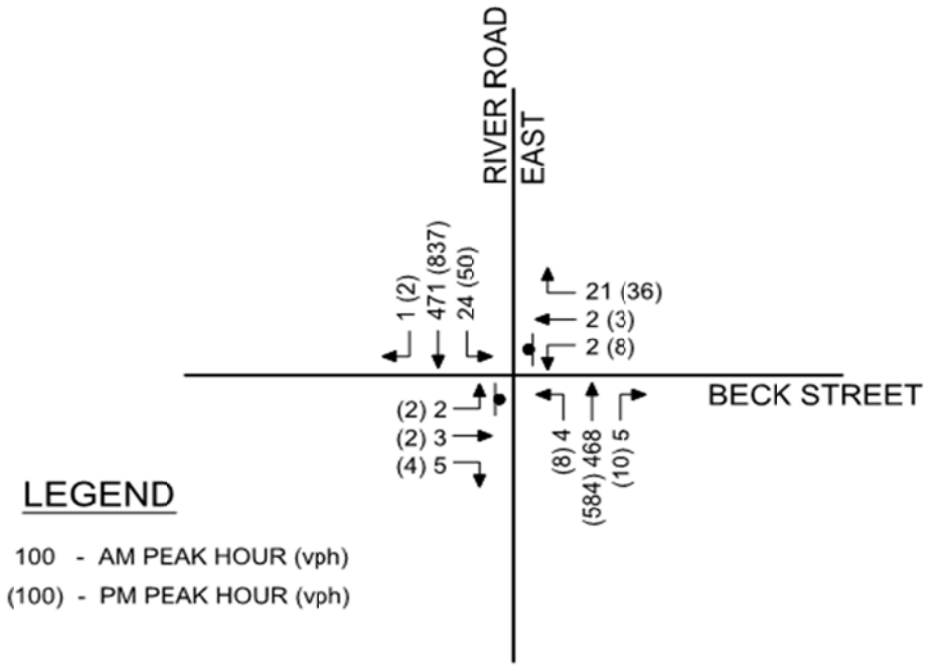


Figure 7 – 2024 Total Traffic Volumes

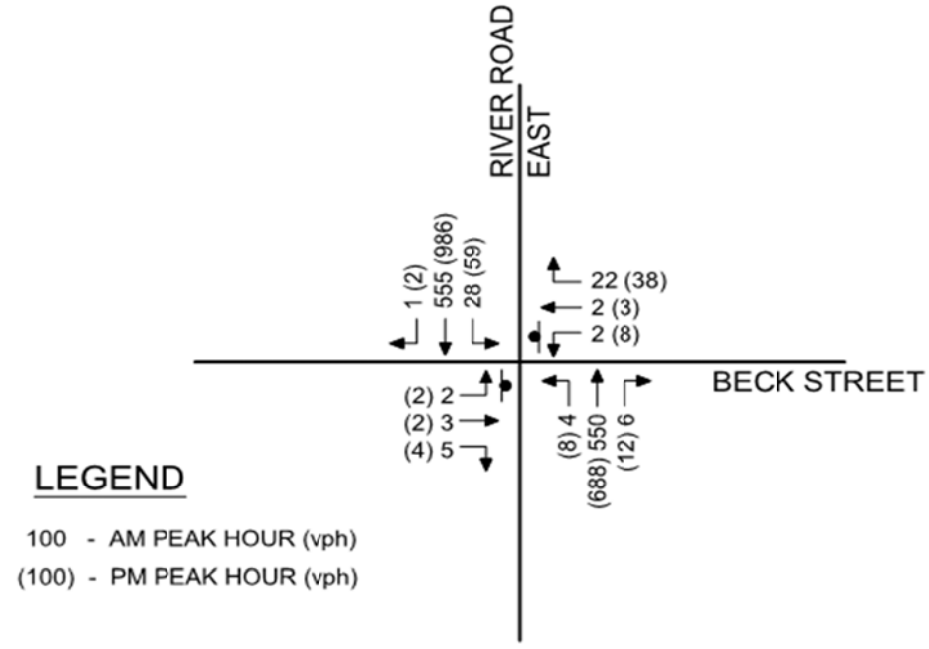


Figure 8 – 2029 Total Traffic Volumes

5.0 Traffic Impact Analysis

5.1 Analysis Criteria and Approach

The traffic operations at the subject intersections in the Study Area have been assessed based on the following criteria:

- Turning lane requirements based on Ministry of Transportation Ontario (MTO) warrant nomographs and criteria (Geometric Design Standards for Ontario Highways).
- Level of Service (LOS, delay) and volume-to-capacity (v/c) ratio at the intersection of River Road East / Beck Street. The LOS is based on criteria in the *Highway Capacity Manual (HCM)*, analyzed using Synchro 9 software.
- Geometric constraints.
- Link volume considerations.

5.2 Left-Turn Lane Requirements

The warrants for left-turn lanes at the River Road East / Beck Street intersection have been assessed based on Ministry of Transportation Ontario (MTO) nomographs. The analysis is based on design speeds of 10 km/h over the posted speeds. The results of the left-turn lane warrant analysis is summarized below in Table 5.1.

Table 5.1 – Left-Turn Lane Warrants at the River Road East & Beck Street Intersection

Left-Turn Storage Lane Warrants				
Design Speed = 60 km/h			**Time Period = Existing Traffic (2017)**	
Approach Direction	Northbound		Southbound	
Peak Hours	Morning	Afternoon	Morning	Afternoon
Advancing Traffic	377	475	394	706
Opposing Traffic	394	706	377	475
Left Turning Traffic	1	2	19	40
Percentage of Left Turning Traffic	0.3%	0.4%	4.8%	5.7%
Figure Used*	N/A	N/A	EA-6	EA-6
Storage Length Required	**0 m**	**0 m**	**0 m**	**15 m**
Design Speed = 60 km/h			**Time Period = Background Traffic (2024)**	
Approach Direction	Northbound		Southbound	
Peak Hours	Morning	Afternoon	Morning	Afternoon
Advancing Traffic	474	597	495	887
Opposing Traffic	495	887	474	597
Left Turning Traffic	1	3	24	50
Percentage of Left Turning Traffic	0.2%	0.5%	4.8%	5.6%
Figure Used*	N/A	N/A	EA-6	EA-6
Storage Length Required	**0 m**	**0 m**	**15 m**	**25 m**

Design Speed = 60 km/h			**Time Period = Total Traffic (2024)**	
Approach Direction	Northbound		Southbound	
Peak Hours	Morning	Afternoon	Morning	Afternoon
Advancing Traffic	477	603	496	889
Opposing Traffic	496	889	477	603
Left Turning Traffic	4	9	24	50
Percentage of Left Turning Traffic	0.8%	1.5%	4.8%	5.6%
Figure Used*	N/A	N/A	EA-6	EA-6
Storage Length Required	**0 m**	**0 m**	**15 m**	**25 m**
Design Speed = 60 km/h			**Time Period = Background Traffic (2029)**	
Approach Direction	Northbound		Southbound	
Peak Hours	Morning	Afternoon	Morning	Afternoon
Advancing Traffic	557	703	583	1,045
Opposing Traffic	583	1,045	557	703
Left Turning Traffic	1	3	28	59
Percentage of Left Turning Traffic	0.2%	0.4%	4.8%	5.6%
Figure Used*	N/A	N/A	EA-6	EA-6
Storage Length Required	**0 m**	**0 m**	**15 m**	**25 m**
Design Speed = 60 km/h			**Time Period = Total Traffic (2029)**	
Approach Direction	Northbound		Southbound	
Peak Hours	Morning	Afternoon	Morning	Afternoon
Advancing Traffic	560	709	584	1,047
Opposing Traffic	584	1,047	560	709
Left Turning Traffic	4	9	28	59
Percentage of Left Turning Traffic	0.7%	1.3%	4.8%	5.6%
Figure Used*	N/A	N/A	EA-6	EA-6
Storage Length Required	**0 m**	**0 m**	**15 m**	**25 m**

* Ministry of Transportation Ontario Geometric Design Standards for Ontario Highways, 1994.

As shown in Table 5.1 above, a southbound left-turn lane with a 15 m storage length is warranted at the River Road East and Beck Street intersection under existing (2017) traffic conditions. Under 2024 and 2029 background traffic conditions, a southbound left-turn lane with a 25 m storage length is warranted. The proposed development will not have any impact on these warrant requirements, since it does not contribute to this traffic movement and contributes only a relatively small volume of traffic into the intersection.

On the intersections northbound approach (i.e., access to the proposed development), the forecast volume of left-turning vehicles is too low to warrant consideration for a left-turn lane (i.e., there are less than 10 forecasted left-turning vehicles in the 2029 total p.m. peak hour).

5.3 Right-Turn Lane Requirements

MTO guidelines (Geometric Design Standards for Ontario Highways) note that right-turn lanes or tapers may be considered where right-turn volumes exceed 60 vph and where right-turning vehicles create a hazard or reduce capacity at an intersection.

Under 2029 total traffic conditions at the River Road East / Beck Street intersection, the largest right-turning movements are 6 vph and 12 vph in the a.m. and p.m. peak hours, respectively. Therefore, since none of the forecast right-turning movements exceed 60 vph in any of the horizon years, it is concluded that a right-turn lane or taper is not warranted through horizon year 2029 (based on volume criteria).

5.4 Operational Level of Service

The intersections within the study area have been analyzed using Synchro 9 software, which uses methodologies based on the *Highway Capacity Manual (HCM)*. The Level of Service (LOS) and volume-to-capacity (v/c) ratio were determined for all movements at the River Road East / Beck Street intersection. The LOS is a measure qualifying the amount of delay experienced by motorists. The delays associated with various LOS are summarized in the following table:

Table 5.2 – Level of Service Delay Criteria

Level of Service	Unsignalized Intersection Average Total Delay (seconds/vehicle)
A	0-10
B	>10-15
C	>15-25
D	>25-35
E	>35-50
F	> 50

It is desirable that turning movements operate at LOS E, or better, and within their capacity. However, traffic movements from minor stop-controlled streets often operate at LOS F during peak periods, which is considered to be acceptable if the v/c ratios indicate that sufficient gaps are available to accommodate these movements.

The Synchro analyses completed for the River Road East / Beck Street intersection are included in Appendix B, and the results are summarized in Table 5.3 (LOS and v/c ratios) and Table 5.4 (95^{th} percentile queuing).

Table 5.3 –Traffic Operations at the River Road East & Beck Street Intersection

Movement	Horizon Year	Traffic Condition	Weekday a.m. Peak Hour		Weekday p.m. Peak Hour	
			LOS	v/c	LOS (Delay)	v/c
Eastbound Left-Through-Right	2017	Existing	A	0.00	A	0.09
	2024	Background	A	0.00	A	0.09
	2029		A	0.00	A	0.09
	2024	Total	C	0.07	E	0.09
	2029		D	0.09	F (78 s)	0.15
Westbound Left-Through-Right	2017	Existing	B	0.06	C	0.15
	2024	Background	B	0.08	D	0.26
	2029		C	0.11	F (50 s)	0.40
	2024	Total	C	0.10	E	0.32
	2029		C	0.13	F (67 s)	0.50
Northbound Left-Through-Right	2017	Existing	A	0.00	A	0.00
	2024	Background	A	0.00	A	0.01
	2029		A	0.00	A	0.01
	2024	Total	A	0.01	A	0.02
	2029		A	0.01	A	0.02
Southbound Left-Through-Right	2017	Existing	A	0.02	A	0.05
	2024	Background	A	0.03	A	0.07
	2029		A	0.04	A	0.09
	2024	Total	A	0.03	A	0.07
	2029		A	0.04	A	0.09

As shown in Table 5.3, all movements at the River Road East / Beck Street intersection operate acceptably through horizon year 2029, as summarized below:

- The traffic movement from the west leg of Beck Street onto River Road East (i.e., access from the proposed development) is forecasted to operate with a LOS F by horizon year 2029, with a delay of 78 seconds and a v/c ratio of 0.15, during the p.m. peak hour period. While this delay is considered significant, the reserve capacity for this movement indicates that sufficient gaps are available to allow for acceptable operations.
- The traffic movement from the east leg of Beck Street onto River Road East is forecasted to operate with a LOS F by horizon year 2029, with a delay of 67 seconds and a v/c ratio of 0.50, during the p.m. peak hour period. While this delay is

considered significant, the reserve capacity for this movement indicates that sufficient gaps are available to allow for acceptable operations.

Table 5.4 – Queuing at the River Road East and Beck Street Intersection

Movement	Horizon Year	Traffic Condition	Weekday a.m. Peak Hour 95th Percentile Queue (m)	Weekday p.m. Peak Hour 95th Percentile Queue (m)
Eastbound Left-Through-Right	2017	Existing	0.0	0.0
	2024	Background	0.0	0.0
	2029		0.0	0.0
	2024	Total	1.6	2.3
	2029		2.2	3.9
Westbound Left-Through-Right	2017	Existing	1.5	4.0
	2024	Background	2.0	7.5
	2029		2.7	12.9
	2024	Total	2.6	9.6
	2029		3.5	17.3
Northbound Left-Through-Right	2017	Existing	0.0	0.1
	2024	Background	0.0	0.1
	2029		0.0	0.2
	2024	Total	0.1	0.4
	2029		0.1	0.4
Southbound Left-Through-Right	2017	Existing	0.6	1.1
	2024	Background	0.8	1.6
	2029		1.0	2.2
	2024	Total	0.8	1.6
	2029		1.0	2.2

As shown in Table 5.4, no movements are forecasted to have more than 1-car queues during peak periods, through horizon period 2029, with the exception of the westbound movement from Beck Street onto River Road East. The westbound movement is forecasted to have maximum queues of 2 or 3 cars during peak p.m. periods by 2029, which is considered acceptable.

5.5 Geometric Considerations

River Road East is a two lane arterial road running northeast-southwest through the Study Area. The section of River Road East in the Study Area is relatively straight and flat. All geometric considerations were based on a design speed of 60 km/h.

The minimum stopping sight distance required along the area of River Road East studied is 85 m, and the desirable turning sight distance is approximately 175 m. Both

requirements are based on MTO criteria (Geometric Design Standards for Ontario Highways). It has been determined that both requirements have been met at the intersection of River Road East / Beck Street.

The Town's standards include provision for a daylighting triangle of 4 m (local street) x 15 m (arterial street). However, the west leg of Beck Street essentially operates as a short driveway to the developments (i.e., the proposed apartment and the existing Pier 24), with very low traffic and therefore approach daylighting is not required.

The intersection of the west leg of Beck Street (i.e., access to the proposed development) is offset from the east leg of Beck Street by about 15 m. This offset is sufficient to allow for left turning vehicles to turn concurrently into the two legs of Beck Street without conflict. In addition, the offset distance is sufficient to negate the potential for vehicles travelling between the east and west legs of Beck Street cutting the corner for this movement.

5.6 Link Volume Considerations

The *Town of Wasaga Beach Road Needs Study 2013* (C.C. Tatham & Associates, September 2013) assumed that two-lane arterial roads will have a capacity of 16,000 vehicles per day (vpd), while the *Town of Wasaga Beach 2012 Transportation Study Update* (Ainley Group, January 2013) notes that the capacity of two-lane urban roads is generally from 12,000 vpd to 15,000 vpd. These capacities re provided for comparative purposes in the analysis of the link volumes on River Road East in the Study Area.

On an hourly basis, typical planning capacities for urban arterial roads are 900 vehicles per hour per lane (vphpl) in the peak direction. The LOS (i.e., operating speeds) will decline once these planning capacities are exceeded. If such conditions prevail over a relatively short duration throughout the day, these operating conditions may be acceptable and therefore not justify an expansion of the two-lane facility to a three-lane or four-lane facility. However, the addition of turning lanes at intersections is recommended under such conditions, to maximize traffic mobility along the corridor.

Based on data in the *Town of Wasaga Beach 2012 Transportation Study Update* (Ainley Group, January 2013), it is estimated that the a.m. peak hour traffic on River Road East equates to about 8% of the daily traffic and that the p.m. peak hour traffic equates to about 12% of the daily traffic, both considered on weekdays in the summer. The existing peak hour, peak direction traffic volumes on River Road East are about 400 vphpl in the a.m. peak hour and about 700 vphpl in the p.m. peak hour. The existing weekday daily traffic on River Road East is calculated to equate to about 10,000 vpd, which equates to about 62.5% of its link capacity (i.e., assuming 16,000 vpd capacity).

Assuming that traffic growth of 3.3%/annum on River Road East to horizon year 2029, it is estimated that the traffic volumes in the peak direction on River Road East on summer weekdays may grow to about 575 vphpl in the a.m. peak hour and to about 1,050 vphpl in the p.m. peak hour. Under such conditions the weekday daily traffic on River Road East is calculated to equate to about 15,000 vpd, which is nearing its theoretical link capacity. However, it is suggested that the link capacity will remain adequate within this time horizon, based on the following:

- The assumed growth rate is conservative, since it is based on growth in AADT (i.e., based on the Town's Road Study), which is expected to be higher than growth in the peak summer traffic.
- Potential improvements to the road network in the broader area will provide alternate travel routes, diverting traffic away from the River Road East corridor.
- Improvements to active transportation linkages (i.e., pedestrian and cyclist connections), as well as transit will shift demand to alternate travel modes.

Based on the above it is concluded that the link capacity (two-lane facility) along River Road East will be sufficient to beyond horizon year 2029, although operations at intersections along the corridor should be optimized (e.g., through the addition of turning lanes, where required) to maintain traffic mobility.

6.0 Alternate Travel Modes

6.1 Pedestrian and Cyclist Considerations

There are currently no sidewalks present on the sections of River Road East and Beck Street being studied. A concrete sidewalk is proposed along the frontage of development on River Road East. A concrete sidewalk is also proposed internal to the site to connect to the surface parking lot and the apartment's primary access, and a walkway from the apartment building to the proposed boat-slips along the Nottawasaga River.

The proposed development is located in close proximity to Beach 1, as well as to the Stonebridge Town Centre (which offers a variety of retail services). It is estimated that the time to walk to the Beach is about 8 minutes and to cycle to the beach about 3 minutes. The time to walk to the Stonebridge Town Centre is estimated to be about 15 minutes and to cycle to the Centre is about 5 minutes. Therefore the site location is conducive to residents choosing to use alternate active travel modes, as opposed to choosing car travel.

The existing shoulders on River Road East are fully paved, providing for pedestrian and cyclist use along the travelled lanes. These paved shoulders are designated as the Shore Lane Road Trail in the Town's *Active Transportation Plan for the Town of Wasaga Beach* (Meridian Planning Consultants, August 2008).

The Town's Zoning By-law does not currently have requirements for bike parking in residential developments. However, all residents in the proposed apartment will have access to either lockers or bike hooks in the underground parking garage, providing secure storage for bicycles, further promoting this mode of travel.

The *Active Transportation Plan* proposed a "Nancy Island Recreational Trail Loop" that would connect Nancy Island on the Nottawasaga River to both sides of the River via proposed pedestrian bridge crossings at the existing dead-end sections of Beck Street and 2nd Street (see Figure 9). Since there have not been any efforts made to proceed with these additional crossings, their implementation remains indeterminate.

Figure 9 – Potential Nancy Island Recreational Trail Loop (*Active Transportation Plan for the Town of Wasaga Beach*, Meridian Planning Consultants Inc., August 2008)

The *Active Transportation Plan* does not propose sidewalks nor bicycle lanes along River Road East or Beck Street in the Study Area, however a multi-use recreational trail is proposed along River Road East between Main Street and Beck Street in order to connect the two proposed pedestrian Bridge crossings at 2nd Street and Beck Street. The implication of installing the multi-use trail on River Road East and constructing the pedestrian crossing over the River would result in greater volumes of pedestrians and cyclists travelling through the River Road East / Beck Street intersection in order to access the pedestrian bridge. However, given the current low volume of pedestrians and cyclists at the intersection, it can be assumed that further increases due to the

potential implementation of the recommendations in the *Active Transportation Plan* will have negligible impact on the intersection.

6.2 Transit Considerations

The Town of Wasaga Beach operates conventional transit services. There are currently two (2) bus routes operating in the Town. Both routes operate, with 1.5 hour headways, on Monday to Saturday from 7:00 a.m. to 9:00 p.m., and on Sunday from 7:00 a.m. to 7:00 p.m. Wasaga Beach Transit also links with Collingwood Transit on a continuous loop. It should be noted that Wasaga Beach Transit "Route 1" has a bus stop located near the intersection of Main Street and River Road East, which is approximately 300 m to 350 m southwest of the proposed development. Typical bus service areas assume a preferred 400 m maximum walking distance to bus stops, and thus the proposed development does lie within the service area for this bus stop. Therefore, it can be concluded that the Town's existing transit system will sufficiently service the proposed development.

7.0 Parking Justification Study

Parking requirements were addressed based on the *Town of Wasaga Beach Comprehensive Zoning By-law 2003-60* and other relevant parking considerations. The purpose of this analysis is to assess whether there is sufficient parking capacity to meet the demand by residents and visitors to the proposed apartment development.

7.1 By-law Parking Requirement Compared to Proposed Amount

The Town's By-law indicates that the required amount of parking for "Residential Apartment Uses" is 1.75 parking spaces per dwelling unit. Given that the proposed development consists of 50 apartment units, this results in a By-law requirement of 88 parking spaces. A total of 57 parking spaces are proposed for the development (17 surface and 40 underground), representing a reduction of 31 parking spaces from the By-law requirement.

7.2 Zoning By-law Requirements in Other Municipalities

The minimum parking requirements in other municipalities, similar to the Town of Wasaga Beach in size and/or geography, based on local by-laws, have been reviewed and summarized in the following table.

Table 7.1 – Parking By-law Requirements for Comparable Municipalities

City / Town	Land Use	By-law Parking Requirement	Equivalent Number of Spaces Required for the Proposed Development
Collingwood	Dwelling, apartment	1 space per unit, plus an additional 0.25 spaces per unit for visitor parking	63
Midland	Apartment Dwelling Unit	1.5 per dwelling unit of which 25% shall be for designated visitor parking	75
Barrie	Residential building containing more than 3 dwelling units	1.5 spaces per dwelling unit	75
Orillia	Residential building containing more than 3 dwelling units	1.5 spaces per dwelling unit of which 25% shall be for visitor parking	75

As shown in the above table, the parking requirement in all of the comparable municipalities reviewed is less than the amount of parking required in the Town of Wasaga Beach Zoning By-law.

Typical zoning by-laws for larger municipalities (e.g., in the Greater Toronto Area), or for sites within Central Business Districts, have minimum parking requirements of 1.05 to 1.1 spaces per 1 bedroom unit and 1.1 to 1.3 spaces per 2 bedroom unit, with these rates being inclusive of visitor parking that range from 0.15 to 0.2 spaces per unit. These rates are based on parking utilization studies that have been completed for various land uses within those municipalities.

7.3 Parking Requirements Based on Parking Generation Manual

The parking requirements for the proposed development were reviewed based on *Parking Generation, 4th Edition* (Institute of Transportation Engineers [ITE], 2010). The ITE studies show an average peak period parking demand ratio of 1.20 vehicles per dwelling unit in an urban environment (Low/Mid-rise Apartment, Land Use Code 221). For the proposed 50 unit apartment, this results in a peak period parking demand of 60 parking spaces, or 3 spaces more than the proposed 57 spaces on-site. However, since this is an average peak period parking demand, 50% of the sites surveyed will have had peak period parking demands which were less than this demand.

Parking Generation (ITE, 2010) also provides data for the variation of parking demand throughout the day at apartments, which shows that the parking demands throughout the day are less than 50% between 9:00 a.m. and 5:00 p.m., which indicates that there may be opportunity for shared parking among users, assuming that appropriate parking demand management measures are put in place.

7.4 Reductions in Parking Due to Other Modes of Transportation

It is likely that a significant number of residents in the proposed development will choose walking, cycling or transit as their primary mode of travel around the Town, given the developments location relative to the primary commercial and recreational areas in the Town and to transit stops. The availability of travel choices decreases the need for residents to own a car, or at least to have their car at the site on a continuous basis, thereby decreasing the parking demand at the site at any particular time.

7.5 Site Specific Parking Considerations

While the form of development is condominium apartment, its unique requirements should be considered in establishing appropriate parking requirements. The application of typical zoning by-law parking standards may result in an over-supply of parking for this site. Current practice is to strive to provide optimal parking supply, ensuring that

such facilities are used efficiently and that alternate travel modes are increasingly used, in lieu of automobile travel.

The proposed development includes twenty (20) 1-bedroom apartment units and twenty eight (28) 2-bedroom apartment units. The proposed 57 parking spaces allows for a parking supply of 1.14 spaces per unit (i.e., for residents and visitors). This supply would meet the parking by-law requirements for condominiums in larger municipalities or central business districts, whose rates have been established through parking utilization studies in those areas.

It is our understanding that the market for this development will be to residents that will use these apartments for recreational / seasonal purposes (e.g., summer homes with boat slips). In this respect, the developer has estimated that the typical peak period occupancy of the units may only be 70% at any point. The parking demands during the non-summer season will also be significantly reduced. These factors will translate into reduced peak period parking demands (i.e., from both residents and visitors). In this respect the proposed developer has indicated that the proposed parking will provide adequate market and operational flexibility in servicing the resident / visitor needs.

The site offers flexibility in responding to market/demand requirements in the allocation of parking spaces between resident and visitor demands. It is anticipated that the 40 underground spaces will service resident demands. The 17 aboveground spaces can be allocated to service residents and visitors, as demand determines.

An entry gate is proposed to control access to the parking areas and therefore there is full control to manage access to these areas (i.e., restricting parking to approved users of the site).

Rather than automatically including a certain amount of parking with building space, it is intended that parking costs be borne directly to users, which means that parking is rented or sold separately. This is more equitable and efficient, since occupants are not forced to pay for parking they do not need, and allows consumers to adjust their parking supply to reflect their needs. Unbundling of parking typically reduces vehicle ownership and parking demand by 10 to 20%.

If there are peak periods where on-site visitor parking is demand exceeds supply, visitors can be directed to park at the nearest municipal lot (130 Main Street), which is locate a 3 minute walk from the site. The municipal lot offers about 140 paid parking spaces ($2.00/hour or $10.00/day). No parking restrictions are strictly enforced along the municipal roads and therefore parking spill-over into those areas is unlikely. Similarly the parking at the adjacent Pier 24 development is controlled via an entry gate, which restricts parking spill-over into that area.

Based on the above considerations it is concluded that the proposed parking (57 spaces) will adequately meet the demands of the proposed apartment development.

8.0 Conclusions and Recommendations

Based on the analysis completed, the following primary conclusions and recommendations are made in this study:

- The proposed development is forecast to generate about 15 vehicles per hour (vph) in the a.m. peak hour and 19 vph in the p.m. peak hour.
- A southbound left-turn lane with a 15 m storage length is warranted at the River Road East / Beck Street intersection under existing (2017) traffic conditions. Under 2024 and 2029 background the warranted storage for this southbound left-turn lane increases to 25 m. The proposed development will not have any impact on these warrant requirements, since it does not contribute to this traffic movement and contributes only a relatively small volume of traffic into the intersection.
- A northbound left-turn lane is not warranted at the River Road East / Beck Street intersection through horizon period 2029, since the forecasted volume of left-turning vehicles is too low to meet the warrant requirements.
- Right-turn lanes or tapers are not warranted at the intersection of River Road East / Beck Street through horizon year 2029.
- The traffic movement from the west leg of Beck Street onto River Road East (i.e., access from the proposed development) is forecasted to operate with a Level of Service (LOS) F by horizon year 2029, with a delay of 78 seconds and a volume/capacity (v/c) ratio of 0.15, during the p.m. peak hour period. While this delay is considered significant, the reserve capacity for this movement indicates that sufficient gaps are available to allow for acceptable operations.
- The traffic movement from the east leg of Beck Street onto River Road East is forecasted to operate with a LOS F by horizon year 2029, with a delay of 67 seconds and a v/c ratio of 0.50, during the p.m. peak hour period. While this delay is considered significant, the reserve capacity for this movement indicates that sufficient gaps are available to allow for acceptable operations.
- No traffic queuing issues were identified at the intersection of River Road East / Beck Street, based on the queuing analysis completed.
- The desirable turning sight distance, as well as the minimum stopping sight distance at the River Road East / Beck Street intersection meets the guidelines of the Ministry of Transportation and of the Town. The west leg of Beck Street essentially functions as a short driveway to the developments (i.e., proposed apartment development and Pier 24), with minor traffic volumes, and therefore does not justify the need for daylight triangles. The geometrics at this intersection adequately support all traffic movements, without modification.
- River Road East (two-lane facility) provides sufficient link capacity to beyond horizon year 2029, although operations at intersections along the corridor should be optimized (e.g., through the addition of turning lanes, where required, to maintain traffic mobility.

- The shoulders have been paved along both sides of River Road East, providing a pedestrian and cyclist connection along the roadway in this area. A concrete sidewalk is also proposed on the River Road East right-of-way, along the frontage of the development, with the apartment connected to this sidewalk via internal walkways.
- The location of the proposed development is relatively close to the existing, and planned, recreational and commercial areas in the Town. Therefore there is a high potential for active transportation modes of travel to be utilized, in lieu of auto modes.
- The Active Transportation Plan for the Town of Wasaga Beach (Meridian Planning Consultants Inc., August 2008) proposed a potential "Nancy Island Recreational Trail Loop" that would connect Nancy Island on the Nottawasaga River to both sides of the River via proposed pedestrian bridge crossings at the existing dead-end sections of Beck Street and 2nd Street. This potential connection has not been programmed and therefore its implementation is indeterminate at this time.
- The Town's existing transit system (Wasaga Beach Transit) currently services River Road East, with a bus stop located at Main Street, which adequately services the proposed development.
- The proposed amount of parking (57 spaces) does not meet the Town's Zoning By-law requirements, however, based on site specific considerations this parking supply is considered to be sufficient to meet the demands of the residents and visitors of the apartment building.

BURNSIDE

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Appendix A

Traffic Turning Movement Count (TMC) Data

Ontario Traffic Inc.

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 9:00:00

One Hour Peak
From: 8:00:00
To: 9:00:00

Municipality: Wasaga Beach
Site #: 1718700001
Intersection: River Rd E & Beck St
TFR File #: 15
Count date: 15-Jun-17

Weather conditions:

Person(s) who counted:

**** Non-Signalized Intersection ****

Major Road: River Rd E runs W/E

North Leg Total:	1			
North Entering:	0			
North Peds:	1			
Peds Cross:	⋈			

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	0	0	0	0
Totals	0	0	0	

Heavys	0
Trucks	0
Cars	1
Totals	1

East Leg Total:	713
East Entering:	358
East Peds:	0
Peds Cross:	⧖

Private Driveway

Heavys	Trucks	Cars	Totals
5	12	326	343

Cars	Trucks	Heavys	Totals
0	0	0	0
324	12	5	341
16	1	0	17
340	13	5	

River Rd E

N
W E
S

Heavys	Trucks	Cars	Totals
0	0	1	1
7	20	311	338
0	1	3	4
7	21	315	

River Rd E

Cars	Trucks	Heavys	Totals
327	21	7	355

Beck St

Peds Cross:	⧖			
West Peds:	3			
West Entering:	343			
West Leg Total:	686			

Cars	19			
Trucks	2			
Heavys	0			
Totals	21			

Cars	2	0	16	18
Trucks	0	0	1	1
Heavys	0	0	0	0
Totals	2	0	17	

Peds Cross:	⋈			
South Peds:	0			
South Entering:	19			
South Leg Total:	40			

Comments

Ontario Traffic Inc.

Afternoon Peak Diagram

Specified Period
From: 16:00:00
To: 18:00:00

One Hour Peak
From: 16:00:00
To: 17:00:00

Municipality: Wasaga Beach
Site #: 1718700001
Intersection: River Rd E & Beck St
TFR File #: 15
Count date: 15-Jun-17

Weather conditions:

Person(s) who counted:

**** Non-Signalized Intersection ****

Major Road: River Rd E runs W/E

North Leg Total:	2
North Entering:	0
North Peds:	3
Peds Cross:	⋈

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	0	0	0	0
Totals	0	0	0	

Heavys	0
Trucks	0
Cars	2
Totals	2

East Leg Total:	1094
East Entering:	641
East Peds:	1
Peds Cross:	⧖

Private Driveway

Heavys	Trucks	Cars	Totals
7	19	585	611

Cars	Trucks	Heavys	Totals
0	0	0	0
579	19	7	605
36	0	0	36
615	19	7	

River Rd E

N
W E
S

Heavys	Trucks	Cars	Totals
0	0	2	2
6	19	398	423
0	0	7	7
6	19	407	

River Rd E

Cars	Trucks	Heavys	Totals
427	20	6	453

Beck St

Peds Cross:	⧖
West Peds:	3
West Entering:	432
West Leg Total:	1043

Cars	43
Trucks	0
Heavys	0
Totals	43

Cars	6	0	29	35
Trucks	0	0	1	1
Heavys	0	0	0	0
Totals	6	0	30	

Peds Cross:	⋈
South Peds:	0
South Entering:	36
South Leg Total:	79

Comments

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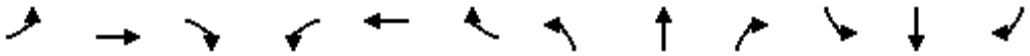
Appendix B

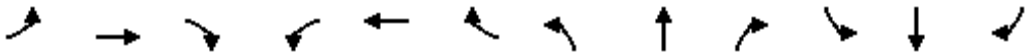
Traffic Operations (Synchro)



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	2	0	19	1	372	4	19	375	0
Future Volume (Veh/h)	0	0	0	2	0	19	1	372	4	19	375	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.82	0.82	0.82	0.73	0.73	0.73
Hourly flow rate (vph)	0	0	0	3	0	28	1	454	5	26	514	0
Pedestrians		1						3				
Lane Width (m)		3.7						3.7				
Walking Speed (m/s)		1.1						1.1				
Percent Blockage		0						0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1054	1028	518	1028	1026	456	515			459		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1054	1028	518	1028	1026	456	515			459		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.3		
p0 queue free %	100	100	100	99	100	95	100			98		
cM capacity (veh/h)	192	230	559	210	231	596	1060			1081		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	31	460	540
Volume Left	0	3	1	26
Volume Right	0	28	5	0
cSH	1700	506	1060	1081
Volume to Capacity	0.00	0.06	0.00	0.02
Queue Length 95th (m)	0.0	1.5	0.0	0.6
Control Delay (s)	0.0	12.6	0.0	0.7
Lane LOS	A	B	A	A
Approach Delay (s)	0.0	12.6	0.0	0.7
Approach LOS	A	B		

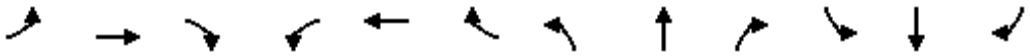
Intersection Summary				
Average Delay	0.7			
Intersection Capacity Utilization	45.1%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	7	0	33	2	465	8	40	666	0
Future Volume (Veh/h)	0	0	0	7	0	33	2	465	8	40	666	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.84	0.84	0.84	0.83	0.83	0.83
Hourly flow rate (vph)	0	0	0	8	0	38	2	554	10	48	802	0
Pedestrians		3						3			1	
Lane Width (m)		3.7						3.7			3.7	
Walking Speed (m/s)		1.1						1.1			1.1	
Percent Blockage		0						0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1503	1469	808	1464	1464	560	805			564		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1503	1469	808	1464	1464	560	805			564		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	92	100	93	100			95		
cM capacity (veh/h)	90	122	382	103	123	525	826			1018		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	46	566	850
Volume Left	0	8	2	48
Volume Right	0	38	10	0
cSH	1700	307	826	1018
Volume to Capacity	0.09	0.15	0.00	0.05
Queue Length 95th (m)	0.0	4.0	0.1	1.1
Control Delay (s)	0.0	18.8	0.1	1.2
Lane LOS	A	C	A	A
Approach Delay (s)	0.0	18.8	0.1	1.2
Approach LOS	A	C		

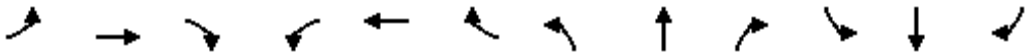
Intersection Summary				
Average Delay	1.3			
Intersection Capacity Utilization	75.2%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	2	0	21	1	468	5	24	471	0
Future Volume (Veh/h)	0	0	0	2	0	21	1	468	5	24	471	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.82	0.82	0.82	0.73	0.73	0.73
Hourly flow rate (vph)	0	0	0	3	0	31	1	571	6	33	645	0
Pedestrians		1						3				
Lane Width (m)		3.7						3.7				
Walking Speed (m/s)		1.1						1.1				
Percent Blockage		0						0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1319	1291	649	1290	1288	574	646			577		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1319	1291	649	1290	1288	574	646			577		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.3		
p0 queue free %	100	100	100	98	100	94	100			97		
cM capacity (veh/h)	124	159	472	138	160	511	948			977		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	34	578	678
Volume Left	0	3	1	33
Volume Right	0	31	6	0
cSH	1700	412	948	977
Volume to Capacity	0.00	0.08	0.00	0.03
Queue Length 95th (m)	0.0	2.0	0.0	0.8
Control Delay (s)	0.0	14.5	0.0	0.9
Lane LOS	A	B	A	A
Approach Delay (s)	0.0	14.5	0.0	0.9
Approach LOS	A	B		

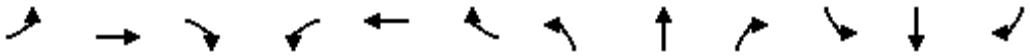
Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	54.2%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	8	0	36	3	584	10	50	837	0
Future Volume (Veh/h)	0	0	0	8	0	36	3	584	10	50	837	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.84	0.84	0.84	0.83	0.83	0.83
Hourly flow rate (vph)	0	0	0	9	0	41	4	695	12	60	1008	0
Pedestrians		3						3			1	
Lane Width (m)		3.7						3.7			3.7	
Walking Speed (m/s)		1.1						1.1			1.1	
Percent Blockage		0						0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1882	1846	1014	1840	1840	702	1011			707		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1882	1846	1014	1840	1840	702	1011			707		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	84	100	91	99			93		
cM capacity (veh/h)	47	70	291	55	71	436	692			901		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	50	711	1068
Volume Left	0	9	4	60
Volume Right	0	41	12	0
cSH	1700	194	692	901
Volume to Capacity	0.09	0.26	0.01	0.07
Queue Length 95th (m)	0.0	7.5	0.1	1.6
Control Delay (s)	0.0	29.8	0.2	2.0
Lane LOS	A	D	A	A
Approach Delay (s)	0.0	29.8	0.2	2.0
Approach LOS	A	D		

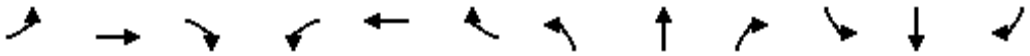
Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	3	5	2	2	21	4	468	5	24	471	1
Future Volume (Veh/h)	2	3	5	2	2	21	4	468	5	24	471	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.82	0.82	0.82	0.73	0.73	0.73
Hourly flow rate (vph)	3	4	7	3	3	31	5	571	6	33	645	1
Pedestrians		1						3				
Lane Width (m)		3.7						3.7				
Walking Speed (m/s)		1.1						1.1				
Percent Blockage		0						0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1329	1300	650	1308	1297	574	647			577		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1329	1300	650	1308	1297	574	647			577		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.3		
p0 queue free %	97	97	99	98	98	94	99			97		
cM capacity (veh/h)	119	156	471	129	157	511	947			977		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	14	37	582	679
Volume Left	3	3	5	33
Volume Right	7	31	6	1
cSH	214	359	947	977
Volume to Capacity	0.07	0.10	0.01	0.03
Queue Length 95th (m)	1.6	2.6	0.1	0.8
Control Delay (s)	23.0	16.2	0.1	0.9
Lane LOS	C	C	A	A
Approach Delay (s)	23.0	16.2	0.1	0.9
Approach LOS	C	C		

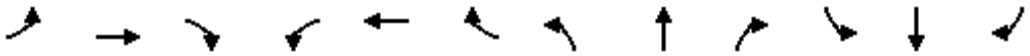
Intersection Summary				
Average Delay	1.2			
Intersection Capacity Utilization	51.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	2	4	8	3	36	9	584	10	50	837	2
Future Volume (Veh/h)	2	2	4	8	3	36	9	584	10	50	837	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.84	0.84	0.84	0.83	0.83	0.83
Hourly flow rate (vph)	2	2	5	9	3	41	11	695	12	60	1008	2
Pedestrians		3						3			1	
Lane Width (m)		3.7						3.7			3.7	
Walking Speed (m/s)		1.1						1.1			1.1	
Percent Blockage		0						0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1898	1861	1015	1861	1856	702	1013			707		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1898	1861	1015	1861	1856	702	1013			707		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	97	98	82	96	91	98			93		
cM capacity (veh/h)	44	68	290	51	68	436	690			901		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	9	53	718	1070
Volume Left	2	9	11	60
Volume Right	5	41	12	2
cSH	97	168	690	901
Volume to Capacity	0.09	0.32	0.02	0.07
Queue Length 95th (m)	2.3	9.6	0.4	1.6
Control Delay (s)	45.8	36.0	0.4	2.0
Lane LOS	E	E	A	A
Approach Delay (s)	45.8	36.0	0.4	2.0
Approach LOS	E	E		

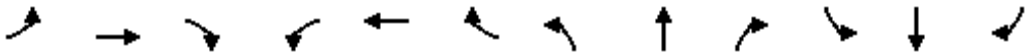
Intersection Summary				
Average Delay	2.6			
Intersection Capacity Utilization	83.9%	ICU Level of Service	E	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	2	0	22	1	550	6	28	555	0
Future Volume (Veh/h)	0	0	0	2	0	22	1	550	6	28	555	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.82	0.82	0.82	0.73	0.73	0.73
Hourly flow rate (vph)	0	0	0	3	0	33	1	671	7	38	760	0
Pedestrians		1						3				
Lane Width (m)		3.7						3.7				
Walking Speed (m/s)		1.1						1.1				
Percent Blockage		0						0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1546	1517	764	1516	1514	674	761			678		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1546	1517	764	1516	1514	674	761			678		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.3		
p0 queue free %	100	100	100	97	100	93	100			96		
cM capacity (veh/h)	84	115	405	95	116	447	859			895		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	36	679	798
Volume Left	0	3	1	38
Volume Right	0	33	7	0
cSH	1700	342	859	895
Volume to Capacity	0.00	0.11	0.00	0.04
Queue Length 95th (m)	0.0	2.7	0.0	1.0
Control Delay (s)	0.0	16.8	0.0	1.1
Lane LOS	A	C	A	A
Approach Delay (s)	0.0	16.8	0.0	1.1
Approach LOS	A	C		

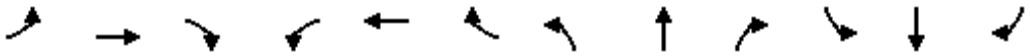
Intersection Summary				
Average Delay	1.0			
Intersection Capacity Utilization	61.9%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	8	0	38	3	688	12	59	986	0
Future Volume (Veh/h)	0	0	0	8	0	38	3	688	12	59	986	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.84	0.84	0.84	0.83	0.83	0.83
Hourly flow rate (vph)	0	0	0	9	0	43	4	819	14	71	1188	0
Pedestrians		3						3			1	
Lane Width (m)		3.7						3.7			3.7	
Walking Speed (m/s)		1.1						1.1			1.1	
Percent Blockage		0						0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	2211	2174	1194	2167	2167	827	1191			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2211	2174	1194	2167	2167	827	1191			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	100	72	100	88	99			91		
cM capacity (veh/h)	26	43	228	32	43	370	592			809		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	0	52	837	1259
Volume Left	0	9	4	71
Volume Right	0	43	14	0
cSH	1700	130	592	809
Volume to Capacity	0.09	0.40	0.01	0.09
Queue Length 95th (m)	0.0	12.9	0.2	2.2
Control Delay (s)	0.0	50.0	0.2	3.3
Lane LOS	A	F	A	A
Approach Delay (s)	0.0	50.0	0.2	3.3
Approach LOS	A	F		

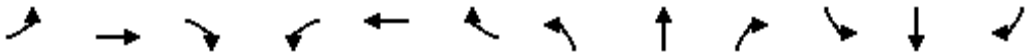
Intersection Summary			
Average Delay	3.2		
Intersection Capacity Utilization	105.9%	ICU Level of Service	G
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	3	5	2	2	22	4	550	6	28	555	1
Future Volume (Veh/h)	2	3	5	2	2	22	4	550	6	28	555	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.67	0.67	0.67	0.67	0.67	0.82	0.82	0.82	0.73	0.73	0.73
Hourly flow rate (vph)	3	4	7	3	3	33	5	671	7	38	760	1
Pedestrians		1						3				
Lane Width (m)		3.7						3.7				
Walking Speed (m/s)		1.1						1.1				
Percent Blockage		0						0				
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1556	1526	764	1533	1522	674	762			678		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1556	1526	764	1533	1522	674	762			678		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.3	4.1			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.4	2.2			2.3		
p0 queue free %	96	96	98	97	97	93	99			96		
cM capacity (veh/h)	81	113	405	88	114	447	859			895		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	14	39	683	799
Volume Left	3	3	5	38
Volume Right	7	33	7	1
cSH	156	291	859	895
Volume to Capacity	0.09	0.13	0.01	0.04
Queue Length 95th (m)	2.2	3.5	0.1	1.0
Control Delay (s)	30.3	19.3	0.2	1.1
Lane LOS	D	C	A	A
Approach Delay (s)	30.3	19.3	0.2	1.1
Approach LOS	D	C		

Intersection Summary				
Average Delay	1.4			
Intersection Capacity Utilization	59.2%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	2	4	8	3	38	9	688	12	59	986	2
Future Volume (Veh/h)	2	2	4	8	3	38	9	688	12	59	986	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.84	0.84	0.84	0.83	0.83	0.83
Hourly flow rate (vph)	2	2	5	9	3	43	11	819	14	71	1188	2
Pedestrians		3						3			1	
Lane Width (m)		3.7						3.7			3.7	
Walking Speed (m/s)		1.1						1.1			1.1	
Percent Blockage		0						0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	2228	2189	1195	2188	2183	827	1193			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2228	2189	1195	2188	2183	827	1193			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	92	95	98	69	93	88	98			91		
cM capacity (veh/h)	24	41	228	29	42	370	591			809		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	9	55	844	1261
Volume Left	2	9	11	71
Volume Right	5	43	14	2
cSH	58	109	591	809
Volume to Capacity	0.15	0.50	0.02	0.09
Queue Length 95th (m)	3.9	17.3	0.4	2.2
Control Delay (s)	77.9	67.4	0.6	3.3
Lane LOS	F	F	A	A
Approach Delay (s)	77.9	67.4	0.6	3.3
Approach LOS	F	F		

Intersection Summary				
Average Delay	4.2			
Intersection Capacity Utilization	98.5%	ICU Level of Service	F	
Analysis Period (min)	15			