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400 Millennium Boulevard, Waterloo Transportation Impact Study

Paradigm Transportation Solutions Limited

October 2023
220328



Project Summary



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400 Millennium Boulevard, Waterloo Transportation Impact Study

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Content

Paradigm Transportation Solutions Limited (Paradigm) has been retained to conduct this Transportation Impact Study (TIS) for a proposed residential development located at 400 Millennium Boulevard in the City of Waterloo.

This TIS includes existing traffic conditions analysis, a description of the proposed development, future traffic conditions analysis, and development traffic impact assessment and appropriate recommendations to accommodate the proposed development.

Development Concept

The subject site is located on Millennium Boulevard south of Country Squire Road and east of University Avenue. The property owner is proposing to construct a residential development with a total of 630 units comprising 77 single detached houses, 83 street townhouses, 470 stacked townhouses, and approximately 11,033 sq. ft. GFA of commercial space.

Vehicle access is proposed via three connections to Millennium Boulevard: opposite of Crossgate Boulevard, Oak Park Drive, and RIM Park Road.

The development is assumed to built-out by 2026.

TIS Scope

The City-approved scope of the Transportation Impact Study for the proposed development includes:

- ▶ **Study Area Intersections:**
 - University Avenue and Millennium Boulevard;
 - University Avenue and Park Road;
 - Millennium Boulevard and Glasgow Street South;
 - Millennium Boulevard and Oak Park Drive;
 - Millennium Boulevard and Crossgate Boulevard; and
 - Millennium Boulevard and RIM Park Road.
- ▶ **Analysis Periods:** Weekday AM and PM peak hours.
- ▶ **Traffic Conditions:** Existing (2023) and ten years after assumed full buildout of development (2036).



Conclusions

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

- ▶ **Existing Traffic Conditions:** All study area intersections are currently operating at acceptable levels of service.
- ▶ **Development Trip Generation:** The development is forecast to generate 285 and 400 net trips during the AM and PM peak hours, respectively.
- ▶ **2036 Background Traffic Conditions:** All study area intersections are forecast to operate at acceptable levels of service.
- ▶ **2036 Total Traffic Conditions:** All study area intersections are forecast to operate at acceptable levels of service except for the westbound left-turn movement at University Avenue and Millennium Boulevard, which is forecast to operate at LOS F with a v/c ratio greater than 1.00 during the PM peak hour. The 95th percentile queue length is also projected to exceed the available storage for the right-turn lane by approximately 30 metres during the PM peak hour.
- ▶ **University Avenue and Millennium Boulevard:** The requirement for traffic signal control was assessed at the intersection. Traffic signal control is not warranted at the intersection of University Avenue and Millennium Boulevard under 2036 total traffic conditions. Traffic intending to turn left onto University Avenue East will have the option to use the intersection at Park Road, which is forecast to operate within capacity.

The westbound left-turn movement 95th percentile queue length is forecast to exceed the available storage for the right-turn lane by approximately 30 metres during the PM peak hour. The westbound right-turn lane could be extended by 30 metres by removing approximately five on-street parking spaces on the north side of Millennium Boulevard through re-painting the pavement marking.

- ▶ **Site Access Intersections:** The Site Access intersections on Millennium Boulevard are forecast to operate at acceptable levels of service under 2036 total traffic conditions.

It is noted that an eastbound left-turn lane is warranted with 15 metres of storage on Millennium Boulevard at RIM Park Roadway / Street Two under 2036 total traffic conditions.



Recommendations

Based on the findings of this study, it is recommended that the development be considered for approval, as proposed, with the following transportation-related conditions:

- ▶ the westbound right-turn lane at University Avenue and Millennium Boulevard be extended by 30 metres through repainting the pavement marking; and
- ▶ an eastbound left-turn lane be constructed on Millennium Boulevard at Street Two.



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1 Introduction

1.1 Overview

Paradigm Transportation Solutions Limited (Paradigm) has been retained to conduct this Transportation Impact Study (TIS) for a proposed residential development located at 400 Millennium Boulevard in the City of Waterloo. **Figure 1.1** details the subject development location.

The subject site is located on Millennium Boulevard south of Country Squire Road, and east of University Avenue. The property owner is proposing to construct a residential development with a total of 630 units comprising 77 single detached houses, 83 street townhouses, 470 stacked townhouses, and approximately 11,033 sq. ft. GFA of commercial space.

Vehicle access is proposed via three connections to Millennium Boulevard: opposite of Crossgate Boulevard, Oak Park Drive, and RIM Park Road.

The development is assumed to built-out by 2026.

1.2 Purpose and Scope

The purpose of this report is to identify and assess the potential traffic impact resulting from the proposed development. The scope of the study includes:

- ▶ assessing current traffic and site conditions within the study area;
- ▶ estimating background traffic growth for ten years after the assumed buildout of the development (2036);
- ▶ forecasting additional site-generated traffic;
- ▶ analysing future traffic impacts on the surrounding road network, including the following study area intersections:
 - University Avenue and Millennium Boulevard;
 - University Avenue and Park Road;
 - Millennium Boulevard and Glasgow Street South;
 - Millennium Boulevard and Oak Park Drive;
 - Millennium Boulevard and Crossgate Boulevard; and
 - Millennium Boulevard and RIM Park Road.



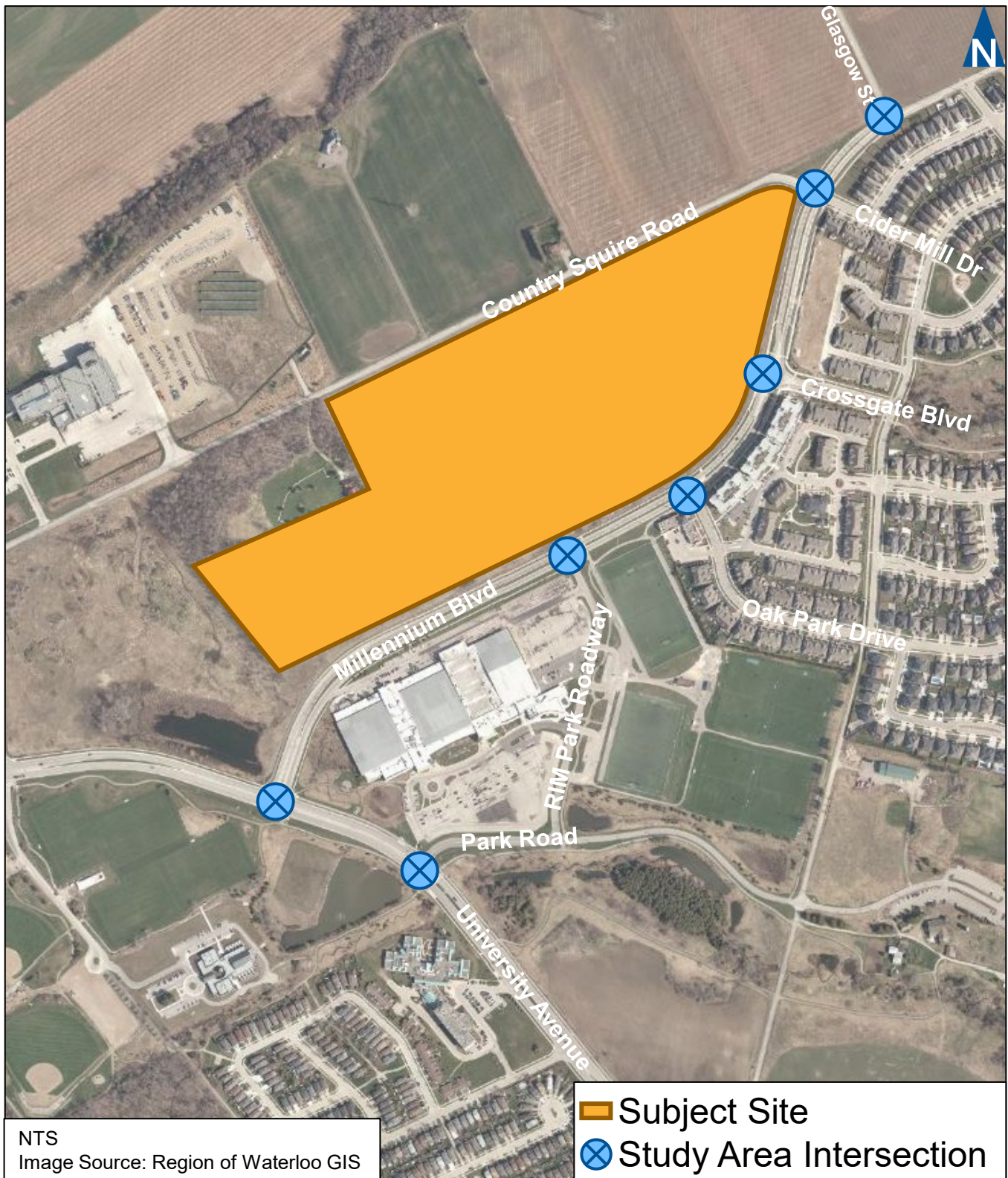
- ▶ recommending, as necessary, mitigating measures to accommodate the site-generated traffic in a satisfactory manner.

This study has been prepared in consultation with the City of Waterloo (the City) and the Region of Waterloo (the Region) staff, and in accordance with the requirements of the Region TIS Guidelines¹.

Appendix A contains the Region's pre-study conference form.

¹ Transportation Impact Study Guidelines, Region of Waterloo, 22 July 2014





2 Existing Conditions

2.1 Existing Roadways

The main roadways near the subject development considered in assessing the traffic impacts of the development include:

- ▶ **University Avenue** is a four-lane city arterial road² with a speed limit of 50 km/h;
- ▶ **Millennium Boulevard** is a two-lane east-west major collector road with an assumed speed limit of 50 km/h;
- ▶ **Country Squire Road** is a two-lane east-west minor collector road with a speed limit of 50 km/h;
- ▶ **Park Road** is a two-lane east-west local road with an assumed speed limit of 50 km/h;
- ▶ **Oak Park Drive** is a two-lane north-south local road with an assumed speed limit of 50 km/h;
- ▶ **RIM Park Roadway** is a two-lane north-south local road with an assumed speed limit of 50 km/h;
- ▶ **Crossgate Boulevard** is a two-lane east-west local road with an assumed speed limit of 50 km/h;
- ▶ **Glasgow Street** is a two-lane north-south local road with an assumed speed limit of 50 km/h; and
- ▶ **Cider Mill Drive** is a two-lane east-west with an assumed speed limit of 50 km/h.

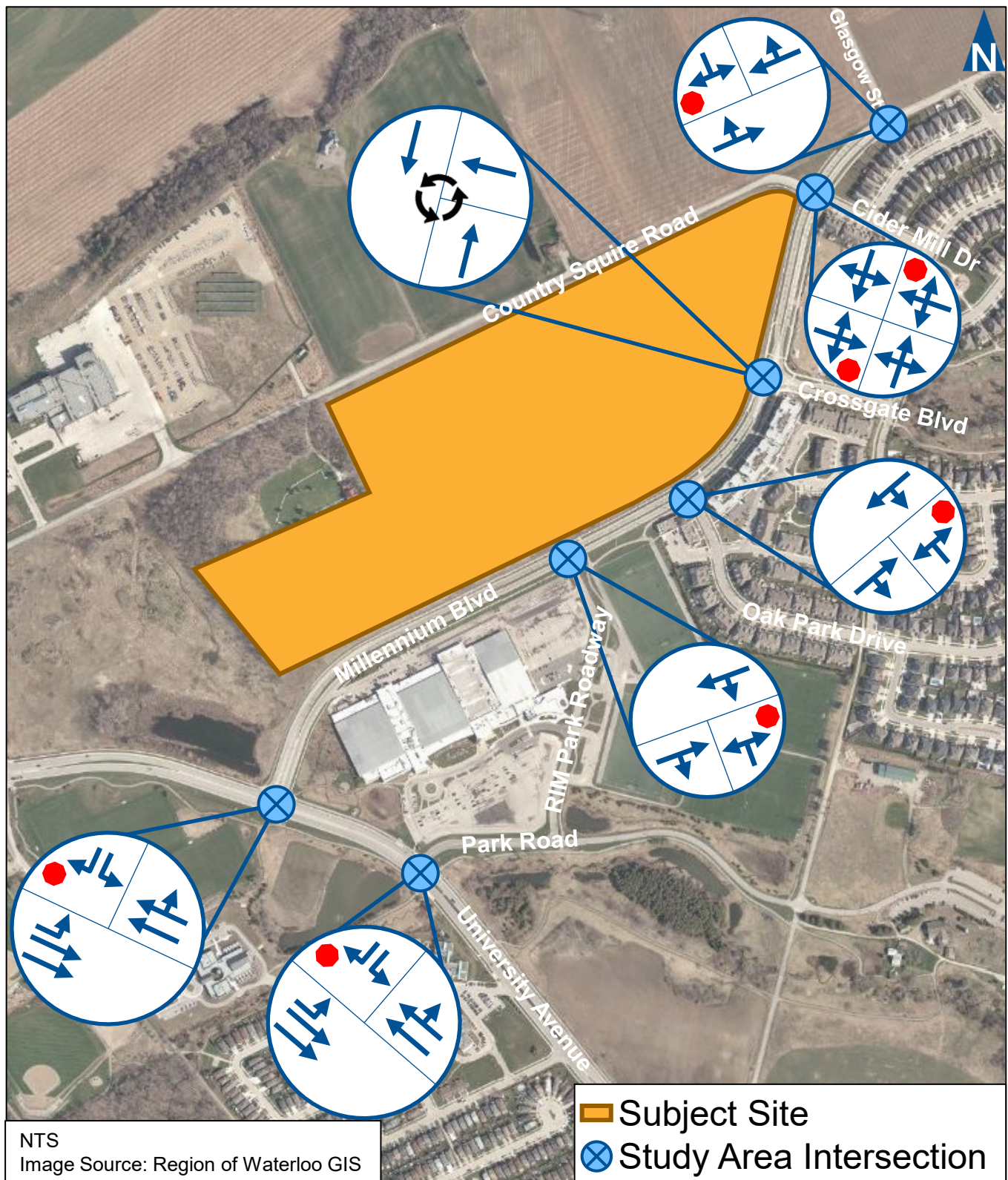
The intersection of Millennium Boulevard and Crossgate Boulevard is controlled by a roundabout, while the balance of the study area intersections operate under side-street stop control.

The study area borders primarily residential and recreational uses, including the RIM Park Recreational Centre.

Figure 2.1 illustrates the traffic control and lane configuration at the study area intersections.

² *City of Waterloo Official Plan*, Schedule E: Road Classification System, February 2018.





2.2 Transit Service

Grant River Transit (GRT) operates one route, **Route 202**, within the study area, with the nearest bus stops located at the intersection of University Avenue and Park Road. Route 202 provides service seven days a week with 10- to 30-minute headways.

Figure 2.2 illustrates the existing transit service routes.

2.3 Cycling and Pedestrian Facilities

Sidewalks or multi-use trails are provided on both sides of Cider Mill Drive, Crossgate Boulevard, Oak Park Drive, and University Avenue. Sidewalks or multi-use trails are also provided on both sides of Millennium Boulevard west of Glasgow Street, on the south side of Park Road, and the east side RIM Park Roadway.

Exclusive cycle lanes are provided on both sides of Millennium Boulevard and University Avenue.

Figure 2.3 illustrates the Region of Waterloo trails map.

2.4 Traffic Volumes

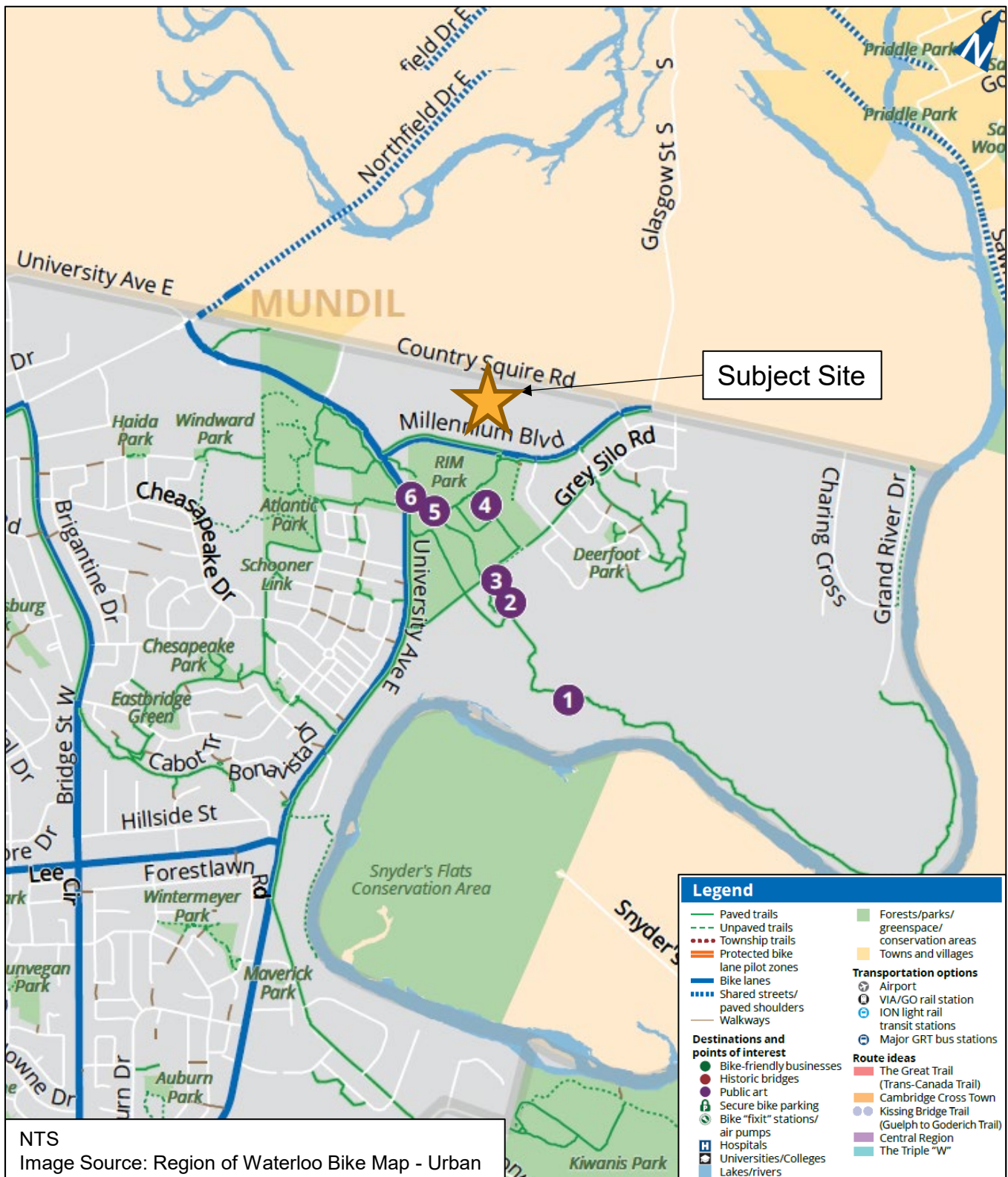
Paradigm conducted turning movement counts at the study area intersections on 06 December 2022.

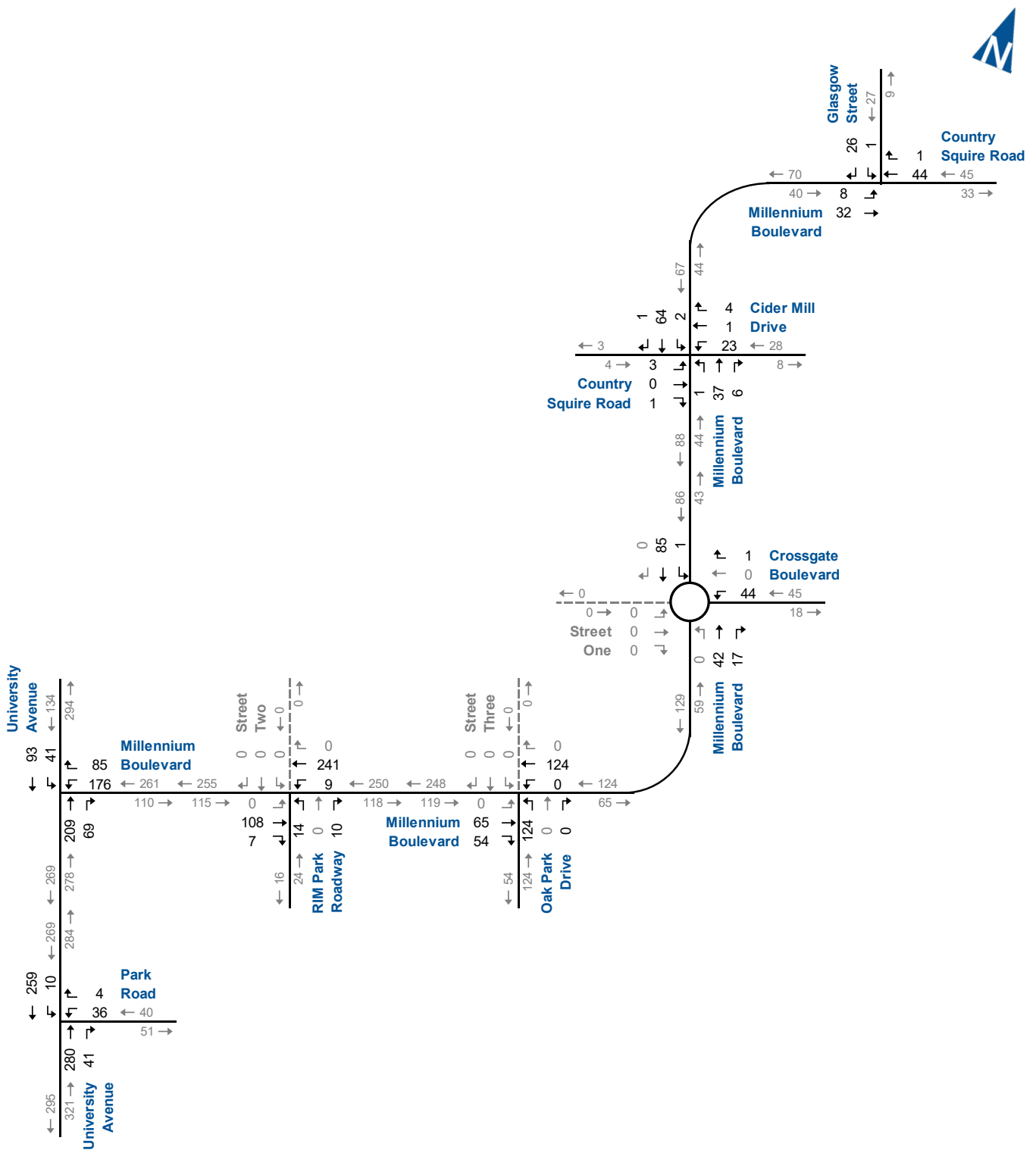
Figure 2.4a and **Figure 2.4b** respectively illustrate the existing AM and PM weekday peak hour turning movement traffic volumes.

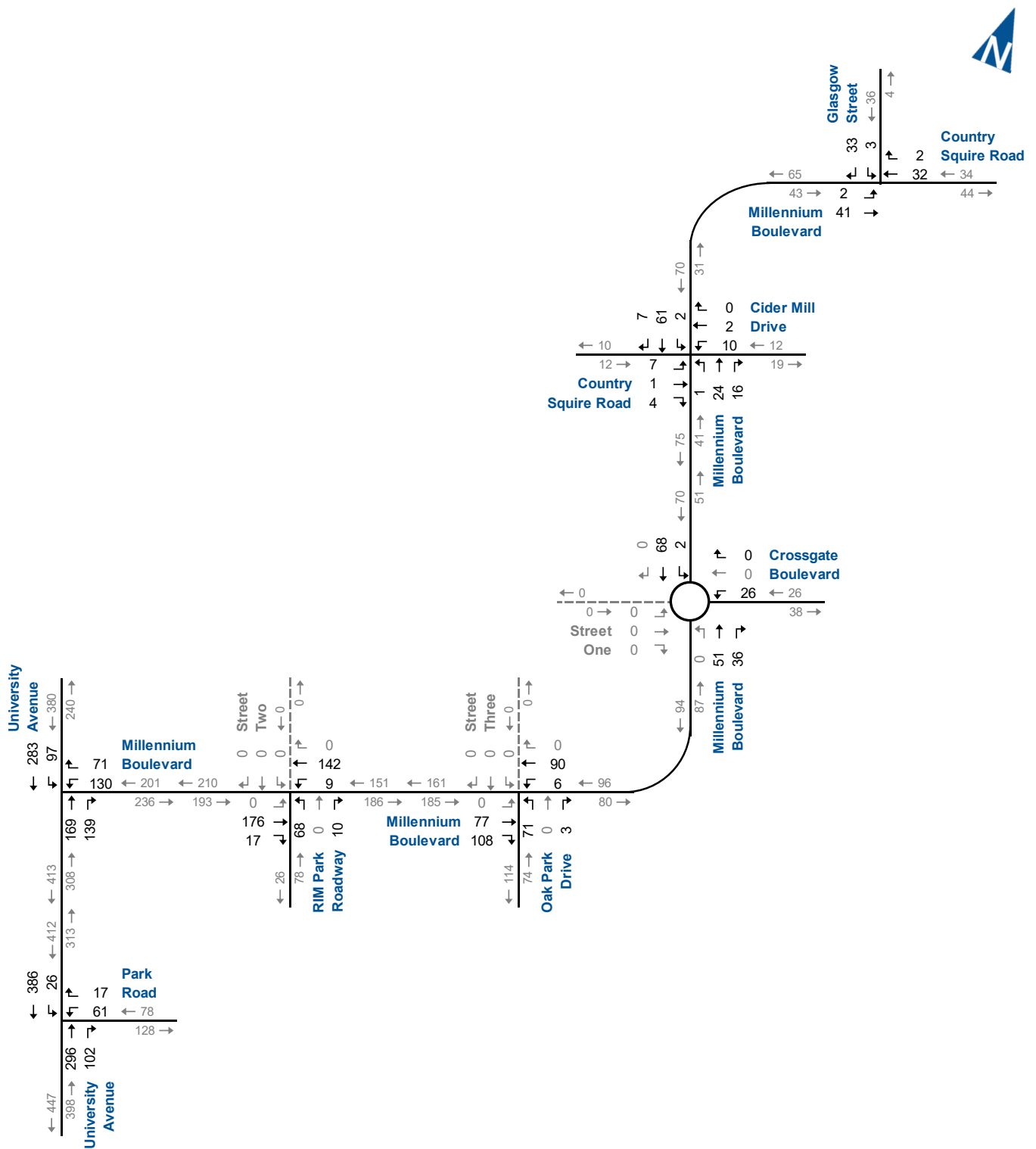
Appendix B contains the detailed traffic count information.











2.5 Traffic Operations

The level of service conditions at the study area intersections have been assessed through intersection operational analysis using Synchro 11.

Intersection level of service (LOS) is a recognized method of quantifying the average delay experienced by drivers at intersections. It is based on the delay experienced by individual vehicles executing the various movements. The delay is related to the number of vehicles intending to make a particular movement, compared to the estimated capacity for that movement. The capacity is based on several criteria related to the opposing traffic flows and intersection geometry.

The highest possible rating is LOS A, under which the average total delay is equal or less than 10.0 seconds per vehicle. When the average delay exceeds 80 seconds for signalized intersections, 50 seconds for unsignalized intersections or when the volume to capacity ratio is greater than 1.00, the movement is classed as LOS F and remedial measures are usually implemented if they are feasible. LOS E is usually used as a guideline for the determination of road improvement needs on through lanes, while LOS F may be acceptable for left-turn movements at peak times, depending on delays.

Movements are considered critical under the following conditions:

- ▶ overall intersection LOS E or F for signalized and unsignalized intersections;
- ▶ the average control delay for individual movements is greater than 55 seconds;
- ▶ estimated 95th percentile queue length for an exclusive movement exceeds the available storage space;
- ▶ estimated 95th percentile queue length for an individual movement will block an existing access; and
- ▶ exclusive turning lanes are inaccessible because of queue lengths in adjacent through lanes.

Table 2.1 summarizes the results of the intersection operational analysis under existing conditions, including the AM and PM peak hour LOS, v/c ratios, and 95th percentile queues experienced.

The results indicate that the study area intersections are operating at acceptable levels of service, and with no problem movements.

Appendix C contains the supporting detailed Synchro 11 reports.



TABLE 2.1A: EXISTING TRAFFIC OPERATIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	University Avenue & Park Road	TWSC	LOS Delay V/C Q Stor. Avail.					B 12 0.07 2 -		> > > > >	B 12		A 0 0.00 0 -	> > > > >	A 0	A 8 0.01 0 25 25	A 0 0 -		A 0	
	University Avenue & Millennium Boulevard	TWSC	LOS Delay V/C Q Stor. Avail.					B 14 0.30 10 -		A 10 0.10 2 80 78	B 12		A 0 0.00 0 -	> > > > >	A 0	A 8 0.03 1 105 104	A 0 0 -		A 2	
	RIM Park Roadway & Millennium Boulevard	TWSC	LOS Delay V/C Q		A 0 0.00 0	> > > >	A 0	< < < <	A 7 0.01 0		A 0	B 10 0.03 1		> > > >	B 10					
	Oak Park Drive & Millennium Boulevard	TWSC	LOS Delay V/C Q		A 0 0.00 0	> > > >	A 0	< < < <	A 0 0.00 0		A 0	B 11 0.16 4		> > > >	B 11					
	Millennium Boulevard & Crossgate Boulevard	RBT	LOS Delay V/C Q																	
	Millennium Boulevard & Country Squire Road/Cider Mills Drive	TWSC	LOS Delay V/C Q	< < < <	A 9 0.01 0	> > > >	A 9	< < < <	A 9 0.03 1	> > > >	A 9	< < < <	A 7 0.00 0	> > > >	A 0	< < < <	A 7 0.00 0	> > > >	A 0	
	Millennium Boulevard/Country Squire Road & Glasgow Street	TWSC	LOS Delay V/C Q	< < < <	A 7 0.01 0		A 2		A 0 0.00 0	> > > >	A 0					A 9 0.03 1		> > > >	A 9	

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio

Q - 95th Percentile Queue Length (m)

Stor. - Existing Storage (m)

Avail. - Available Storage (m)

TWSC - Two-Way Stop Control

RBT - Roundabout

</> - Shared with through movement



TABLE 2.1B: EXISTING TRAFFIC OPERATIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	University Avenue & Park Road	TWSC	LOS Delay V/C Stor. Avail.					B 14 0.16 4 - -		> > > >	B 14		A 0 0.00 0 - -	> > > >	A 0	A 8 0.02 1 25 24	A 0 0 - -	A 0		
	University Avenue & Millennium Boulevard	TWSC	LOS Delay V/C Stor. Avail.					C 18 0.31 10 - -		A 10 0.08 2 80 78	B 15		A 0 0.00 0 - -	> > > >	A 0	A 8 0.08 2 105 103	A 0 0 - -	A 2		
	RIM Park Roadway & Millennium Boulevard	TWSC	LOS Delay V/C Q		A 0 0.00 0	> > >	A 0	< < < <	A 8 0.01 0		A 0	B 11 0.12 3		> > >	B 11					
	Oak Park Drive & Millennium Boulevard	TWSC	LOS Delay V/C Q		A 0 0.00 0	> > >	A 0	< < < <	A 8 0.00 0		A 0	B 10 0.10 2		> > >	B 10					
	Millennium Boulevard & Crossgate Boulevard	RBT	LOS Delay V/C Q																	
	Millennium Boulevard & Country Squire Road/Cider Mills Drive	TWSC	LOS Delay V/C Q	< < < <	A 9 0.01 0	> > >	A 9	< < < <	A 9 0.01 0	> > >	A 9	< < < <	A 7 0.00 0	> > >	A 0	< < < <	A 7 0.00 0	> > >	A 0	
	Millennium Boulevard/Country Squire Road & Glasgow Street	TWSC	LOS Delay V/C Q	< < < <	A 7 0.00 0		A 0		A 0 0.00 0	> > >	A 0						A 9 0.04 1		> > >	A 9

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio

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Stor. - Existing Storage (m)

Avail. - Available Storage (m)

TWSC - Two-Way Stop Control

RBT - Roundabout

</> - Shared with through movement



3 Development Concept

3.1 Development Description

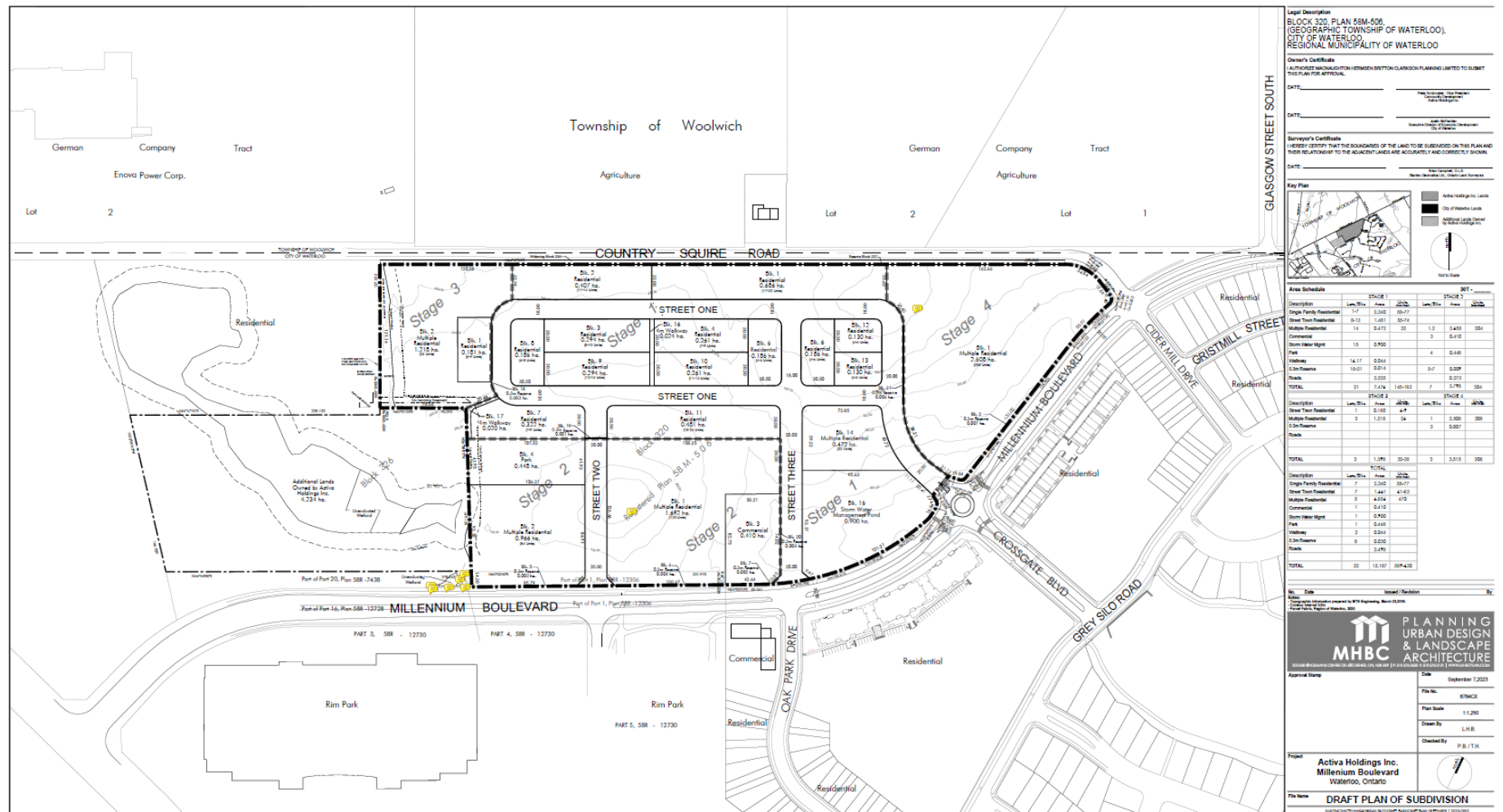
The subject site is located on Millennium Boulevard, south of Country Squire Road and east of University Avenue. The property owner is proposing to construct a residential development with a total of 630 units comprising 77 single detached houses, 83 street townhouses, 470 stacked townhouses, and approximately 11,033 sq. ft. GFA of commercial space.

Vehicle access is proposed via three connections to Millennium Boulevard: opposite of Crossgate Boulevard, Oak Park Drive, and RIM Park Road.

The development is assumed to be built-out by 2026.

Figure 3.1 shows the draft plan of subdivision.





3.2 Development Trip Generation

The Institute of Transportation Engineers (ITE) Trip Generation Manual³ rates and equations were used to estimate the peak hour traffic volumes generated by the subject development based on the following ITE Land Use Codes:

- ▶ 210, Single Family Detached Housing;
- ▶ 215, Single Family Attached Housing;
- ▶ 220, Multifamily Housing (Low Rise); and
- ▶ 822, Strip Retail Plaza (<40k).

Since this development includes residential and commercial land uses, ITE Internal Capture calculations have been applied to the total trip generation. **Appendix D** contains the internal capture calculations.

Table 3.1 summarizes the forecast number of net new trips generated by the proposed development.

TABLE 3.1: TRIP GENERATION

Land Use Code	Units	AM Peak Hour				PM Peak Hour			
		Rate	In	Out	Total	Rate	In	Out	Total
210: Single-Family Detached Housing	77 Units	Eq	15	44	59	Eq	49	29	78
215: Single-Family Attached Housing	83 Units	Eq	9	28	37	Eq	27	19	46
220: Multifamily Housing (Low-Rise)	470 Units	Eq	39	130	169	Eq	136	87	223
822: Strip Retail Plaza (<40k)	11,033 sq. ft.	2.36	16	10	26	Eq	42	41	83
Total Trip Generation			79	212	291		254	176	430
<i>Internal Trip Capture</i>		-	-3	-3	-6	-	-15	-15	-30
Net Trip Generation			76	209	285		239	161	400

LUC 210 | AM: $\ln(T) = 0.91 \ln(X) + 0.12$ | PM: $\ln(T) = 0.94 \ln(X) + 0.27$

LUC 215 | AM: $T = 0.52(X) - 5.70$ | PM: $T = 0.60(X) - 3.93$

LUC 220 | AM: $T = 0.31(X) + 22.85$ | PM: $T = 0.43(X) + 20.55$

LUC 822 | PM: $\ln(T) = 0.71 \ln(X) + 2.72$

3.3 Development Trip Distribution and Assignment

The trip distribution was determined based on Transportation Tomorrow Survey⁴ (TTS) data and existing travel patterns within the study area. The site trips are expected to follow similar routing to the exiting distribution within the study area due to the similar land uses

³ Institute of Transportation Engineers, *Trip Generation Manual*, 11th ed., (Washington, DC: ITE, 2021).

⁴ University of Toronto Department of Civil Engineering Data Management Group, *2006 Traffic Zone Boundaries*, June 2009.



surrounding the subject site. **Table 3.2** displays the breakdown of trip distributions used in this study.

The traffic volumes travelling to and from University Avenue and the residential lands on the south side of Millennium Boulevard east of the RIM Park Recreational Centre were reviewed to determine the proportion of vehicles that use Millennium Boulevard or Park Road.

Based on travel time, convenience, and delay, as well as the existing travel demands of the current carriage crossing residents, it is conservatively assumed that 90% of the site traffic volumes will use Millennium Boulevard and 10% will use Park Road.

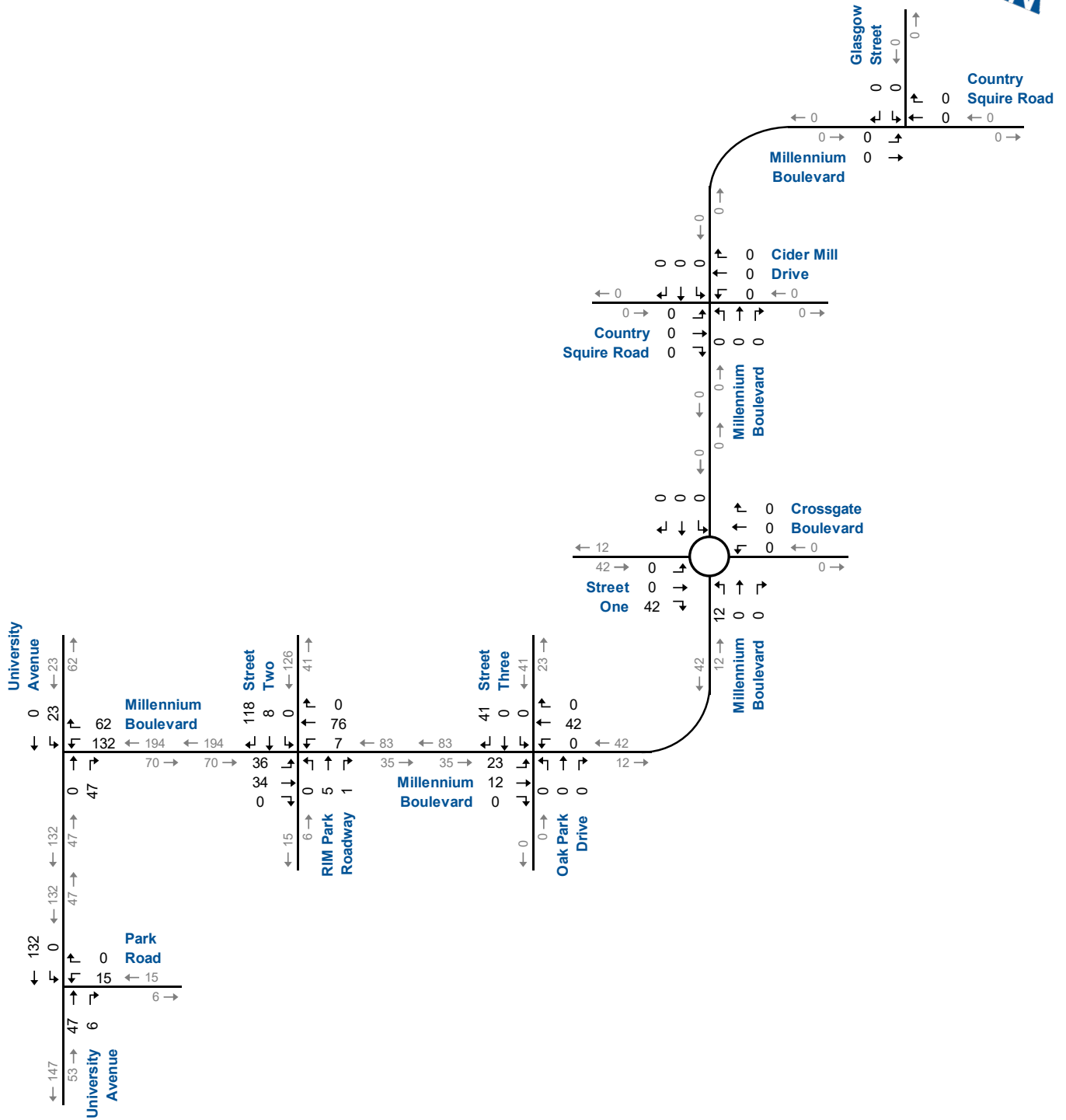
Appendix D contains the TTS survey data.

TABLE 3.2: ESTIMATED TRIP DISTRIBUTION

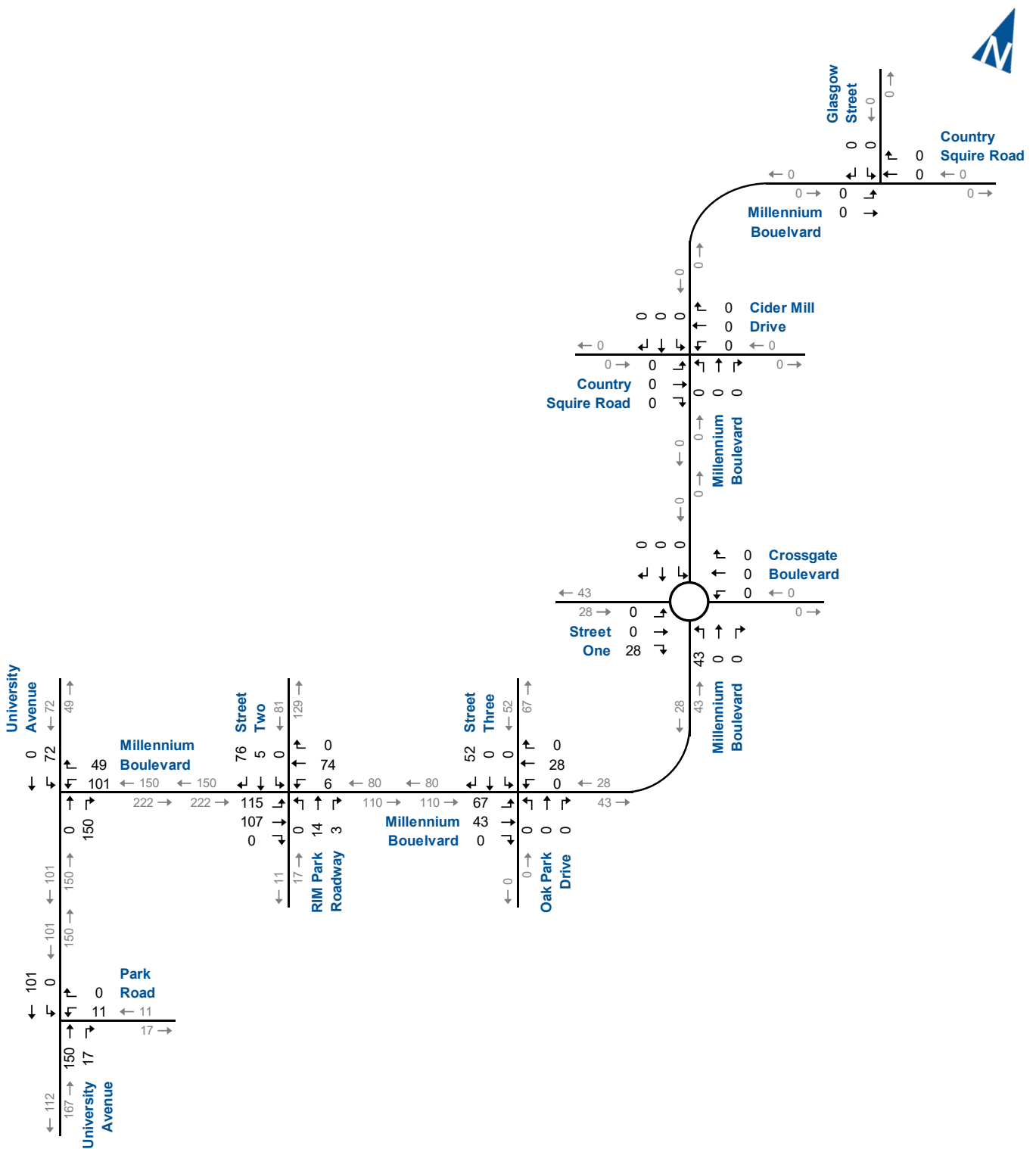
Direction	Inbound/ Outbound
North via University Avenue	30%
South via University Avenue	70%
Total	100%

Figure 3.2a and **Figure 3.2b** illustrate the site-generated traffic volumes for the AM and PM peak hours, respectively.





Site Generated Traffic Volumes AM Peak Hour



Site Generated Traffic Volumes PM Peak Hour

4 Evaluation of Future Traffic Conditions

The assessment of future traffic conditions contained in this section includes estimates of future background and total traffic volumes, and the analyses for the traffic conditions ten years after development opening (2036).

4.1 Background Traffic Forecasts

To derive the 2036 generalized background traffic volumes, a growth rate of 2.0% per annum was applied to the existing roadway traffic volumes. This growth rate was confirmed with the City during pre-study consultation.

No background developments were identified by the City during pre-study consultation.

4.2 2036 Background Traffic Operations

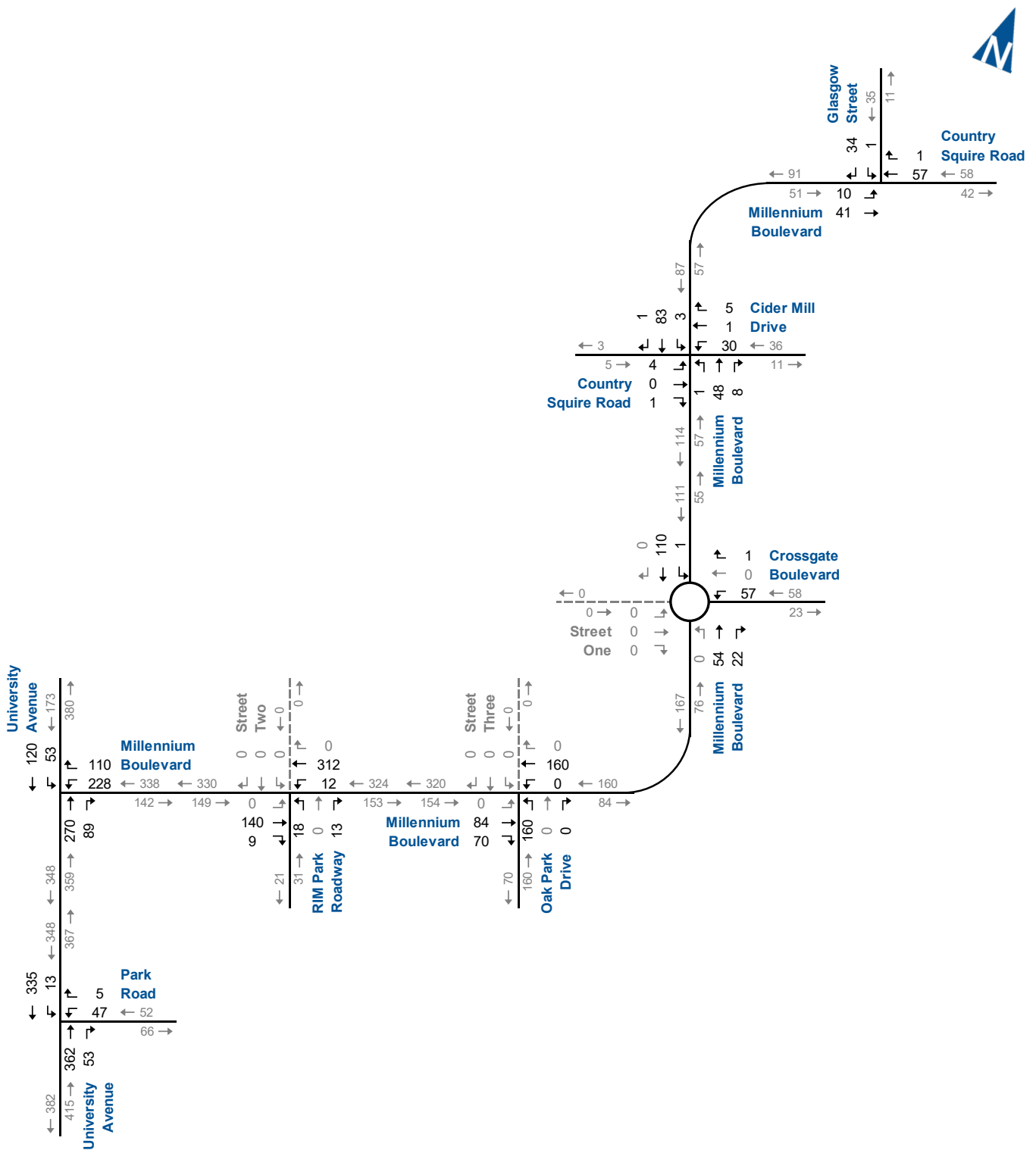
Figure 4.1a and **Figure 4.1b** respectively illustrate the 2036 background traffic volumes for the AM and PM peak hours, including road traffic growth.

The 2036 background traffic volumes have been analyzed using the same methodology as under existing traffic conditions.

Table 4.1a and **Table 4.1b** summarize the results of the 2036 background traffic operations for the AM and PM peak hours, respectively. The results indicate that the study area intersections are forecast to operate at acceptable levels of service during the AM and PM peak hours.

Appendix E contains the supporting detailed Synchro 11 reports.





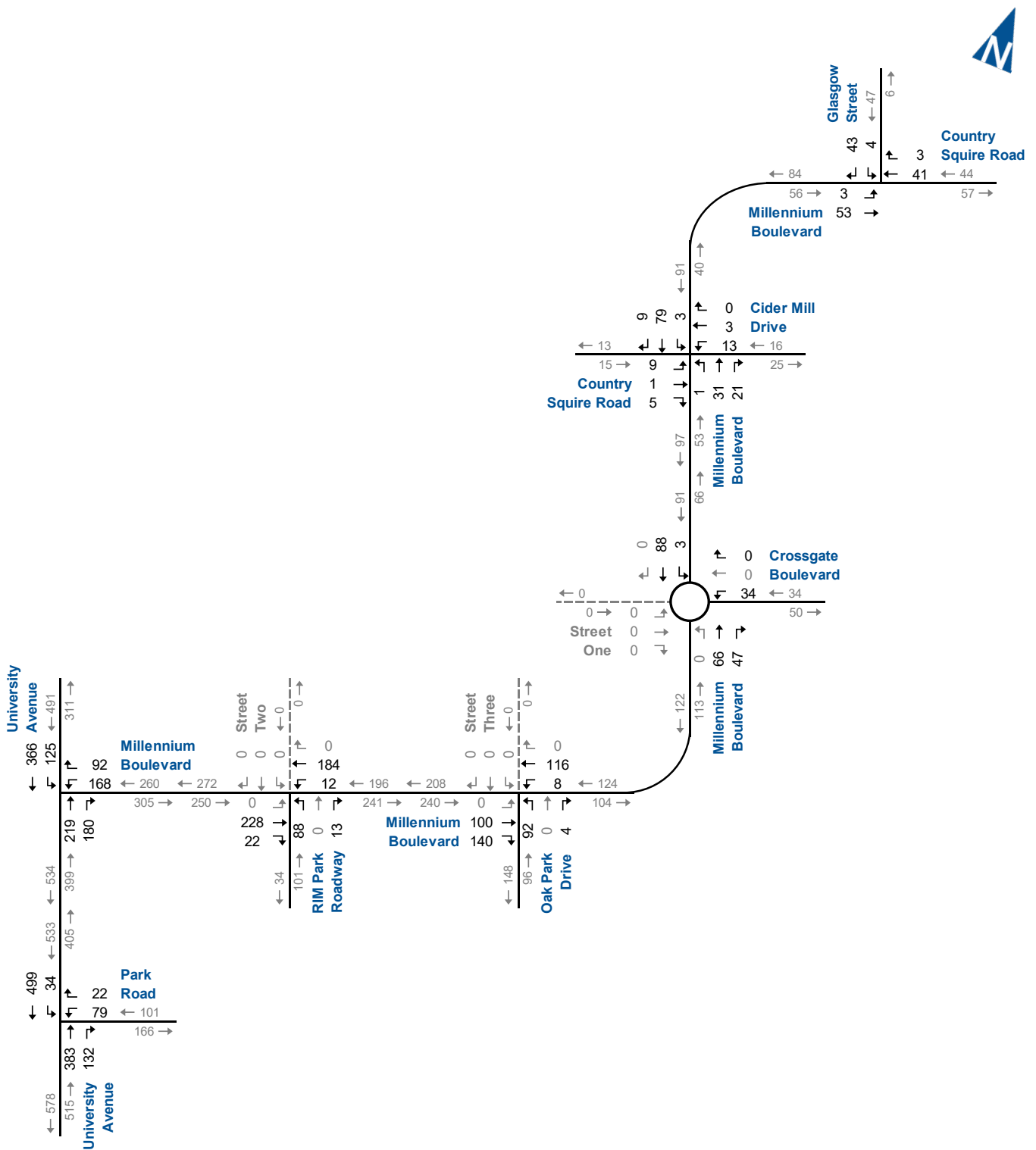


TABLE 4.1A: 2036 BACKGROUND TRAFFIC OPERATIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	University Avenue & Park Road	TWSC	LOS Delay V/C Q Stor. Avail.					B 14 0.11 3 -		> > > > >	B 14		A 0 0.00 0 -	> > > > >	A 0	A 8 0.01 0 25 25	A 0 0 0 -		A 0	
	University Avenue & Millennium Boulevard	TWSC	LOS Delay V/C Q Stor. Avail.					C 18 0.46 18 -		A 10 0.13 4 80 76	C 16		A 0 0.00 0 -	> > > > >	A 0	A 8 0.04 1 105 104	A 0 0 0 -		A 2	
	RIM Park Roadway & Millennium Boulevard	TWSC	LOS Delay V/C Q		A 0 0.00 0	> > > >	A 0	< < < <	A 8 0.01 0		A 0	B 11 0.05 2		> > > >	B 11					
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	Millennium Boulevard & Crossgate Boulevard	RBT	LOS Delay V/C Q					A 3 0.05 0		> > > >	A 3		A 3 0.07 1	> > > >	A 3	< < < <	A 3 0.10 1		A 3	
	Millennium Boulevard & Country Squire Road/Cider Mills Drive	TWSC	LOS Delay V/C Q	< < < <	A 9 0.01 0	> > > >	A 9	< < < <	A 10 0.04 1	> > > >	A 10	< < < <	A 7 0.00 0	> > > >	A 0	< < < <	A 7 0.00 0	> > > >	A 0	
	Millennium Boulevard/Country Squire Road & Glasgow Street	TWSC	LOS Delay V/C Q	< < < <	A 8 0.01 0		A 2		A 0 0.00 0	> > > >	A 0					A 9 0.04 1	> > > >		A 9	

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RBT - Roundabout

</> - Shared with through movement



TABLE 4.1B: 2036 BACKGROUND TRAFFIC OPERATIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	University Avenue & Park Road	TWSC	LOS Delay V/C Stor. Avail.					C 18 0.27 8 -		> > > >	C 18		A 0 0.00 0 -	> > > >	A 0	A 8 0.03 1 25 24	A 0 0.00 -	A 0		
	University Avenue & Millennium Boulevard	TWSC	LOS Delay V/C Stor. Avail.					D 28 0.53 22 -		A 10 0.11 3 80 77	C 22		A 0 0.00 0 -	> > > >	A 0	A 8 0.11 3 105 102	A 0 0.00 -	A 2		
	RIM Park Roadway & Millennium Boulevard	TWSC	LOS Delay V/C Q		A 0 0.00 0	> > >	A 0	< < < <	A 8 0.01 0		A 0	B 12 0.17 4		> > >	B 12					
	Oak Park Drive & Millennium Boulevard	TWSC	LOS Delay V/C Q		A 0 0.00 0	> > >	A 0	< < < <	A 8 0.01 0		A 0	B 11 0.14 4		> > >	B 11					
	Millennium Boulevard & Crossgate Boulevard	RBT	LOS Delay V/C Q					A 3 0.03 0		> > > >	A 3		A 3 0.10 1	> > >	A 3	< < < <	A 3 0.08 1		A 3	
	Millennium Boulevard & Country Squire Road/Cider Mills Drive	TWSC	LOS Delay V/C Q	< < < <	A 9 0.02 1	> > >	A 9	< < < <	A 10 0.02 1	> > >	A 10	< < < <	A 7 0.00 0	> > >	A 0	< < < <	A 7 0.00 0	> > >	A 0	
	Millennium Boulevard/Country Squire Road & Glasgow Street	TWSC	LOS Delay V/C Q	< < < <	A 7 0.00 0		A 0		A 0 0.00 0	> > >	A 0					A 9 0.05 1		> > >	A 9	

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio

Q - 95th Percentile Queue Length (m)

Stor. - Existing Storage (m)

Avail. - Available Storage (m)

TWSC - Two-Way Stop Control

RBT - Roundabout

</> - Shared with through movement



4.3 2036 Total Traffic Operations

Figure 4.2a and **Figure 4.2b** respectively illustrate the 2036 total traffic volumes for the AM and PM peak hours, including trips generated by the proposed development.

The 2036 total traffic volumes have been analyzed using the same methodology as under existing and background traffic conditions.

Table 4.2a and **Table 4.2b** summarize the results of the 2036 total traffic operations for the AM and PM peak hours, respectively.

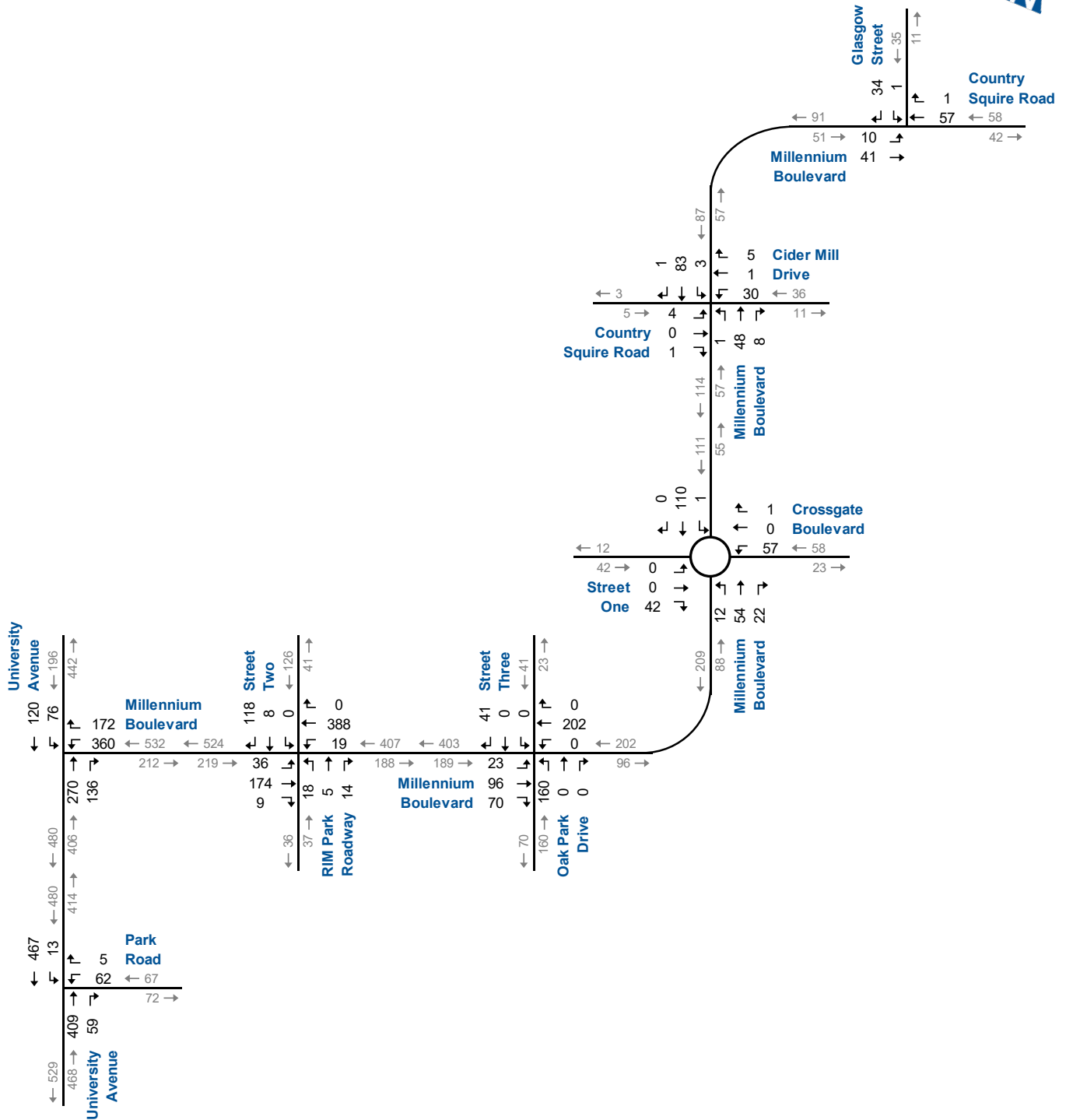
The results indicate that the study area intersections are forecast to operate at acceptable levels of service during the AM and PM peak hours, except for the westbound left-turn movement at University Avenue and Millennium Boulevard, which is forecast to operate at LOS F with a v/c ratio greater than 1.00 during the PM peak hour. The 95th percentile queue length is also projected to exceed the available storage for the right-turn lane by approximately 30 metres during the PM peak hour.

It is noted that the westbound right-turn lane could be extended by 30 metres by removing approximately five on-street parking spaces on the north side of Millennium Boulevard through re-painting the pavement marking.

Traffic intending to turn left onto University Avenue East will have the option to use the intersection at Park Road, which is forecast to operate within capacity.

Appendix F contains the supporting detailed Synchro 11 reports.





2036 Total Traffic Volumes AM Peak Hour

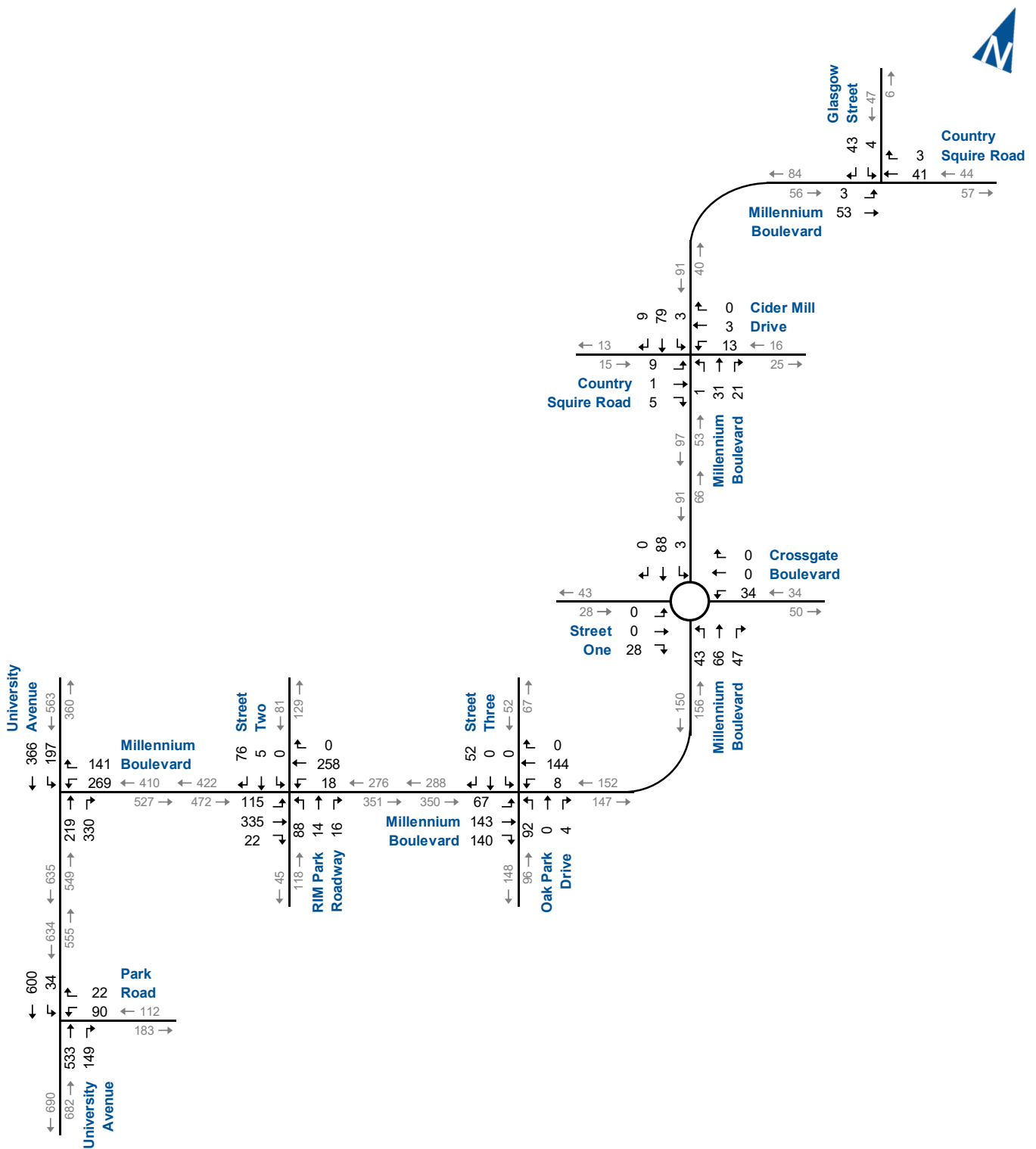


TABLE 4.2A: 2036 TOTAL TRAFFIC OPERATIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	University Avenue & Park Road	TWSC	LOS Delay V/C Q Stor. Avail.					C 16 0.17 4 - -		> > > > >	C 16		A 0 0.00 0 - -	> > > > >	A 0	A 8 0.01 0 25 25	A 0 0.00 0 - -		A 0	
	University Avenue & Millennium Boulevard	TWSC	LOS Delay V/C Q Stor. Avail.					E 42 0.83 58 - -		B 11 0.22 6 80 74	D 32		A 0 0.00 0 - -	> > > > >	A 0	A 8 0.07 2 105 103	A 0 0.00 0 - -		A 3	
	RIM Park Roadway/Street Two & Millennium Boulevard	TWSC	LOS Delay V/C Q	< < < <	A 8 0.03 1	> > > >	A 1	< < < <	A 8 0.01 0	> > > >	A 0	< < < <	C 16 0.10 2	> > > >	C 16	< < < <	B 12 0.20 5	> > > >	B 12	
	Oak Park Drive/Street Three & Millennium Boulevard	TWSC	LOS Delay V/C Q	< < < <	A 8 0.02 1	> > > >	A 1	< < < <	A 0 0.00 0	> > > >	A 0	< < < <	B 15 0.31 10	> > > >	B 15	< < < <	A 10 0.05 2	> > > >	A 10	
	Millennium Boulevard & Crossgate Boulevard	RBT	LOS Delay V/C Q	< < < <	A 3 0.04 0	> > > >	A 3	< < < <	A 3 0.05 0	> > > >	A 3	< < < <	A 3 0.07 1	> > > >	A 3	< < < <	A 3 0.09 1	> > > >	A 3	
	Millennium Boulevard & Country Squire Road/Cider Mills Drive	TWSC	LOS Delay V/C Q	< < < <	A 9 0.01 0	> > > >	A 9	< < < <	A 10 0.04 1	> > > >	A 10	< < < <	A 7 0.00 0	> > > >	A 0	< < < <	A 7 0.00 0	> > > >	A 0	
	Millennium Boulevard/Country Squire Road & Glasgow Street	TWSC	LOS Delay V/C Q	< < < <	A 8 0.01 0		A 2		A 0 0.00 0	> > > >	A 0					A 9 0.04 1		> > > >	A 9	

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio

Q - 95th Percentile Queue Length (m)

Stor. - Existing Storage (m)

Avail. - Available Storage (m)

TWSC - Two-Way Stop Control

</> - Shared with through movement



TABLE 4.2B: 2036 TOTAL TRAFFIC OPERATIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction/Movement/Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	University Avenue & Park Road	TWSC	LOS Delay V/C Stor. Avail.					D 27 0.41 14 -		> > > >	D 27		A 0 0.00 0 -	> > > >	A 0	A 9 0.04 1 25 24	A 0 0.00 0 -		A 0	
	University Avenue & Millennium Boulevard	TWSC	LOS Delay V/C Stor. Avail.					F 216 1.31 111 -		B 11 0.20 5 80 75	F 146		A 0 0.00 0 -	> > > >	A 0	A 10 0.20 5 105 100	A 0 0.00 0 -		A 3	
	RIM Park Roadway/Street Two & Millennium Boulevard	TWSC	LOS Delay V/C Q	< < < <	A 8 0.09 2	> > > >	A 2	< < < <	A 8 0.01 0	> > > >	A 0	< < < <	E 36 0.51 20	> > > >	E 36	< < < <	B 11 0.12 3	> > > >	B 11	
	Oak Park Drive/Street Three & Millennium Boulevard	TWSC	LOS Delay V/C Q	< < < <	A 8 0.05 1	> > > >	A 2	< < < <	A 8 0.01 0	> > > >	A 0	< < < <	C 16 0.23 7	> > > >	C 16	< < < <	A 9 0.06 2	> > > >	A 9	
	Millennium Boulevard & Crossgate Boulevard	RBT	LOS Delay V/C Q	< < < <	A 3 0.02 0	> > > >	A 3	< < < <	A 4 0.12 1	> > > >	A 4	< < < <	A 3 0.12 1	> > > >	A 3	< < < <	A 4 0.08 1	> > > >	A 4	
	Millennium Boulevard & Country Squire Road/Cider Mills Drive	TWSC	LOS Delay V/C Q	< < < <	A 9 0.02 1	> > > >	A 9	< < < <	A 10 0.02 1	> > > >	A 10	< < < <	A 7 0.00 0	> > > >	A 0	< < < <	A 0 0.00 0	> > > >	A 0	
	Millennium Boulevard/Country Squire Road & Glasgow Street	TWSC	LOS Delay V/C Q	< < < <	A 0 0.00 0	> > > >	A 0	< < < <	A 0 0.00 0	> > > >	A 0					A 9 0.05 1	> > > >	> > > >	A 9	

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio

Q - 95th Percentile Queue Length (m)

Stor. - Existing Storage (m)

Avail. - Available Storage (m)

TWSC - Two-Way Stop Control

</> - Shared with through movement



4.4 Left-Turn Lanes

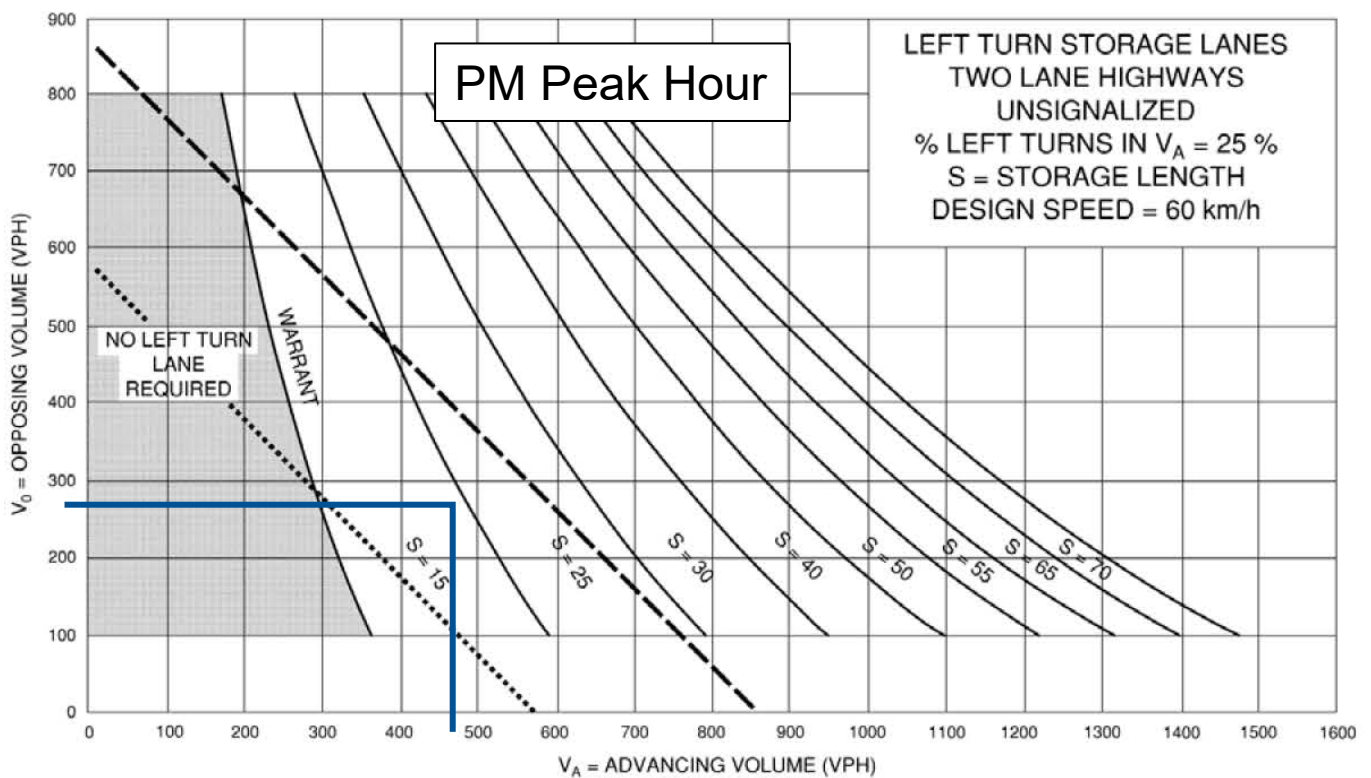
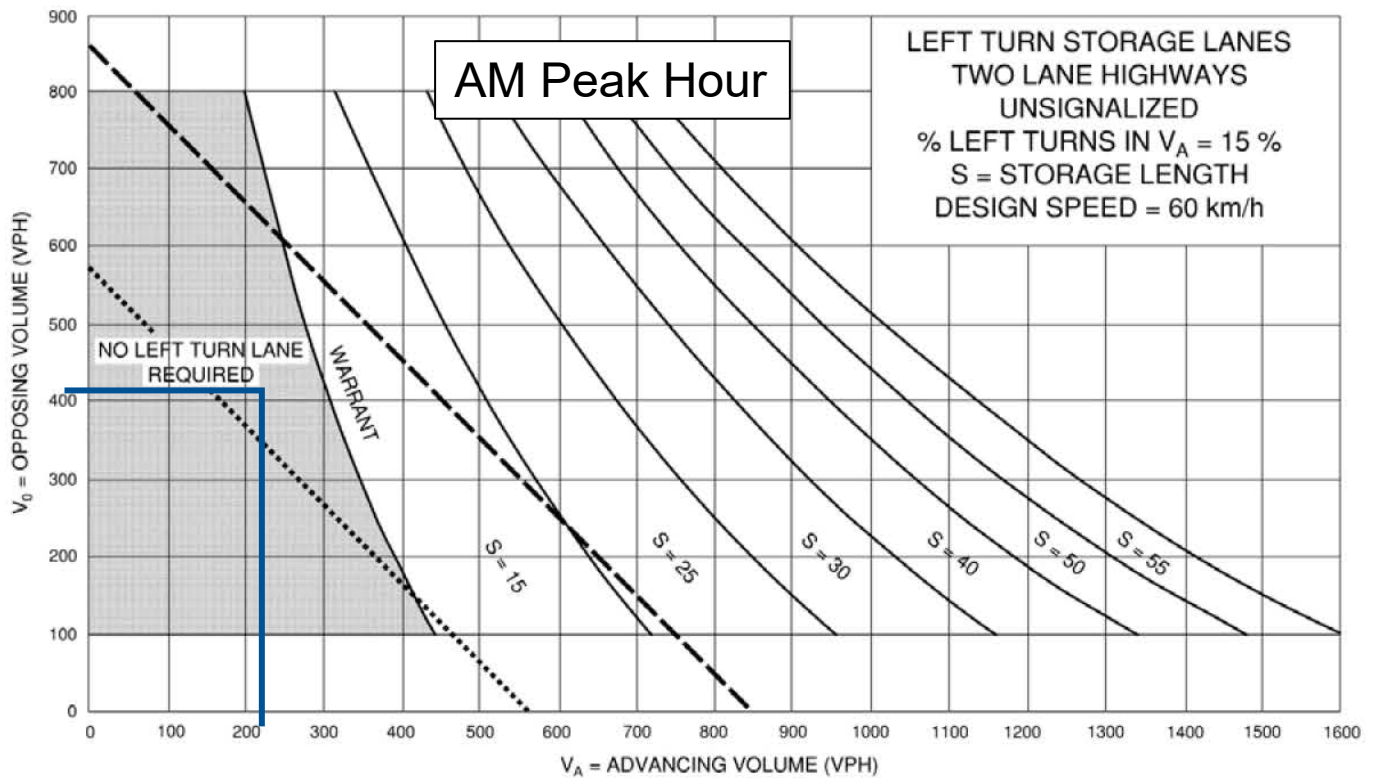
The need for auxiliary eastbound left-turn turning lane on Millennium Boulevard at the proposed site accesses were assessed based on the requirements and procedures detailed in the Ministry of Transportation Design Supplement for the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads⁵. The assessment is based on the nomographs for left-turn lanes on a two-lane undivided highway at an unsignalized intersection with a design speed of 10 kilometres per hour over the assumed speed limit (60 km/h).

Based on these criteria, an eastbound left-turn lane is not warranted on Millennium Boulevard at Street Three; however, an eastbound left-turn lane is warranted on Millennium Boulevard at Street Two with 15 metres of storage under 2036 total traffic conditions.

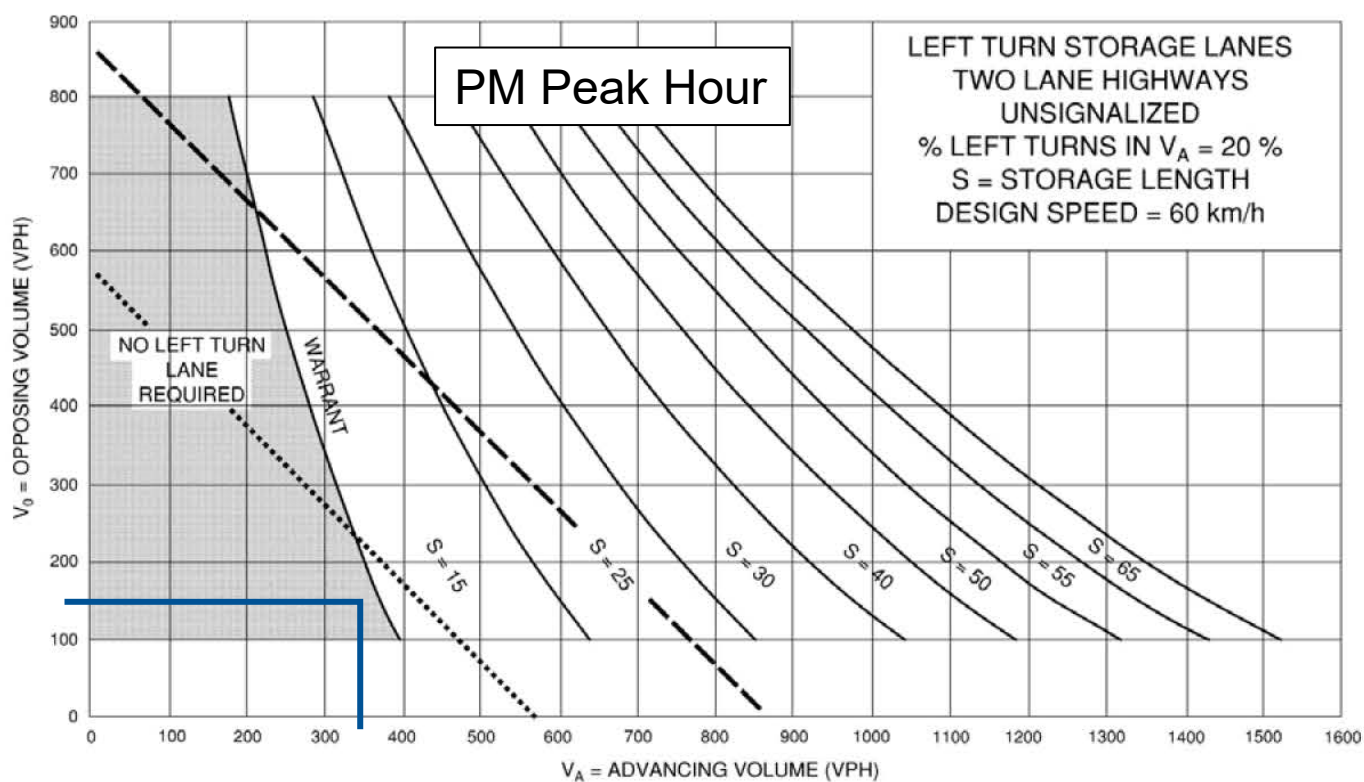
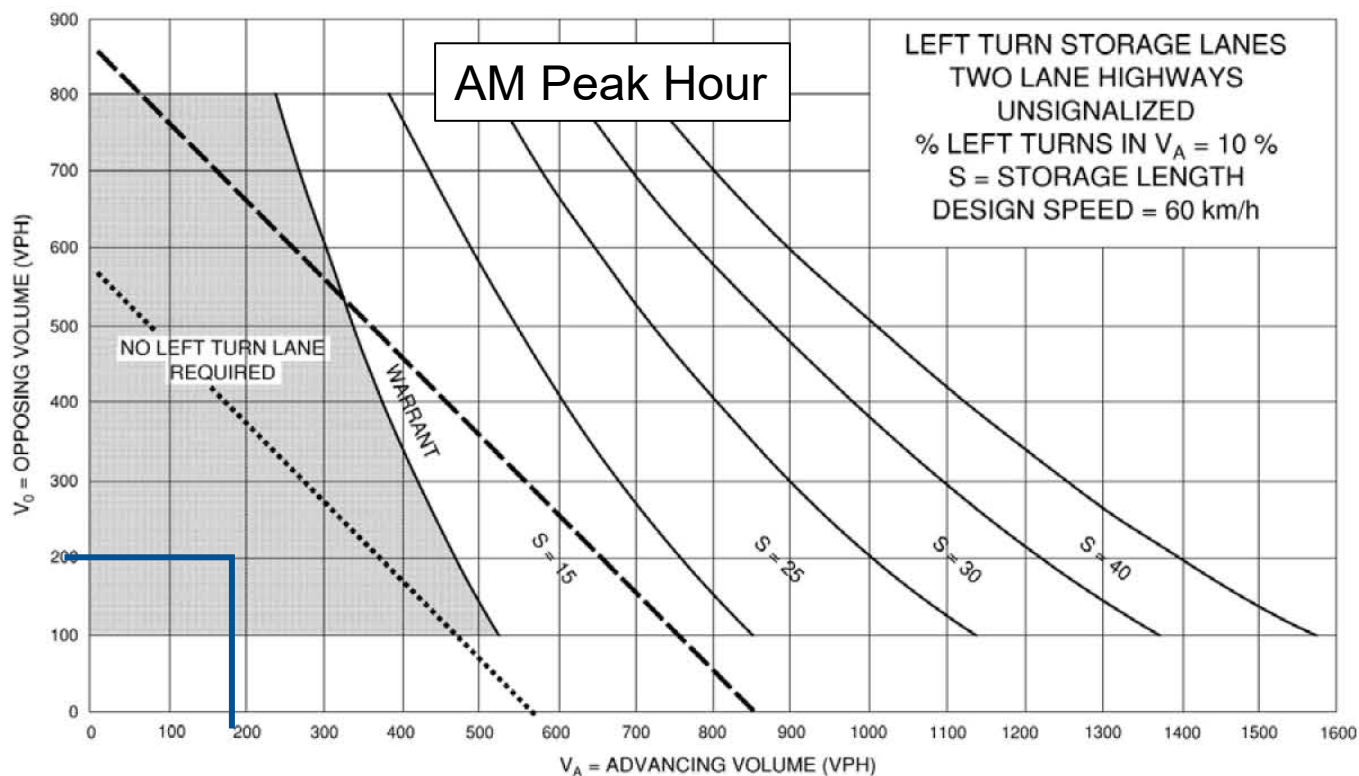
Figure 4.3a and **Figure 4.3b** illustrate the warrant nomographs.

⁵ MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads, June 2017.





Millennium Boulevard and Street Two Eastbound Left-Turn Lane 2036 Total Traffic Conditions



Millennium Boulevard and Street Three Eastbound Left-Turn Lane 2036 Total Traffic Conditions

4.5 Traffic Signal Control Justification

The requirement for traffic signal control at the intersection of University Avenue and Millennium Boulevard was assessed using the Ontario Traffic Manual (OTM) Traffic Signal Control Justification 7⁶.

Based on the warrant analysis in Justification 7, traffic signal control is not justified at the University Avenue and Millennium Boulevard intersection.

Appendix G contains the warrant analysis worksheets.

⁶ Ontario Traffic Manual Book 12 – Traffic Signals.



5 Conclusions and Recommendations

5.1 Conclusions

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

- ▶ **Existing Traffic Conditions:** All study area intersections are currently operating at acceptable levels of service.
- ▶ **Development Trip Generation:** The development is forecast to generate 285 and 400 net trips during the AM and PM peak hours, respectively.
- ▶ **2036 Background Traffic Conditions:** All study area intersections are forecast to operate at acceptable levels of service.
- ▶ **2036 Total Traffic Conditions:** All study area intersections are forecast to operate at acceptable levels of service except for the westbound left-turn movement at University Avenue and Millennium Boulevard, which is forecast to operate at LOS F with a v/c ratio greater than 1.00 during the PM peak hour. The 95th percentile queue length is also projected to exceed the available storage for the right-turn lane by approximately 30 metres during the PM peak hour.
- ▶ **University Avenue and Millennium Boulevard:** The requirement for traffic signal control was assessed at the intersection. Traffic signal control is not warranted at the intersection of University Avenue and Millennium Boulevard under 2036 total traffic conditions. Traffic intending to turn left onto University Avenue East will have the option to use the intersection at Park Road, which is forecast to operate within capacity.

The westbound left-turn movement 95th percentile queue length is noted to be forecast to exceed the available storage for the right-turn lane by approximately 30 metres during the PM peak hour. The westbound right-turn lane could be extended by 30 metres by removing approximately five on-street parking spaces on the north side of Millennium Boulevard through re-painting the pavement marking.

- ▶ **Site Access Intersections:** The Site Access intersections on Millennium Boulevard are forecast to operate at acceptable levels of service under 2036 total traffic conditions.

It is noted that an eastbound left-turn lane is warranted with 15 metres of storage on Millennium Boulevard at RIM Park Roadway / Street Two under 2036 total traffic conditions.



5.2 Recommendations

Based on the findings of this study, it is recommended that the development be considered for approval, as proposed, with the following transportation-related conditions:

- ▶ the westbound right-turn lane at University Avenue and Millennium Boulevard be extended by 30 metres through repainting the pavement marking; and
- ▶ an eastbound left-turn lane be constructed on Millennium Boulevard at Street Two.



Appendix A

Pre-Study Consultation



**PRE-STUDY CONFERENCE FORM
(220328) 400 MILLENNIUM BOULEVARD**

Item	Description	Details
1	List Issues expected that may impact the content or recommendations of the subject Transportation Impact Study	
INTRODUCTION		
2	Nature of application (Attach a drawing)	○ Official Plan Amendment ○ Zoning Amendment ○ Plan of Subdivision
3	TIS process, and relevant policies, procedures and approvals	○ Guidelines for the preparation of Transportation Impact Studies in Support of Development Applications ○ Transportation Impact Studies Requirements for Capacity Analysis, Roundabouts, Turn Lanes
4	Public Meeting	○ Not Required
CONTEXT		
5	Study intersections (Intersections to be analyzed) Note: the consultant is responsible to identify any further intersections impacted as the study progresses.	○ University Avenue and Millennium Boulevard
		○ University Avenue and Park Road
		○ Millennium Boulevard and RIM Park / Site Entrance
		○ Millennium Boulevard and Oak Park Drive
		○ Millennium Boulevard and Crossgate Boulevard
		○ Millennium Boulevard and Country Squire Road / Cider Mill Drive
		○ Millennium Boulevard and Glasgow Street South
6	Size and number of phases of development	○ Single Phase: 623 units; 85 singles, 60 cluster towns, 62 street towns, 416 stacked towns, and approximately 11,033 sq. ft. GFA of commercial uses.

Item	Description	Details
7	Approved and pending approval development applications	○ None
8	Planned transportation system improvements	○ None
TRAVEL DEMAND		
9	Horizon years	○ 10 years after full occupancy
10	Peak hour determination	○ AM weekday peak hour of adjacent roadway ○ PM weekday peak hour of adjacent roadway
11	Background	○ 2% per annum based on 2008 study
12	Trip generation	○ ITE average rates ○ ITE fitted equations
13	Trip reductions (TDM, internal, pass-by)	○ none
14	Trip distribution	○ ITE trip distribution IN/OUT split
15	Trip assignment	○ Site layout and access design ○ TTS data

Item	Description	Details
EVALUATION OF IMPACTS		
16	Traffic impact analysis (Use approved software)	○ Unsignalized intersections ○ left turn warrant analysis ○ signal warrant analysis ○ Signalized intersections ○ LOS, v/c, delay, queuing ○ ROW saturation flow rates ○ Existing signal timings for existing conditions ○ Optimize signal timings for future conditions ○ Queuing analysis ○ Roundabouts
17	Roundabout feasibility (Use approved software)	○ Initial screening ○ Intersection control study (10 year horizon)
18	Transit assessment	○ Frequency and hours of service ○ Presence of bus stops
19	Pedestrian assessment	○ Presence, connectivity, and width of sidewalks ○ Crossing opportunities at intersections
20	Cycling assessment	○ Presence of a dedicated facility ○ Network connectivity
21	Safety analysis	○ Road safety review ○ Collision risk analysis ○ Access conflict evaluation
22	Site access and circulation	○ Review sight distances at all new access points ○ Internal traffic controls
23	Submission Format	○ Three hard copies of main report including appendices (other than analysis/results output (Synchro reports) ○ Minimum one original copy must be sealed by a professional engineer ○ Electronic copy of complete report and all appendices ○ Electronic copy of operational analysis files (e.g. Synchro, Arcady) ○ Electronic copy of signal warrant calculations files ○ Other

Appendix B

Existing Traffic Data





Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cdowness@pts1.com

Count Name: Milleium Blvd & Country Squire
Road
Site Code: 220328
Start Date: 12/06/2022
Page No: 1

Turning Movement Data

Start Time	Millenium Blvd Eastbound						Millenium Blvd Westbound						Cider Mill Drive Northbound						Country Squire Road Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
7:30 AM	0	4	1	0	0	5	1	16	1	0	0	18	1	1	0	0	0	2	2	0	0	0	0	2	27
7:45 AM	0	8	2	0	0	10	0	18	0	0	0	18	2	0	3	0	0	5	1	0	0	0	1	1	34
Hourly Total	0	12	3	0	0	15	1	34	1	0	0	36	3	1	3	0	0	7	3	0	0	0	1	3	61
8:00 AM	1	7	1	0	1	9	0	21	1	0	0	22	9	1	0	0	0	10	1	0	0	0	0	1	42
8:15 AM	0	15	2	0	0	17	2	12	0	0	0	14	6	0	0	0	0	6	0	0	0	0	0	0	37
8:30 AM	0	7	1	0	0	8	0	13	0	0	0	13	6	0	1	0	0	7	1	0	1	0	0	2	30
8:45 AM	0	8	4	0	1	12	0	12	2	0	1	14	5	0	0	0	0	5	0	0	0	0	0	0	31
Hourly Total	1	37	8	0	2	46	2	58	3	0	1	63	26	1	1	0	0	28	2	0	1	0	0	3	140
9:00 AM	0	3	0	0	0	3	0	14	0	0	0	14	4	0	0	0	0	4	1	0	0	0	0	1	22
9:15 AM	0	3	1	0	1	4	0	10	1	1	0	12	2	0	0	0	0	2	1	0	0	0	0	1	19
9:30 AM	0	4	1	0	0	5	0	12	1	0	0	13	3	2	0	0	0	5	1	0	0	0	0	1	24
9:45 AM	0	6	2	0	0	8	0	17	2	0	0	19	2	1	0	0	0	3	0	1	1	0	0	2	32
Hourly Total	0	16	4	0	1	20	0	53	4	1	0	58	11	3	0	0	0	14	3	1	1	0	0	5	97
10:00 AM	1	4	1	0	0	6	0	11	1	0	0	12	1	0	0	0	0	1	1	1	0	0	0	2	21
10:15 AM	0	6	1	1	0	8	0	8	0	0	1	8	1	1	0	0	0	2	1	0	1	0	0	2	20
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	1	10	2	1	0	14	0	19	1	0	1	20	2	1	0	0	0	3	2	1	1	0	0	4	41
12:00 PM	1	7	5	0	0	13	0	14	0	0	0	14	1	1	0	0	0	2	0	0	0	0	0	0	29
12:15 PM	0	4	2	0	0	6	0	4	0	0	0	4	0	1	0	0	0	1	2	0	0	0	1	2	13
12:30 PM	0	6	2	0	1	8	0	11	2	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	21
12:45 PM	1	1	2	0	0	4	0	12	0	0	0	12	2	1	1	0	0	4	0	0	0	0	0	0	20
Hourly Total	2	18	11	0	1	31	0	41	2	0	0	43	3	3	1	0	0	7	2	0	0	0	1	2	83
1:00 PM	0	7	2	0	1	9	0	10	1	0	0	11	1	1	1	0	0	3	1	0	0	0	0	1	24
1:15 PM	1	6	1	1	0	9	0	16	1	0	0	17	2	0	1	0	0	3	1	0	1	0	0	2	31
1:30 PM	0	7	1	0	0	8	2	6	2	0	0	10	1	0	0	0	0	1	0	0	0	0	0	0	19
1:45 PM	0	3	0	0	0	3	0	13	1	0	0	14	3	0	0	0	0	3	1	0	1	0	0	2	22
Hourly Total	1	23	4	1	1	29	2	45	5	0	0	52	7	1	2	0	0	10	3	0	2	0	0	5	96
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	0	10	5	0	0	15	1	16	4	0	0	21	3	0	0	0	0	3	1	0	2	0	0	3	42
3:15 PM	1	4	3	0	0	8	0	17	1	0	0	18	4	0	0	0	1	4	3	0	0	0	0	3	33
3:30 PM	0	6	3	0	1	9	1	11	0	0	0	12	2	1	0	0	1	3	1	0	2	0	0	3	27
3:45 PM	0	4	5	0	0	9	0	17	2	0	1	19	1	1	0	0	0	2	2	1	0	0	0	3	33
Hourly Total	1	24	16	0	1	41	2	61	7	0	1	70	10	2	0	0	2	12	7	1	4	0	0	12	135
4:00 PM	0	12	0	0	0	12	0	13	1	0	0	14	1	0	0	0	0	1	1	0	0	0	0	1	28
4:15 PM	0	6	3	0	0	9	1	17	5	0	0	23	4	0	2	0	0	6	1	0	0	0	0	1	39

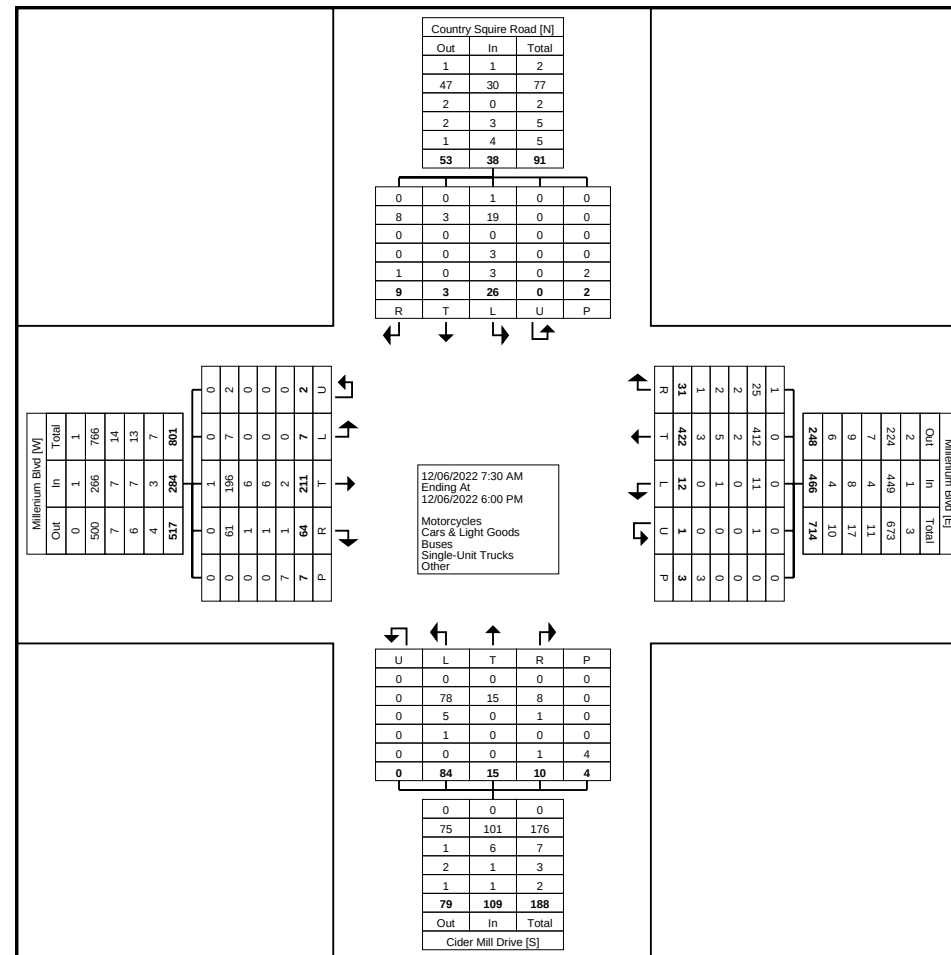
4:30 PM	0	8	2	0	0	10	1	12	1	0	0	14	6	1	0	0	1	7	0	0	0	0	0	0	31
4:45 PM	1	10	0	0	1	11	0	10	0	0	0	10	2	0	0	0	0	2	1	0	0	0	0	1	24
Hourly Total	1	36	5	0	1	42	2	52	7	0	0	61	13	1	2	0	1	16	3	0	0	0	0	3	122
5:00 PM	0	8	1	0	0	9	0	19	1	0	0	20	2	0	1	0	1	3	0	0	0	0	0	0	32
5:15 PM	0	12	7	0	0	19	1	19	0	0	0	20	1	0	0	0	0	1	1	0	0	0	0	1	41
5:30 PM	0	10	2	0	0	12	1	13	0	0	0	14	4	2	0	0	0	6	0	0	0	0	0	0	32
5:45 PM	0	5	1	0	0	6	1	8	0	0	0	9	2	0	0	0	0	2	0	0	0	0	0	0	17
Hourly Total	0	35	11	0	0	46	3	59	1	0	0	63	9	2	1	0	1	12	1	0	0	0	0	1	122
Grand Total	7	211	64	2	7	284	12	422	31	1	3	466	84	15	10	0	4	109	26	3	9	0	2	38	897
Approach %	2.5	74.3	22.5	0.7	-	-	2.6	90.6	6.7	0.2	-	-	77.1	13.8	9.2	0.0	-	-	68.4	7.9	23.7	0.0	-	-	-
Total %	0.8	23.5	7.1	0.2	-	31.7	1.3	47.0	3.5	0.1	-	52.0	9.4	1.7	1.1	0.0	-	12.2	2.9	0.3	1.0	0.0	-	4.2	-
Motorcycles	0	1	0	0	-	1	0	0	1	0	-	1	0	0	0	0	-	0	1	0	0	0	-	1	3
% Motorcycles	0.0	0.5	0.0	0.0	-	0.4	0.0	0.0	3.2	0.0	-	0.2	0.0	0.0	0.0	-	-	0.0	3.8	0.0	0.0	-	-	2.6	0.3
Cars & Light Goods	7	196	61	2	-	266	11	412	25	1	-	449	78	15	8	0	-	101	19	3	8	0	-	30	846
% Cars & Light Goods	100.0	92.9	95.3	100.0	-	93.7	91.7	97.6	80.6	100.0	-	96.4	92.9	100.0	80.0	-	-	92.7	73.1	100.0	88.9	-	-	78.9	94.3
Buses	0	6	1	0	-	7	0	2	2	0	-	4	5	0	1	0	-	6	0	0	0	0	-	0	17
% Buses	0.0	2.8	1.6	0.0	-	2.5	0.0	0.5	6.5	0.0	-	0.9	6.0	0.0	10.0	-	-	5.5	0.0	0.0	0.0	-	-	0.0	1.9
Single-Unit Trucks	0	6	1	0	-	7	1	5	2	0	-	8	1	0	0	0	-	1	3	0	0	0	-	3	19
% Single-Unit Trucks	0.0	2.8	1.6	0.0	-	2.5	8.3	1.2	6.5	0.0	-	1.7	1.2	0.0	0.0	-	-	0.9	11.5	0.0	0.0	-	-	7.9	2.1
Articulated Trucks	0	0	1	0	-	1	0	1	0	0	-	1	0	0	0	0	-	0	0	0	0	0	-	0	2
% Articulated Trucks	0.0	0.0	1.6	0.0	-	0.4	0.0	0.2	0.0	0.0	-	0.2	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.2
Bicycles on Road	0	2	0	0	-	2	0	2	1	0	-	3	0	0	1	0	-	1	3	0	1	0	-	4	10
% Bicycles on Road	0.0	0.9	0.0	0.0	-	0.7	0.0	0.5	3.2	0.0	-	0.6	0.0	0.0	10.0	-	-	0.9	11.5	0.0	11.1	-	-	10.5	1.1
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	7	-	-	-	-	-	3	-	-	-	-	-	4	-	-	-	-	-	2	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsl.com

Count Name: Milleium Blvd & Country Squire
Road
Site Code: 220328
Start Date: 12/06/2022
Page No: 3



Turning Movement Data Plot



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsl.com

Count Name: Milleium Blvd & Country Squire Road
Site Code: 220328
Start Date: 12/06/2022
Page No: 4

Turning Movement Peak Hour Data (7:45 AM)

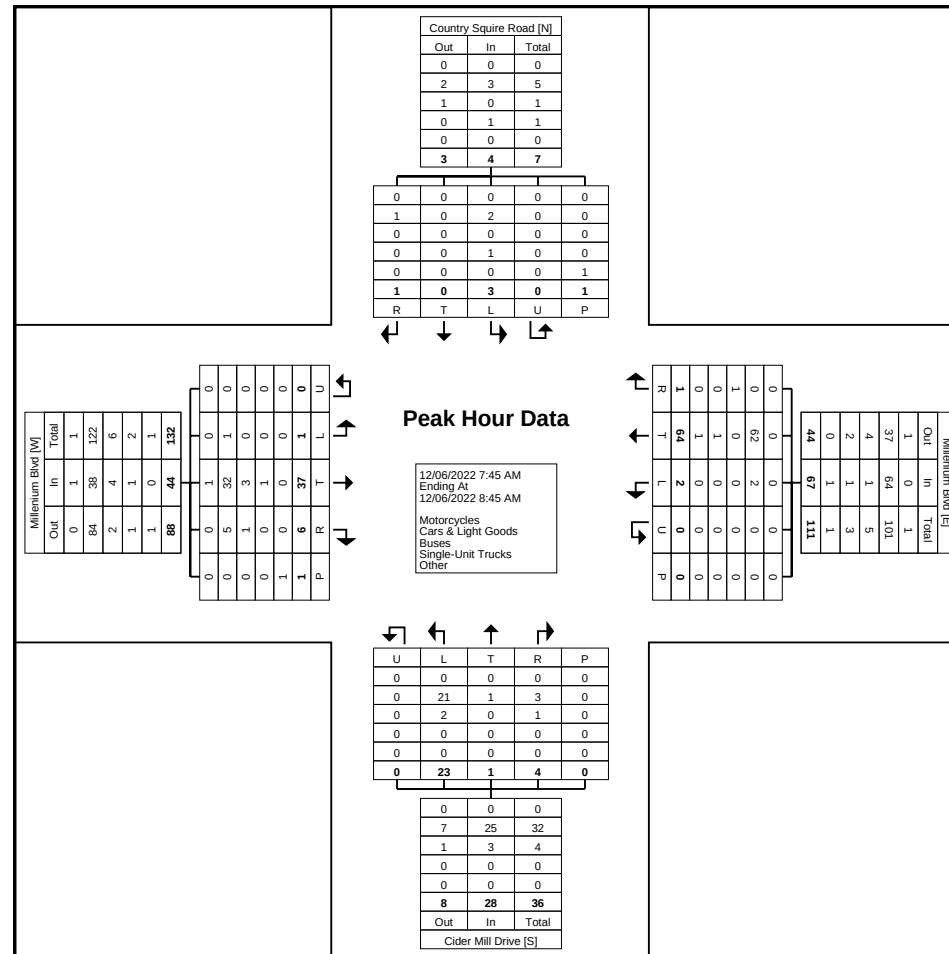
Start Time	Millenium Blvd Eastbound						Millenium Blvd Westbound						Cider Mill Drive Northbound						Country Squire Road Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
7:45 AM	0	8	2	0	0	10	0	18	0	0	0	18	2	0	3	0	0	5	1	0	0	0	1	1	34
8:00 AM	1	7	1	0	1	9	0	21	1	0	0	22	9	1	0	0	0	10	1	0	0	0	0	1	42
8:15 AM	0	15	2	0	0	17	2	12	0	0	0	14	6	0	0	0	0	6	0	0	0	0	0	0	37
8:30 AM	0	7	1	0	0	8	0	13	0	0	0	13	6	0	1	0	0	7	1	0	1	0	0	2	30
Total	1	37	6	0	1	44	2	64	1	0	0	67	23	1	4	0	0	28	3	0	1	0	1	4	143
Approach %	2.3	84.1	13.6	0.0	-	-	3.0	95.5	1.5	0.0	-	-	82.1	3.6	14.3	0.0	-	-	75.0	0.0	25.0	0.0	-	-	-
Total %	0.7	25.9	4.2	0.0	-	30.8	1.4	44.8	0.7	0.0	-	46.9	16.1	0.7	2.8	0.0	-	19.6	2.1	0.0	0.7	0.0	-	2.8	-
PHF	0.250	0.617	0.750	0.000	-	0.647	0.250	0.762	0.250	0.000	-	0.761	0.639	0.250	0.333	0.000	-	0.700	0.750	0.000	0.250	0.000	-	0.500	0.851
Motorcycles	0	1	0	0	-	1	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	1
% Motorcycles	0.0	2.7	0.0	-	-	2.3	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	-	0.0	-	-	0.0	0.7
Cars & Light Goods	1	32	5	0	-	38	2	62	0	0	-	64	21	1	3	0	-	25	2	0	1	0	-	3	130
% Cars & Light Goods	100.0	86.5	83.3	-	-	86.4	100.0	96.9	0.0	-	-	95.5	91.3	100.0	75.0	-	-	89.3	66.7	-	100.0	-	-	75.0	90.9
Buses	0	3	1	0	-	4	0	0	1	0	-	1	2	0	1	0	-	3	0	0	0	0	-	0	8
% Buses	0.0	8.1	16.7	-	-	9.1	0.0	0.0	100.0	-	-	1.5	8.7	0.0	25.0	-	-	10.7	0.0	-	0.0	-	-	0.0	5.6
Single-Unit Trucks	0	1	0	0	-	1	0	1	0	0	-	1	0	0	0	0	-	0	1	0	0	0	-	1	3
% Single-Unit Trucks	0.0	2.7	0.0	-	-	2.3	0.0	1.6	0.0	-	-	1.5	0.0	0.0	0.0	-	-	0.0	33.3	-	0.0	-	-	25.0	2.1
Articulated Trucks	0	0	0	0	-	0	0	1	0	0	-	1	0	0	0	0	-	0	0	0	0	0	-	0	1
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	1.6	0.0	-	-	1.5	0.0	0.0	0.0	-	-	0.0	0.0	-	0.0	-	-	0.0	0.7
Bicycles on Road	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	-	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-



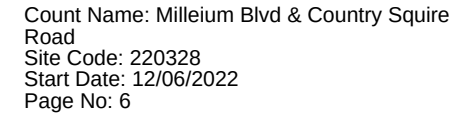
Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Milleium Blvd & Country Squire
Road
Site Code: 220328
Start Date: 12/06/2022
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Turning Movement Peak Hour Data Plot (7:45 AM)

[illegible]

Turning Movement Peak Hour Data Plot (12:30 PM)



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsl.com

Count Name: Milleium Blvd & Country Squire Road
Site Code: 220328
Start Date: 12/06/2022
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Turning Movement Peak Hour Data (3:00 PM)

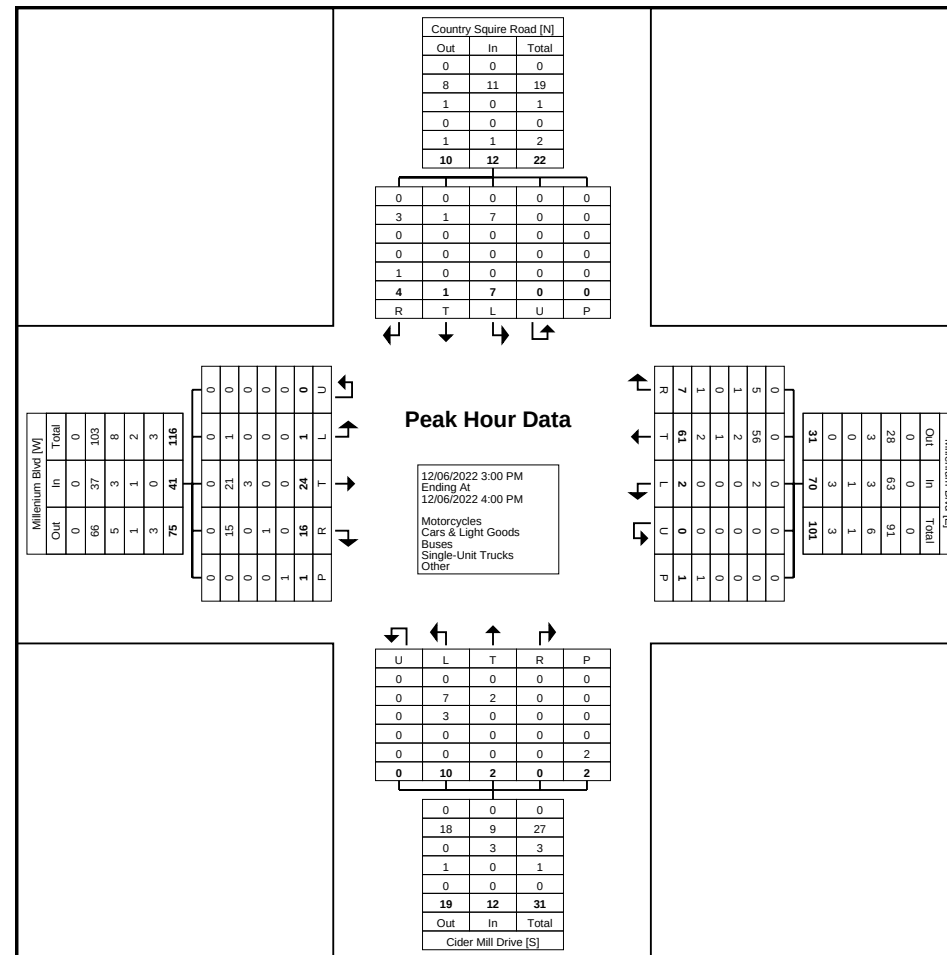
Start Time	Millenium Blvd Eastbound						Millenium Blvd Westbound						Cider Mill Drive Northbound						Country Squire Road Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
3:00 PM	0	10	5	0	0	15	1	16	4	0	0	21	3	0	0	0	0	3	1	0	2	0	0	3	42
3:15 PM	1	4	3	0	0	8	0	17	1	0	0	18	4	0	0	0	1	4	3	0	0	0	0	3	33
3:30 PM	0	6	3	0	1	9	1	11	0	0	0	12	2	1	0	0	1	3	1	0	2	0	0	3	27
3:45 PM	0	4	5	0	0	9	0	17	2	0	1	19	1	1	0	0	0	2	2	1	0	0	0	3	33
Total	1	24	16	0	1	41	2	61	7	0	1	70	10	2	0	0	2	12	7	1	4	0	0	12	135
Approach %	2.4	58.5	39.0	0.0	-	-	2.9	87.1	10.0	0.0	-	-	83.3	16.7	0.0	0.0	-	-	58.3	8.3	33.3	0.0	-	-	-
Total %	0.7	17.8	11.9	0.0	-	30.4	1.5	45.2	5.2	0.0	-	51.9	7.4	1.5	0.0	0.0	-	8.9	5.2	0.7	3.0	0.0	-	8.9	-
PHF	0.250	0.600	0.800	0.000	-	0.683	0.500	0.897	0.438	0.000	-	0.833	0.625	0.500	0.000	0.000	-	0.750	0.583	0.250	0.500	0.000	-	1.000	0.804
Motorcycles	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	1	21	15	0	-	37	2	56	5	0	-	63	7	2	0	0	-	9	7	1	3	0	-	11	120
% Cars & Light Goods	100.0	87.5	93.8	-	-	90.2	100.0	91.8	71.4	-	-	90.0	70.0	100.0	-	-	-	75.0	100.0	100.0	75.0	-	-	91.7	88.9
Buses	0	3	0	0	-	3	0	2	1	0	-	3	3	0	0	0	-	3	0	0	0	0	-	0	9
% Buses	0.0	12.5	0.0	-	-	7.3	0.0	3.3	14.3	-	-	4.3	30.0	0.0	-	-	-	25.0	0.0	0.0	0.0	-	-	0.0	6.7
Single-Unit Trucks	0	0	1	0	-	1	0	1	0	0	-	1	0	0	0	0	-	0	0	0	0	0	-	0	2
% Single-Unit Trucks	0.0	0.0	6.3	-	-	2.4	0.0	1.6	0.0	-	-	1.4	0.0	0.0	-	-	-	0.0	0.0	0.0	0.0	-	-	0.0	1.5
Articulated Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	0	0	0	0	-	0	0	2	1	0	-	3	0	0	0	0	-	0	0	0	1	0	-	1	4
% Bicycles on Road	0.0	0.0	0.0	-	-	0.0	0.0	3.3	14.3	-	-	4.3	0.0	0.0	-	-	-	0.0	0.0	0.0	25.0	-	-	8.3	3.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	0	-	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	0	-	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Milleium Blvd & Country Squire
Road
Site Code: 220328
Start Date: 12/06/2022
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Turning Movement Peak Hour Data Plot (3:00 PM)



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: University Avenue & Park Road
Site Code: 220328
Start Date: 12/06/2022
Page No: 1

Turning Movement Data

Start Time	Park Road Westbound					University Avenue Northbound					University Avenue Southbound					Int. Total
	Left	Right	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	
7:30 AM	17	3	0	0	20	63	2	0	0	65	0	52	0	0	52	137
7:45 AM	11	1	0	1	12	76	11	0	0	87	0	55	0	0	55	154
Hourly Total	28	4	0	1	32	139	13	0	0	152	0	107	0	0	107	291
8:00 AM	11	0	0	1	11	60	7	1	0	68	0	72	0	0	72	151
8:15 AM	12	3	0	1	15	77	6	0	0	83	1	65	0	0	66	164
8:30 AM	2	0	0	2	2	67	17	0	0	84	9	67	0	0	76	162
8:45 AM	6	0	0	1	6	47	27	1	0	75	10	63	0	0	73	154
Hourly Total	31	3	0	5	34	251	57	2	0	310	20	267	0	0	287	631
9:00 AM	10	0	0	0	10	52	11	2	0	65	4	58	0	0	62	137
9:15 AM	3	1	0	2	4	49	11	0	0	60	3	45	0	0	48	112
9:30 AM	4	1	0	4	5	45	7	0	0	52	3	45	0	0	48	105
9:45 AM	9	4	0	1	13	50	11	0	0	61	0	45	0	0	45	119
Hourly Total	26	6	0	7	32	196	40	2	0	238	10	193	0	0	203	473
10:00 AM	4	1	0	2	5	51	12	0	0	63	4	42	0	0	46	114
10:15 AM	5	3	0	3	8	30	10	0	0	40	2	32	0	0	34	82
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	9	4	0	5	13	81	22	0	0	103	6	74	0	0	80	196
12:00 PM	16	6	0	1	22	41	8	0	0	49	4	57	1	0	62	133
12:15 PM	4	3	0	0	7	46	11	1	0	58	2	58	0	0	60	125
12:30 PM	12	4	0	2	16	52	8	3	0	63	0	47	1	1	48	127
12:45 PM	3	2	0	1	5	39	7	0	0	46	2	44	0	0	46	97
Hourly Total	35	15	0	4	50	178	34	4	0	216	8	206	2	1	216	482
1:00 PM	10	0	0	0	10	46	10	0	0	56	2	47	0	0	49	115
1:15 PM	9	3	0	2	12	54	9	1	0	64	1	57	0	0	58	134
1:30 PM	19	5	0	3	24	39	18	1	0	58	1	51	0	1	52	134
1:45 PM	9	5	0	0	14	50	11	5	0	66	3	51	0	0	54	134
Hourly Total	47	13	0	5	60	189	48	7	0	244	7	206	0	1	213	517
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	16	3	0	2	19	51	14	0	0	65	5	68	0	0	73	157
3:15 PM	13	5	0	4	18	56	15	0	0	71	3	65	0	0	68	157
3:30 PM	13	1	0	1	14	58	14	0	0	72	1	67	1	0	69	155
3:45 PM	22	5	0	2	27	73	31	0	0	104	5	58	0	0	63	194
Hourly Total	64	14	0	9	78	238	74	0	0	312	14	258	1	0	273	663
4:00 PM	39	6	0	1	45	69	20	0	0	89	6	71	0	0	77	211
4:15 PM	21	8	0	3	29	74	13	1	0	88	4	64	0	0	68	185
4:30 PM	11	2	0	1	13	77	18	0	0	95	1	97	0	0	98	206

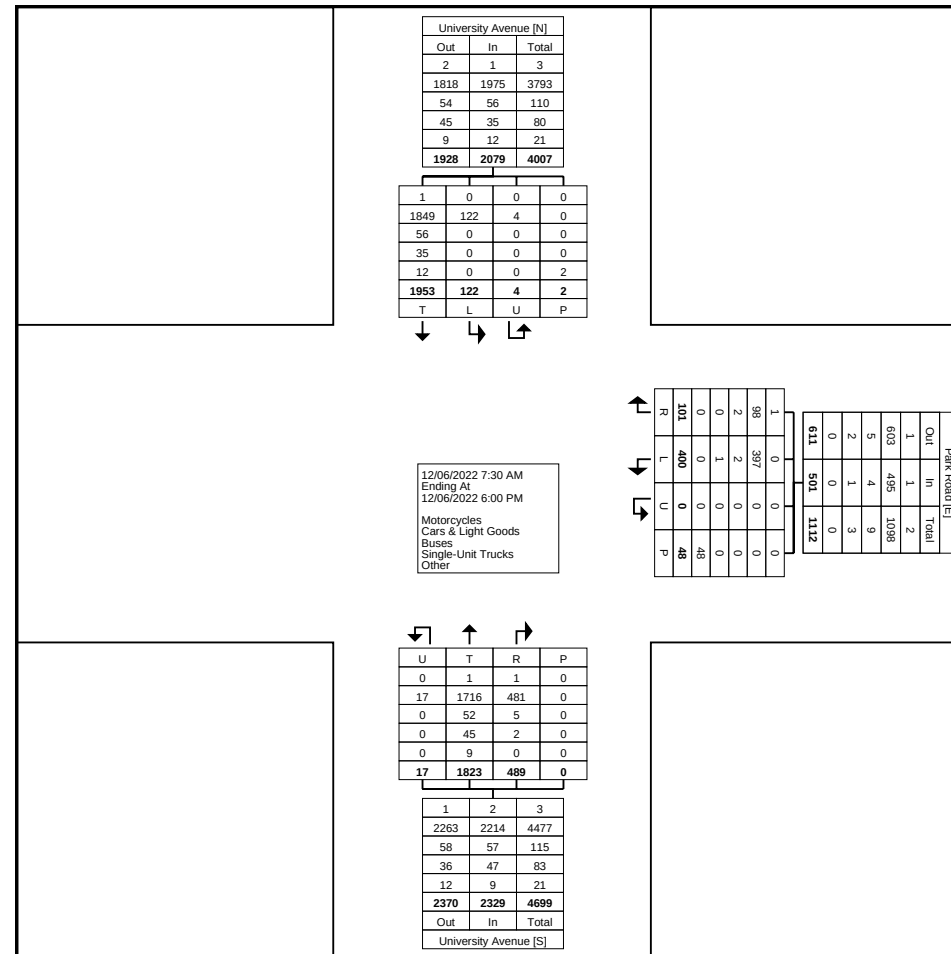
4:45 PM	9	4	0	2	13	79	28	0	0	107	5	94	1	0	100	220
Hourly Total	80	20	0	7	100	299	79	1	0	379	16	326	1	0	343	822
5:00 PM	26	4	0	1	30	74	16	1	0	91	2	100	0	0	102	223
5:15 PM	15	7	0	1	22	66	40	0	0	106	18	95	0	0	113	241
5:30 PM	23	7	0	1	30	60	25	0	0	85	14	62	0	0	76	191
5:45 PM	16	4	0	2	20	52	41	0	0	93	7	59	0	0	66	179
Hourly Total	80	22	0	5	102	252	122	1	0	375	41	316	0	0	357	834
Grand Total	400	101	0	48	501	1823	489	17	0	2329	122	1953	4	2	2079	4909
Approach %	79.8	20.2	0.0	-	-	78.3	21.0	0.7	-	-	5.9	93.9	0.2	-	-	-
Total %	8.1	2.1	0.0	-	10.2	37.1	10.0	0.3	-	47.4	2.5	39.8	0.1	-	42.4	-
Motorcycles	0	1	0	-	1	1	1	0	-	2	0	1	0	-	1	4
% Motorcycles	0.0	1.0	-	-	0.2	0.1	0.2	0.0	-	0.1	0.0	0.1	0.0	-	0.0	0.1
Cars & Light Goods	397	98	0	-	495	1716	481	17	-	2214	122	1849	4	-	1975	4684
% Cars & Light Goods	99.3	97.0	-	-	98.8	94.1	98.4	100.0	-	95.1	100.0	94.7	100.0	-	95.0	95.4
Buses	2	2	0	-	4	52	5	0	-	57	0	56	0	-	56	117
% Buses	0.5	2.0	-	-	0.8	2.9	1.0	0.0	-	2.4	0.0	2.9	0.0	-	2.7	2.4
Single-Unit Trucks	1	0	0	-	1	45	2	0	-	47	0	35	0	-	35	83
% Single-Unit Trucks	0.3	0.0	-	-	0.2	2.5	0.4	0.0	-	2.0	0.0	1.8	0.0	-	1.7	1.7
Articulated Trucks	0	0	0	-	0	8	0	0	-	8	0	10	0	-	10	18
% Articulated Trucks	0.0	0.0	-	-	0.0	0.4	0.0	0.0	-	0.3	0.0	0.5	0.0	-	0.5	0.4
Bicycles on Road	0	0	0	-	0	1	0	0	-	1	0	2	0	-	2	3
% Bicycles on Road	0.0	0.0	-	-	0.0	0.1	0.0	0.0	-	0.0	0.0	0.1	0.0	-	0.1	0.1
Bicycles on Crosswalk	-	-	-	2	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	4.2	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	46	-	-	-	-	0	-	-	-	-	2	-	-
% Pedestrians	-	-	-	95.8	-	-	-	-	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: University Avenue & Park Road
Site Code: 220328
Start Date: 12/06/2022
Page No: 3



Turning Movement Data Plot

[illegible]

Turning Movement Peak Hour Data Plot (7:45 AM)



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: University Avenue & Park Road
Site Code: 220328
Start Date: 12/06/2022
Page No: 6

Turning Movement Peak Hour Data (1:00 PM)

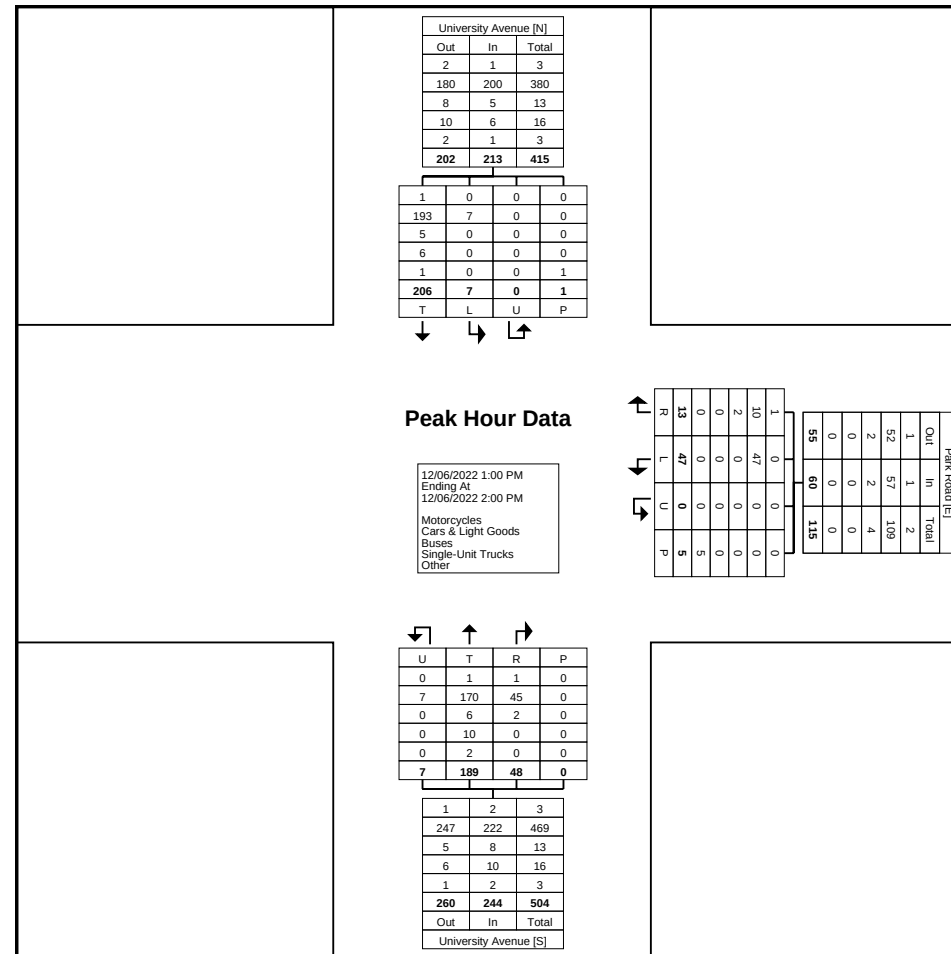
Start Time	Park Road Westbound					University Avenue Northbound					University Avenue Southbound					Int. Total
	Left	Right	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	
1:00 PM	10	0	0	0	10	46	10	0	0	56	2	47	0	0	49	115
1:15 PM	9	3	0	2	12	54	9	1	0	64	1	57	0	0	58	134
1:30 PM	19	5	0	3	24	39	18	1	0	58	1	51	0	1	52	134
1:45 PM	9	5	0	0	14	50	11	5	0	66	3	51	0	0	54	134
Total	47	13	0	5	60	189	48	7	0	244	7	206	0	1	213	517
Approach %	78.3	21.7	0.0	-	-	77.5	19.7	2.9	-	-	3.3	96.7	0.0	-	-	-
Total %	9.1	2.5	0.0	-	11.6	36.6	9.3	1.4	-	47.2	1.4	39.8	0.0	-	41.2	-
PHF	0.618	0.650	0.000	-	0.625	0.875	0.667	0.350	-	0.924	0.583	0.904	0.000	-	0.918	0.965
Motorcycles	0	1	0	-	1	1	1	0	-	2	0	1	0	-	1	4
% Motorcycles	0.0	7.7	-	-	1.7	0.5	2.1	0.0	-	0.8	0.0	0.5	-	-	0.5	0.8
Cars & Light Goods	47	10	0	-	57	170	45	7	-	222	7	193	0	-	200	479
% Cars & Light Goods	100.0	76.9	-	-	95.0	89.9	93.8	100.0	-	91.0	100.0	93.7	-	-	93.9	92.6
Buses	0	2	0	-	2	6	2	0	-	8	0	5	0	-	5	15
% Buses	0.0	15.4	-	-	3.3	3.2	4.2	0.0	-	3.3	0.0	2.4	-	-	2.3	2.9
Single-Unit Trucks	0	0	0	-	0	10	0	0	-	10	0	6	0	-	6	16
% Single-Unit Trucks	0.0	0.0	-	-	0.0	5.3	0.0	0.0	-	4.1	0.0	2.9	-	-	2.8	3.1
Articulated Trucks	0	0	0	-	0	1	0	0	-	1	0	1	0	-	1	2
% Articulated Trucks	0.0	0.0	-	-	0.0	0.5	0.0	0.0	-	0.4	0.0	0.5	-	-	0.5	0.4
Bicycles on Road	0	0	0	-	0	1	0	0	-	1	0	0	0	-	0	1
% Bicycles on Road	0.0	0.0	-	-	0.0	0.5	0.0	0.0	-	0.4	0.0	0.0	-	-	0.0	0.2
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	0.0	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	5	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: University Avenue & Park Road
Site Code: 220328
Start Date: 12/06/2022
Page No: 7



Turning Movement Peak Hour Data Plot (1:00 PM)



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



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Country Squire
Glasgow Street
Site Code: 220328
Start Date: 12/06/2022
Page No: 1

Turning Movement Data

Start Time	Millenium Blvd Eastbound					Country Squire Road Westbound					Glasgow Street Southbound					Int. Total
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
7:30 AM	2	4	0	0	6	15	0	0	0	15	0	2	0	0	2	23
7:45 AM	4	8	0	0	12	11	0	0	0	11	0	8	0	0	8	31
Hourly Total	6	12	0	0	18	26	0	0	0	26	0	10	0	0	10	54
8:00 AM	1	7	0	0	8	12	0	0	0	12	0	8	0	0	8	28
8:15 AM	1	13	0	0	14	6	1	0	0	7	1	8	0	0	9	30
8:30 AM	0	10	0	0	10	7	0	0	0	7	0	6	0	0	6	23
8:45 AM	0	8	0	0	8	9	0	0	0	9	1	5	0	0	6	23
Hourly Total	2	38	0	0	40	34	1	0	0	35	2	27	0	0	29	104
9:00 AM	2	2	0	0	4	7	0	0	0	7	1	7	0	0	8	19
9:15 AM	1	4	0	0	5	6	0	0	0	6	2	6	0	0	8	19
9:30 AM	2	3	0	0	5	7	0	0	0	7	0	6	0	0	6	18
9:45 AM	0	5	0	0	5	11	0	0	0	11	0	8	0	0	8	24
Hourly Total	5	14	0	0	19	31	0	0	0	31	3	27	0	0	30	80
10:00 AM	0	6	0	0	6	11	0	0	0	11	1	2	0	0	3	20
10:15 AM	1	6	0	0	7	6	0	0	0	6	1	2	0	0	3	16
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	1	12	0	0	13	17	0	0	0	17	2	4	0	0	6	36
12:00 PM	0	8	0	0	8	6	2	0	0	8	0	9	0	0	9	25
12:15 PM	0	6	0	0	6	1	0	0	0	1	2	2	0	0	4	11
12:30 PM	0	6	0	0	6	8	0	0	0	8	0	5	0	0	5	19
12:45 PM	1	1	0	0	2	7	0	0	0	7	0	5	0	0	5	14
Hourly Total	1	21	0	0	22	22	2	0	0	24	2	21	0	0	23	69
1:00 PM	1	7	1	0	9	6	1	0	0	7	2	4	0	0	6	22
1:15 PM	2	6	0	0	8	12	2	0	0	14	0	5	0	0	5	27
1:30 PM	0	5	2	0	7	5	0	0	0	5	1	2	0	0	3	15
1:45 PM	2	2	0	0	4	11	0	0	0	11	2	3	0	0	5	20
Hourly Total	5	20	3	0	28	34	3	0	0	37	5	14	0	0	19	84
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	1	10	0	0	11	12	1	0	0	13	1	10	0	0	11	35
3:15 PM	0	7	0	0	7	8	0	0	0	8	0	10	0	0	10	25
3:30 PM	1	6	0	0	7	5	1	0	0	6	0	8	0	0	8	21
3:45 PM	1	5	0	0	6	8	0	0	0	8	2	10	0	0	12	26
Hourly Total	3	28	0	0	31	33	2	0	0	35	3	38	0	0	41	107
4:00 PM	0	13	0	0	13	9	0	0	0	9	1	8	0	0	9	31
4:15 PM	3	6	0	0	9	10	0	0	0	10	1	12	0	0	13	32
4:30 PM	1	7	0	0	8	5	0	0	0	5	1	9	0	0	10	23

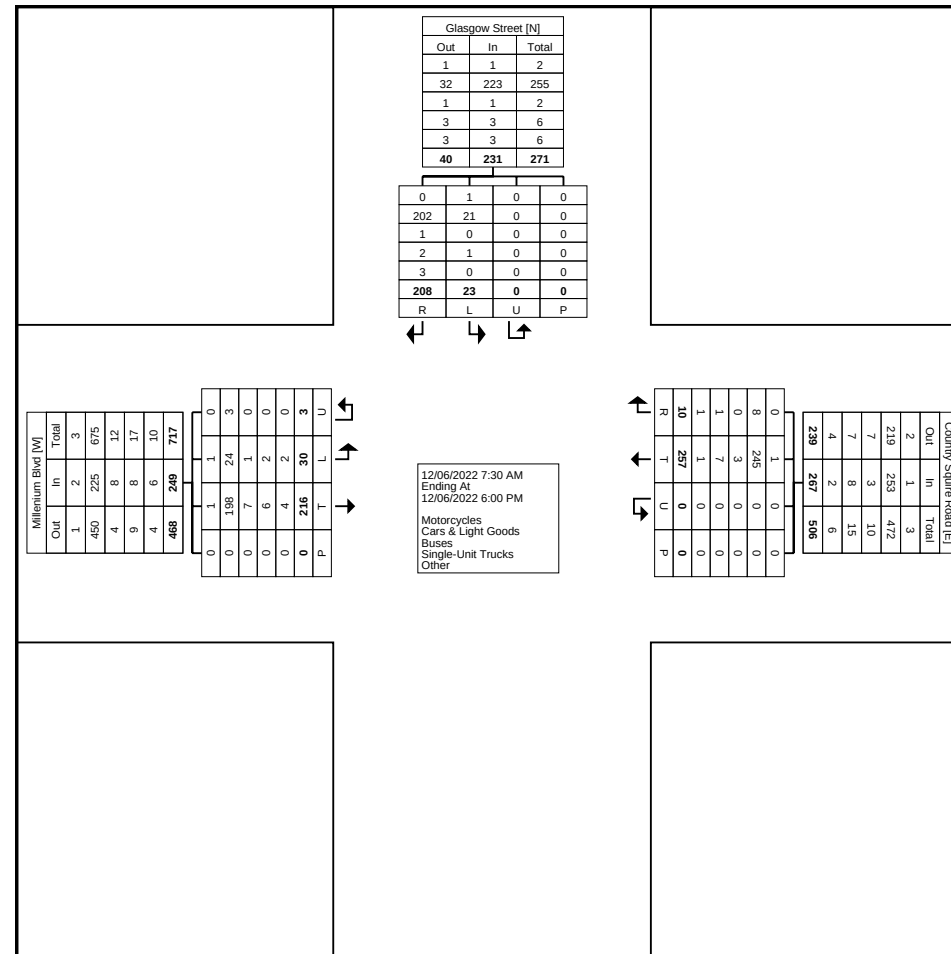
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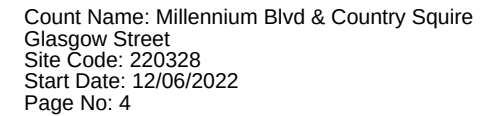
Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsI.com

Count Name: Millennium Blvd & Country Squire
Glasgow Street
Site Code: 220328
Start Date: 12/06/2022
Page No: 3



Turning Movement Data Plot



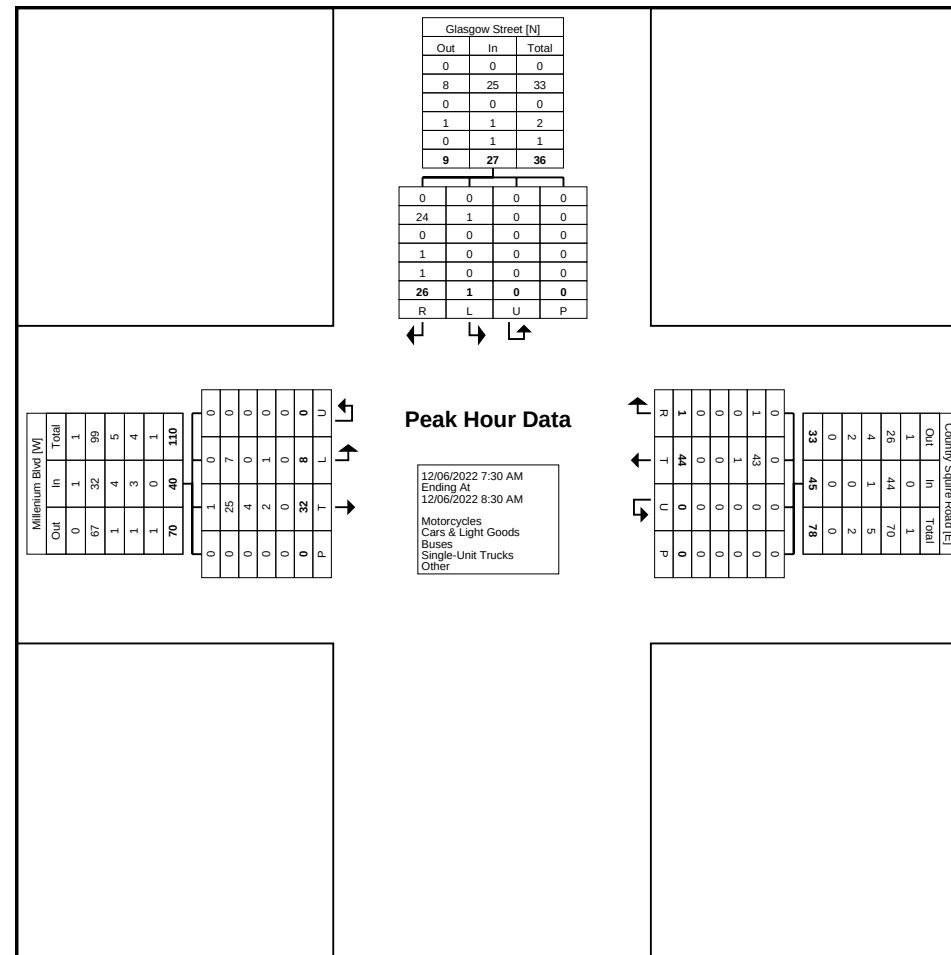
Start Time	Millenium Blvd Eastbound					Country Squire Road Westbound					Glasgow Street Southbound					Int. Total
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
7:30 AM	2	4	0	0	6	15	0	0	0	15	0	2	0	0	2	23
7:45 AM	4	8	0	0	12	11	0	0	0	11	0	8	0	0	8	31
8:00 AM	1	7	0	0	8	12	0	0	0	12	0	8	0	0	8	28
8:15 AM	1	13	0	0	14	6	1	0	0	7	1	8	0	0	9	30
Total	8	32	0	0	40	44	1	0	0	45	1	26	0	0	27	112
Approach %	20.0	80.0	0.0	-	-	97.8	2.2	0.0	-	-	3.7	96.3	0.0	-	-	-
Total %	7.1	28.6	0.0	-	35.7	39.3	0.9	0.0	-	40.2	0.9	23.2	0.0	-	24.1	-
PHF	0.500	0.615	0.000	-	0.714	0.733	0.250	0.000	-	0.750	0.250	0.813	0.000	-	0.750	0.903
Motorcycles	0	1	0	-	1	0	0	0	-	0	0	0	0	-	0	1
% Motorcycles	0.0	3.1	-	-	2.5	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.9
Cars & Light Goods	7	25	0	-	32	43	1	0	-	44	1	24	0	-	25	101
% Cars & Light Goods	87.5	78.1	-	-	80.0	97.7	100.0	-	-	97.8	100.0	92.3	-	-	92.6	90.2
Buses	0	4	0	-	4	1	0	0	-	1	0	0	0	-	0	5
% Buses	0.0	12.5	-	-	10.0	2.3	0.0	-	-	2.2	0.0	0.0	-	-	0.0	4.5
Single-Unit Trucks	1	2	0	-	3	0	0	0	-	0	0	1	0	-	1	4
% Single-Unit Trucks	12.5	6.3	-	-	7.5	0.0	0.0	-	-	0.0	0.0	3.8	-	-	3.7	3.6
Articulated Trucks	0	0	0	-	0	0	0	0	-	0	0	1	0	-	1	1
% Articulated Trucks	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	3.8	-	-	3.7	0.9
Bicycles on Road	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



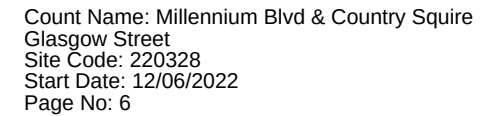
Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsll.com

Count Name: Millennium Blvd & Country Squire
Glasgow Street
Site Code: 220328
Start Date: 12/06/2022
Page No: 5



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

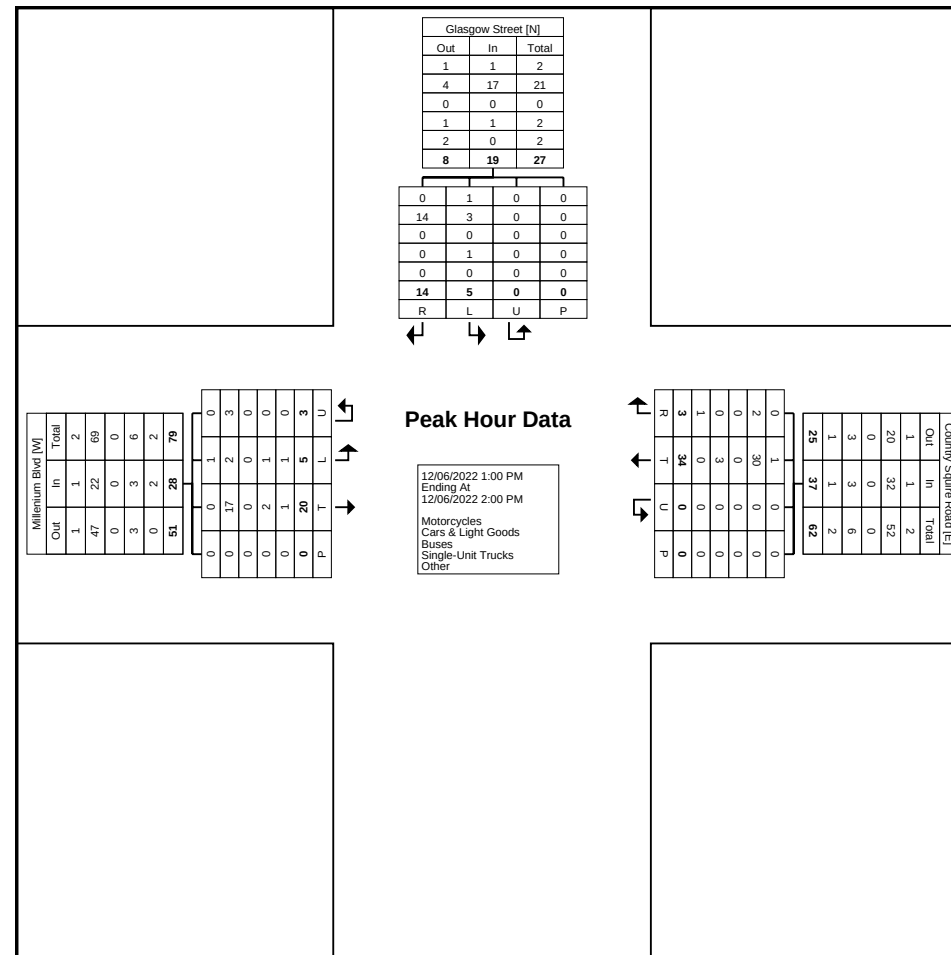
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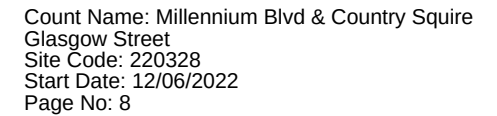


Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Country Squire
Glasgow Street
Site Code: 220328
Start Date: 12/06/2022
Page No: 7





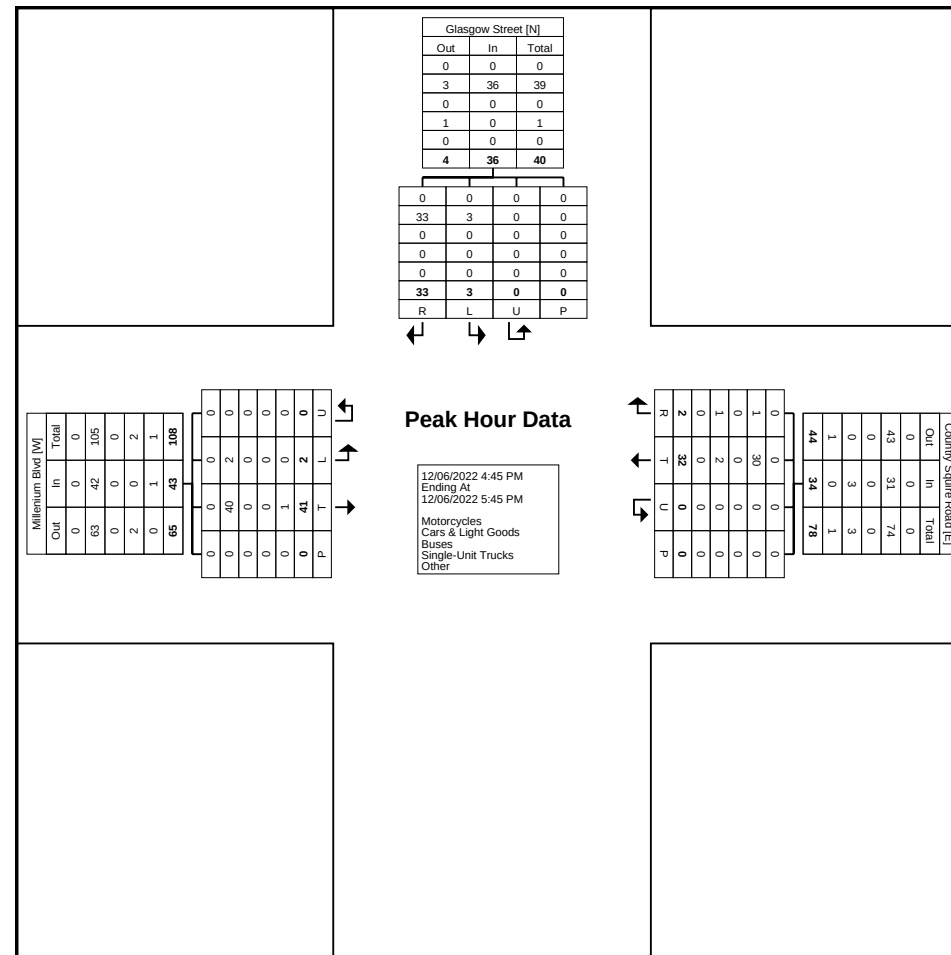
Start Time	Millenium Blvd Eastbound					Country Squire Road Westbound					Glasgow Street Southbound					Int. Total
	Left	Thru	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
4:45 PM	0	11	0	0	11	6	0	0	0	6	0	5	0	0	5	22
5:00 PM	1	8	0	0	9	14	0	0	0	14	3	6	0	0	9	32
5:15 PM	0	13	0	0	13	7	2	0	0	9	0	13	0	0	13	35
5:30 PM	1	9	0	0	10	5	0	0	0	5	0	9	0	0	9	24
Total	2	41	0	0	43	32	2	0	0	34	3	33	0	0	36	113
Approach %	4.7	95.3	0.0	-	-	94.1	5.9	0.0	-	-	8.3	91.7	0.0	-	-	-
Total %	1.8	36.3	0.0	-	38.1	28.3	1.8	0.0	-	30.1	2.7	29.2	0.0	-	31.9	-
PHF	0.500	0.788	0.000	-	0.827	0.571	0.250	0.000	-	0.607	0.250	0.635	0.000	-	0.692	0.807
Motorcycles	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	2	40	0	-	42	30	1	0	-	31	3	33	0	-	36	109
% Cars & Light Goods	100.0	97.6	-	-	97.7	93.8	50.0	-	-	91.2	100.0	100.0	-	-	100.0	96.5
Buses	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Buses	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Single-Unit Trucks	0	0	0	-	0	2	1	0	-	3	0	0	0	-	0	3
% Single-Unit Trucks	0.0	0.0	-	-	0.0	6.3	50.0	-	-	8.8	0.0	0.0	-	-	0.0	2.7
Articulated Trucks	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	0	1	0	-	1	0	0	0	-	0	0	0	0	-	0	1
% Bicycles on Road	0.0	2.4	-	-	2.3	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.9
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Country Squire
Glasgow Street
Site Code: 220328
Start Date: 12/06/2022
Page No: 9



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



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: University Avenue & Millennium
Blvd
Site Code: 220328
Start Date: 12/06/2022
Page No: 1

Turning Movement Data

Start Time	Millennium Blvd Westbound					University Avenue Northbound					University Avenue Southbound					Int. Total
	Left	Right	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	
7:30 AM	31	19	0	0	50	59	8	0	0	67	6	21	0	0	27	144
7:45 AM	36	16	0	0	52	68	10	0	0	78	10	19	0	0	29	159
Hourly Total	67	35	0	0	102	127	18	0	0	145	16	40	0	0	56	303
8:00 AM	56	27	0	0	83	49	10	0	0	59	12	16	0	0	28	170
8:15 AM	40	25	0	0	65	54	25	0	0	79	10	26	0	0	36	180
8:30 AM	44	17	0	0	61	38	24	1	0	63	9	32	0	0	41	165
8:45 AM	39	7	0	0	46	26	24	0	0	50	12	32	0	0	44	140
Hourly Total	179	76	0	0	255	167	83	1	0	251	43	106	0	0	149	655
9:00 AM	35	14	0	0	49	33	19	0	0	52	17	27	0	0	44	145
9:15 AM	24	11	0	2	35	39	11	0	1	50	6	23	0	0	29	114
9:30 AM	27	13	0	3	40	31	15	0	0	46	8	22	0	0	30	116
9:45 AM	23	17	0	0	40	42	12	0	0	54	5	21	0	0	26	120
Hourly Total	109	55	0	5	164	145	57	0	1	202	36	93	0	0	129	495
10:00 AM	27	12	0	0	39	35	17	0	0	52	11	20	0	0	31	122
10:15 AM	12	11	0	0	23	20	12	0	0	32	8	20	0	0	28	83
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	39	23	0	0	62	55	29	0	0	84	19	40	0	0	59	205
12:00 PM	33	7	0	1	40	34	11	0	0	45	6	28	0	0	34	119
12:15 PM	18	10	0	1	28	31	21	0	0	52	14	42	0	0	56	136
12:30 PM	19	8	0	2	27	38	17	0	0	55	9	29	0	0	38	120
12:45 PM	20	18	0	2	38	33	8	0	0	41	8	26	0	0	34	113
Hourly Total	90	43	0	6	133	136	57	0	0	193	37	125	0	0	162	488
1:00 PM	16	16	0	0	32	29	17	2	0	48	11	32	0	0	43	123
1:15 PM	28	17	0	0	45	40	17	0	0	57	12	29	0	0	41	143
1:30 PM	20	14	0	1	34	29	14	0	0	43	14	32	0	0	46	123
1:45 PM	21	14	0	0	35	33	21	0	0	54	16	35	0	0	51	140
Hourly Total	85	61	0	1	146	131	69	2	0	202	53	128	0	0	181	529
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	29	13	0	0	42	30	23	1	0	54	15	43	0	0	58	154
3:15 PM	31	16	0	2	47	37	25	0	0	62	17	35	0	0	52	161
3:30 PM	24	14	0	1	38	32	25	1	0	58	21	44	0	0	65	161
3:45 PM	21	17	0	0	38	39	39	0	0	78	26	43	0	0	69	185
Hourly Total	105	60	0	3	165	138	112	2	0	252	79	165	0	0	244	661
4:00 PM	23	17	0	0	40	44	30	0	0	74	12	54	0	0	66	180
4:15 PM	22	18	0	0	40	43	40	0	0	83	20	45	0	0	65	188
4:30 PM	30	14	1	0	45	43	34	0	0	77	19	69	0	0	88	210

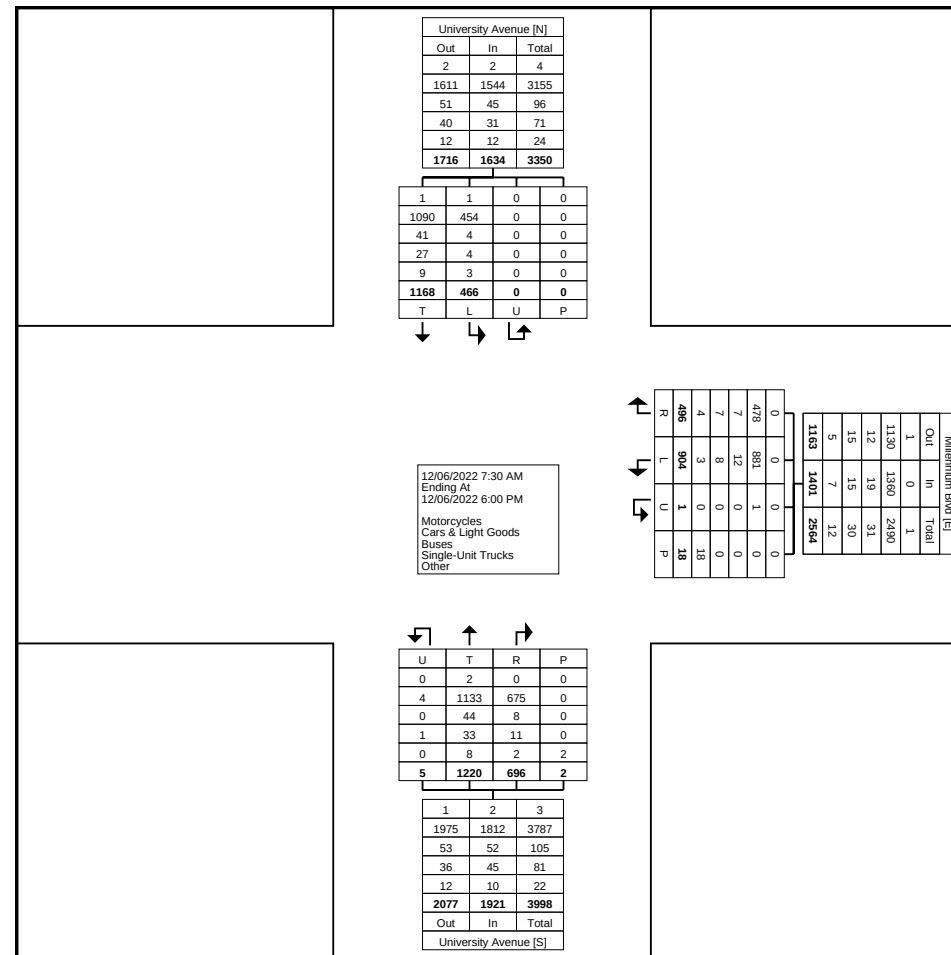
4:45 PM	27	14	0	0	41	51	31	0	0	82	25	72	0	0	97	220
Hourly Total	102	63	1	0	166	181	135	0	0	316	76	240	0	0	316	798
5:00 PM	43	23	0	0	66	40	41	0	0	81	23	60	0	0	83	230
5:15 PM	30	20	0	0	50	35	33	0	1	68	30	82	0	0	112	230
5:30 PM	29	15	0	1	44	38	32	0	0	70	19	47	0	0	66	180
5:45 PM	26	22	0	2	48	27	30	0	0	57	35	42	0	0	77	182
Hourly Total	128	80	0	3	208	140	136	0	1	276	107	231	0	0	338	822
Grand Total	904	496	1	18	1401	1220	696	5	2	1921	466	1168	0	0	1634	4956
Approach %	64.5	35.4	0.1	-	-	63.5	36.2	0.3	-	-	28.5	71.5	0.0	-	-	-
Total %	18.2	10.0	0.0	-	28.3	24.6	14.0	0.1	-	38.8	9.4	23.6	0.0	-	33.0	-
Motorcycles	0	0	0	-	0	2	0	0	-	2	1	1	0	-	2	4
% Motorcycles	0.0	0.0	0.0	-	0.0	0.2	0.0	0.0	-	0.1	0.2	0.1	-	-	0.1	0.1
Cars & Light Goods	881	478	1	-	1360	1133	675	4	-	1812	454	1090	0	-	1544	4716
% Cars & Light Goods	97.5	96.4	100.0	-	97.1	92.9	97.0	80.0	-	94.3	97.4	93.3	-	-	94.5	95.2
Buses	12	7	0	-	19	44	8	0	-	52	4	41	0	-	45	116
% Buses	1.3	1.4	0.0	-	1.4	3.6	1.1	0.0	-	2.7	0.9	3.5	-	-	2.8	2.3
Single-Unit Trucks	8	7	0	-	15	33	11	1	-	45	4	27	0	-	31	91
% Single-Unit Trucks	0.9	1.4	0.0	-	1.1	2.7	1.6	20.0	-	2.3	0.9	2.3	-	-	1.9	1.8
Articulated Trucks	1	4	0	-	5	8	1	0	-	9	1	9	0	-	10	24
% Articulated Trucks	0.1	0.8	0.0	-	0.4	0.7	0.1	0.0	-	0.5	0.2	0.8	-	-	0.6	0.5
Bicycles on Road	2	0	0	-	2	0	1	0	-	1	2	0	0	-	2	5
% Bicycles on Road	0.2	0.0	0.0	-	0.1	0.0	0.1	0.0	-	0.1	0.4	0.0	-	-	0.1	0.1
Bicycles on Crosswalk	-	-	-	2	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	11.1	-	-	-	0.0	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	16	-	-	-	2	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	88.9	-	-	-	100.0	-	-	-	-	-	-	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: University Avenue & Millennium
Blvd
Site Code: 220328
Start Date: 12/06/2022
Page No: 3



Turning Movement Data Plot

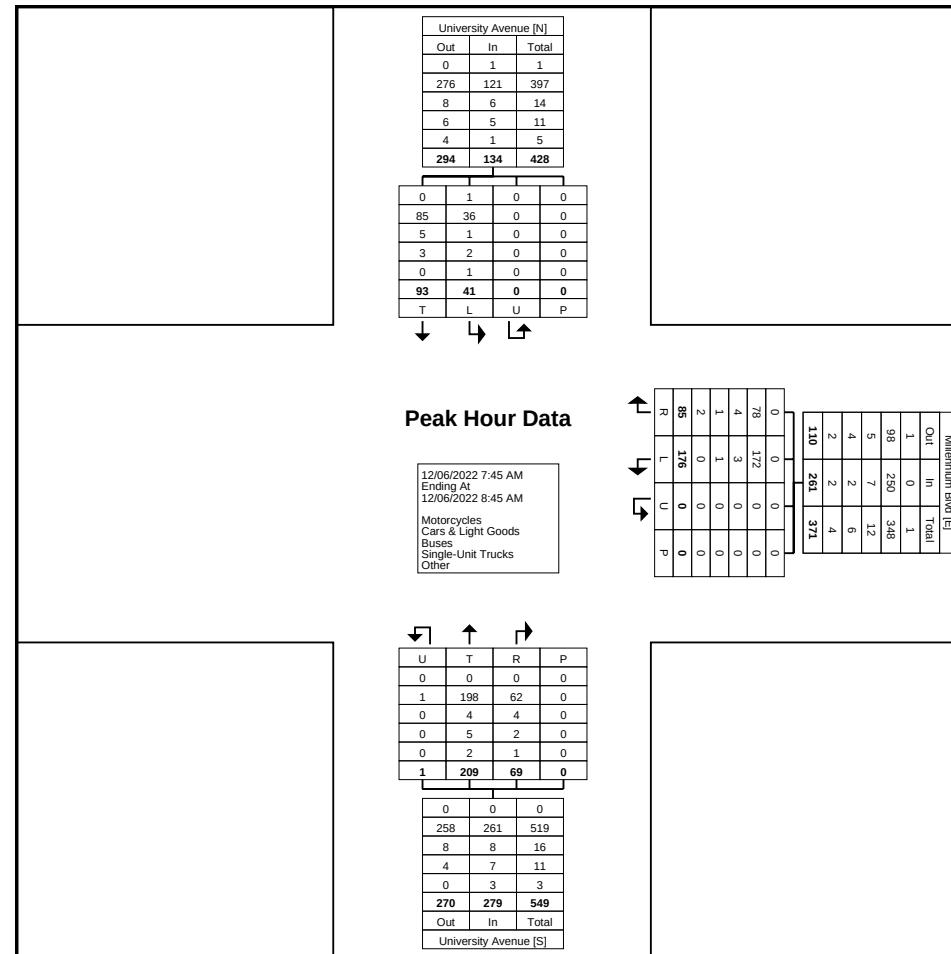
[illegible]



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Turning Movement Peak Hour Data Plot (7:45 AM)

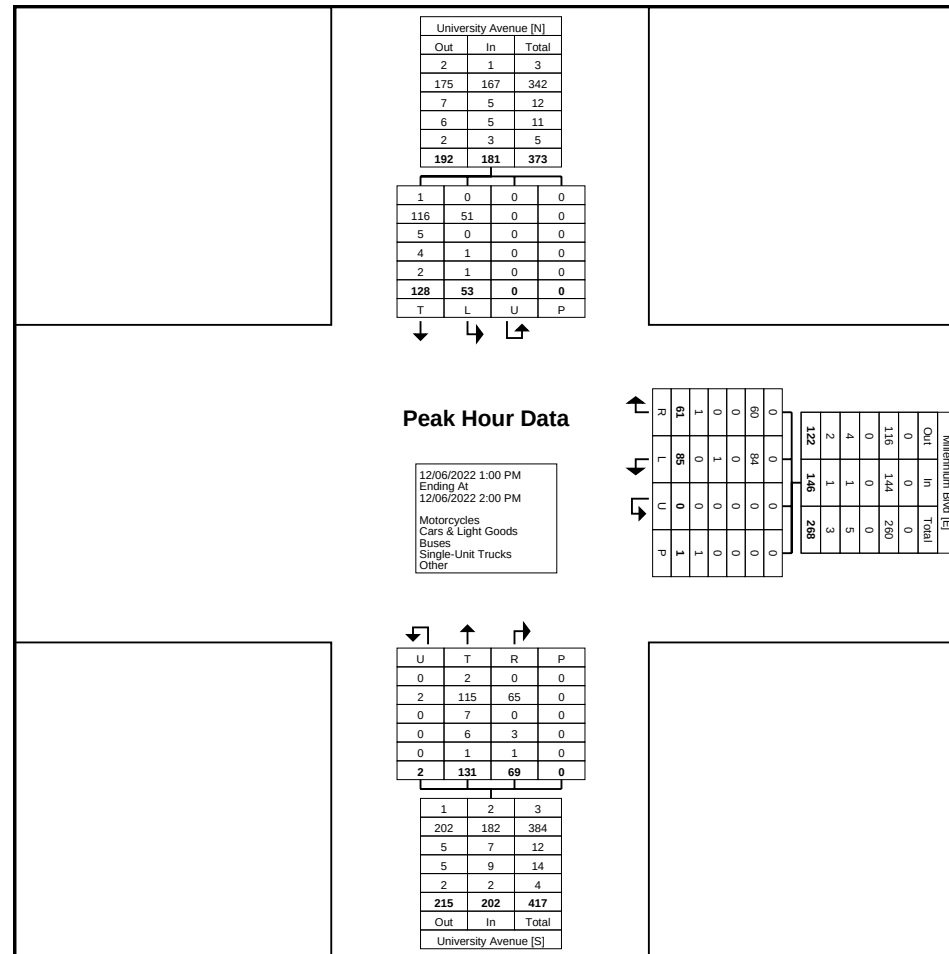
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Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: University Avenue & Millennium
Blvd
Site Code: 220328
Start Date: 12/06/2022
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Turning Movement Peak Hour Data Plot (1:00 PM)



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: University Avenue & Millennium
Blvd
Site Code: 220328
Start Date: 12/06/2022
Page No: 8

Turning Movement Peak Hour Data (4:30 PM)

Start Time	Millennium Blvd Westbound					University Avenue Northbound					University Avenue Southbound					Int. Total
	Left	Right	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	
4:30 PM	30	14	1	0	45	43	34	0	0	77	19	69	0	0	88	210
4:45 PM	27	14	0	0	41	51	31	0	0	82	25	72	0	0	97	220
5:00 PM	43	23	0	0	66	40	41	0	0	81	23	60	0	0	83	230
5:15 PM	30	20	0	0	50	35	33	0	1	68	30	82	0	0	112	230
Total	130	71	1	0	202	169	139	0	1	308	97	283	0	0	380	890
Approach %	64.4	35.1	0.5	-	-	54.9	45.1	0.0	-	-	25.5	74.5	0.0	-	-	-
Total %	14.6	8.0	0.1	-	22.7	19.0	15.6	0.0	-	34.6	10.9	31.8	0.0	-	42.7	-
PHF	0.756	0.772	0.250	-	0.765	0.828	0.848	0.000	-	0.939	0.808	0.863	0.000	-	0.848	0.967
Motorcycles	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	130	70	1	-	201	162	139	0	-	301	97	276	0	-	373	875
% Cars & Light Goods	100.0	98.6	100.0	-	99.5	95.9	100.0	-	-	97.7	100.0	97.5	-	-	98.2	98.3
Buses	0	0	0	-	0	3	0	0	-	3	0	4	0	-	4	7
% Buses	0.0	0.0	0.0	-	0.0	1.8	0.0	-	-	1.0	0.0	1.4	-	-	1.1	0.8
Single-Unit Trucks	0	1	0	-	1	4	0	0	-	4	0	2	0	-	2	7
% Single-Unit Trucks	0.0	1.4	0.0	-	0.5	2.4	0.0	-	-	1.3	0.0	0.7	-	-	0.5	0.8
Articulated Trucks	0	0	0	-	0	0	0	0	-	0	0	1	0	-	1	1
% Articulated Trucks	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0	0.4	-	-	0.3	0.1
Bicycles on Road	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-
Pedestrians	-	-	-	0	-	-	-	-	1	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-

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



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Oak Park Drive
Site Code: 220328
Start Date: 12/06/2022
Page No: 1

Turning Movement Data

Start Time	Millennium Blvd Eastbound					Millennium Blvd Westbound					Oak Park 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	
7:30 AM	6	5	0	0	11	0	25	0	0	25	19	1	0	1	20	56
7:45 AM	10	9	0	0	19	1	25	0	0	26	28	0	0	0	28	73
Hourly Total	16	14	0	0	30	1	50	0	0	51	47	1	0	1	48	129
8:00 AM	14	7	0	0	21	0	46	0	0	46	35	0	0	0	35	102
8:15 AM	22	15	0	0	37	0	25	0	0	25	33	0	0	1	33	95
8:30 AM	14	17	0	0	31	0	31	0	0	31	32	0	0	0	32	94
8:45 AM	15	15	0	0	30	0	22	0	0	22	24	0	0	2	24	76
Hourly Total	65	54	0	0	119	0	124	0	0	124	124	0	0	3	124	367
9:00 AM	10	16	0	0	26	1	24	0	0	25	27	1	0	1	28	79
9:15 AM	6	11	0	0	17	0	18	0	0	18	19	0	0	2	19	54
9:30 AM	12	11	0	0	23	1	21	0	0	22	21	0	0	1	21	66
9:45 AM	13	7	0	0	20	0	24	0	0	24	16	0	0	0	16	60
Hourly Total	41	45	0	0	86	2	87	0	0	89	83	1	0	4	84	259
10:00 AM	8	17	0	0	25	1	14	0	0	15	20	0	0	2	20	60
10:15 AM	7	9	0	0	16	1	12	0	0	13	9	0	0	1	9	38
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	15	26	0	0	41	2	26	0	0	28	29	0	0	3	29	98
12:00 PM	15	17	0	0	32	0	21	0	0	21	17	0	0	1	17	70
12:15 PM	12	18	0	0	30	1	6	0	0	7	21	0	0	0	21	58
12:30 PM	10	14	0	0	24	0	14	0	0	14	22	0	0	0	22	60
12:45 PM	5	8	0	0	13	0	14	0	0	14	18	1	0	3	19	46
Hourly Total	42	57	0	0	99	1	55	0	0	56	78	1	0	4	79	234
1:00 PM	13	17	0	0	30	0	16	0	0	16	15	0	0	0	15	61
1:15 PM	7	18	0	1	25	2	26	0	0	28	15	2	0	2	17	70
1:30 PM	12	14	0	0	26	0	14	0	0	14	14	0	0	1	14	54
1:45 PM	4	28	0	0	32	0	22	0	0	22	13	2	0	3	15	69
Hourly Total	36	77	0	1	113	2	78	0	0	80	57	4	0	6	61	254
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	15	22	0	0	37	2	32	0	0	34	18	1	0	0	19	90
3:15 PM	17	25	0	0	42	2	24	0	0	26	24	0	0	1	24	92
3:30 PM	12	19	0	0	31	0	20	0	0	20	19	1	0	2	20	71
3:45 PM	23	29	0	0	52	4	14	0	0	18	18	0	0	0	18	88
Hourly Total	67	95	0	0	162	8	90	0	0	98	79	2	0	3	81	341
4:00 PM	15	22	0	0	37	1	16	0	0	17	9	2	0	1	11	65
4:15 PM	18	34	0	0	52	3	23	0	0	26	16	0	0	1	16	94
4:30 PM	13	25	0	0	38	1	19	0	0	20	21	0	0	0	21	79

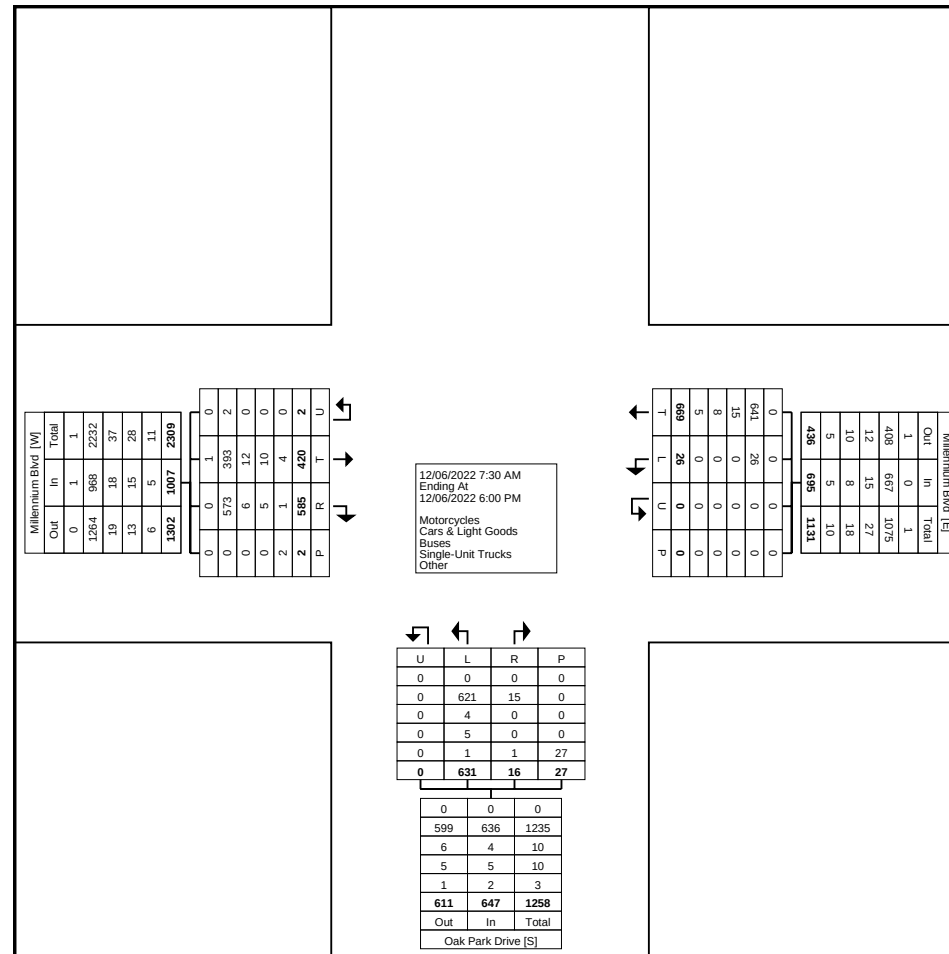
4:45 PM	17	25	0	0	42	2	19	0	0	21	19	1	0	0	20	83
Hourly Total	63	106	0	0	169	7	77	0	0	84	65	3	0	2	68	321
5:00 PM	20	31	1	0	52	2	26	0	0	28	14	2	0	0	16	96
5:15 PM	27	27	0	0	54	1	26	0	0	27	17	0	0	1	17	98
5:30 PM	18	22	0	0	40	0	17	0	0	17	16	1	0	0	17	74
5:45 PM	10	31	1	1	42	0	13	0	0	13	22	1	0	0	23	78
Hourly Total	75	111	2	1	188	3	82	0	0	85	69	4	0	1	73	346
Grand Total	420	585	2	2	1007	26	669	0	0	695	631	16	0	27	647	2349
Approach %	41.7	58.1	0.2	-	-	3.7	96.3	0.0	-	-	97.5	2.5	0.0	-	-	-
Total %	17.9	24.9	0.1	-	42.9	1.1	28.5	0.0	-	29.6	26.9	0.7	0.0	-	27.5	-
Motorcycles	1	0	0	-	1	0	0	0	-	0	0	0	0	-	0	1
% Motorcycles	0.2	0.0	0.0	-	0.1	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	393	573	2	-	968	26	641	0	-	667	621	15	0	-	636	2271
% Cars & Light Goods	93.6	97.9	100.0	-	96.1	100.0	95.8	-	-	96.0	98.4	93.8	-	-	98.3	96.7
Buses	12	6	0	-	18	0	15	0	-	15	4	0	0	-	4	37
% Buses	2.9	1.0	0.0	-	1.8	0.0	2.2	-	-	2.2	0.6	0.0	-	-	0.6	1.6
Single-Unit Trucks	10	5	0	-	15	0	8	0	-	8	5	0	0	-	5	28
% Single-Unit Trucks	2.4	0.9	0.0	-	1.5	0.0	1.2	-	-	1.2	0.8	0.0	-	-	0.8	1.2
Articulated Trucks	1	1	0	-	2	0	3	0	-	3	1	0	0	-	1	6
% Articulated Trucks	0.2	0.2	0.0	-	0.2	0.0	0.4	-	-	0.4	0.2	0.0	-	-	0.2	0.3
Bicycles on Road	3	0	0	-	3	0	2	0	-	2	0	1	0	-	1	6
% Bicycles on Road	0.7	0.0	0.0	-	0.3	0.0	0.3	-	-	0.3	0.0	6.3	-	-	0.2	0.3
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	0.0	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	2	-	-	-	-	0	-	-	-	-	27	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Oak Park Drive
Site Code: 220328
Start Date: 12/06/2022
Page No: 3



Turning Movement Data Plot



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Oak Park Drive
Site Code: 220328
Start Date: 12/06/2022
Page No: 4

Turning Movement Peak Hour Data (8:00 AM)

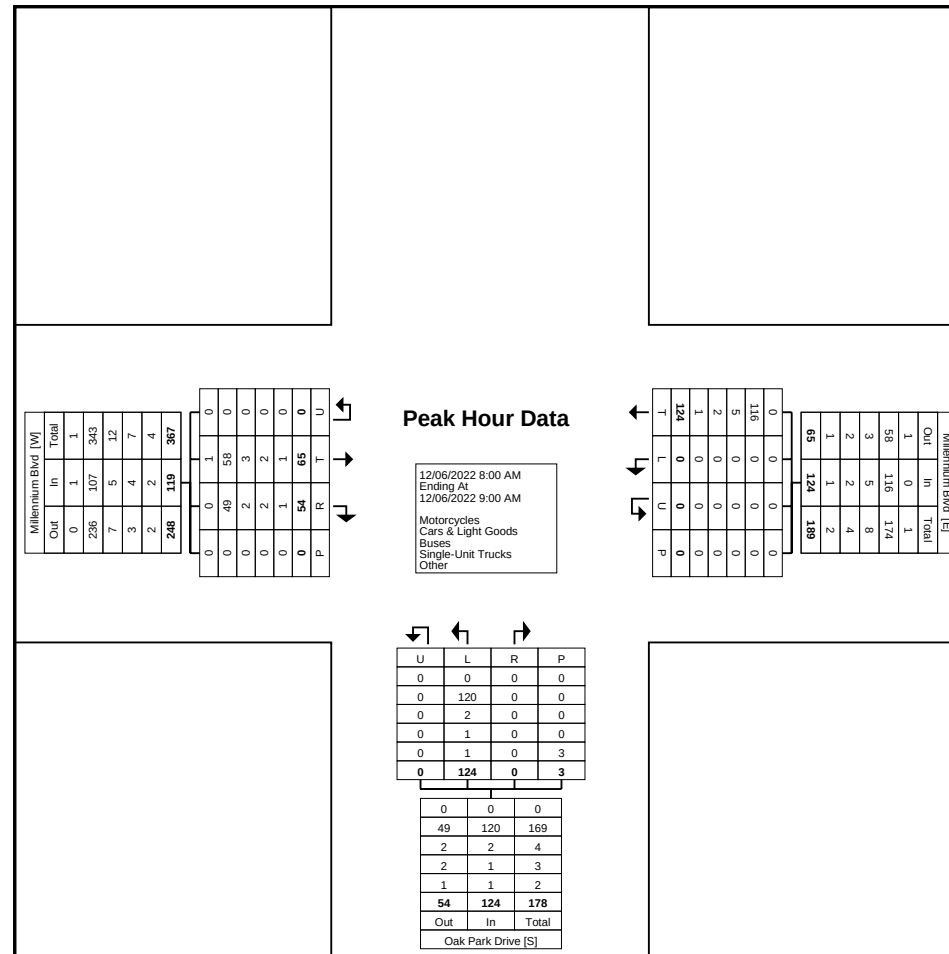
Start Time	Millennium Blvd Eastbound					Millennium Blvd Westbound					Oak Park Drive Northbound					Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
8:00 AM	14	7	0	0	21	0	46	0	0	46	35	0	0	0	35	102
8:15 AM	22	15	0	0	37	0	25	0	0	25	33	0	0	1	33	95
8:30 AM	14	17	0	0	31	0	31	0	0	31	32	0	0	0	32	94
8:45 AM	15	15	0	0	30	0	22	0	0	22	24	0	0	2	24	76
Total	65	54	0	0	119	0	124	0	0	124	124	0	0	3	124	367
Approach %	54.6	45.4	0.0	-	-	0.0	100.0	0.0	-	-	100.0	0.0	0.0	-	-	-
Total %	17.7	14.7	0.0	-	32.4	0.0	33.8	0.0	-	33.8	33.8	0.0	0.0	-	33.8	-
PHF	0.739	0.794	0.000	-	0.804	0.000	0.674	0.000	-	0.674	0.886	0.000	0.000	-	0.886	0.900
Motorcycles	1	0	0	-	1	0	0	0	-	0	0	0	0	-	0	1
% Motorcycles	1.5	0.0	-	-	0.8	-	0.0	-	-	0.0	0.0	-	-	-	0.0	0.3
Cars & Light Goods	58	49	0	-	107	0	116	0	-	116	120	0	0	-	120	343
% Cars & Light Goods	89.2	90.7	-	-	89.9	-	93.5	-	-	93.5	96.8	-	-	-	96.8	93.5
Buses	3	2	0	-	5	0	5	0	-	5	2	0	0	-	2	12
% Buses	4.6	3.7	-	-	4.2	-	4.0	-	-	4.0	1.6	-	-	-	1.6	3.3
Single-Unit Trucks	2	2	0	-	4	0	2	0	-	2	1	0	0	-	1	7
% Single-Unit Trucks	3.1	3.7	-	-	3.4	-	1.6	-	-	1.6	0.8	-	-	-	0.8	1.9
Articulated Trucks	0	1	0	-	1	0	1	0	-	1	1	0	0	-	1	3
% Articulated Trucks	0.0	1.9	-	-	0.8	-	0.8	-	-	0.8	0.8	-	-	-	0.8	0.8
Bicycles on Road	1	0	0	-	1	0	0	0	-	0	0	0	0	-	0	1
% Bicycles on Road	1.5	0.0	-	-	0.8	-	0.0	-	-	0.0	0.0	-	-	-	0.0	0.3
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	3	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Oak Park Drive
Site Code: 220328
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Turning Movement Peak Hour Data Plot (8:00 AM)



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Oak Park Drive
Site Code: 220328
Start Date: 12/06/2022
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Turning Movement Peak Hour Data (1:00 PM)

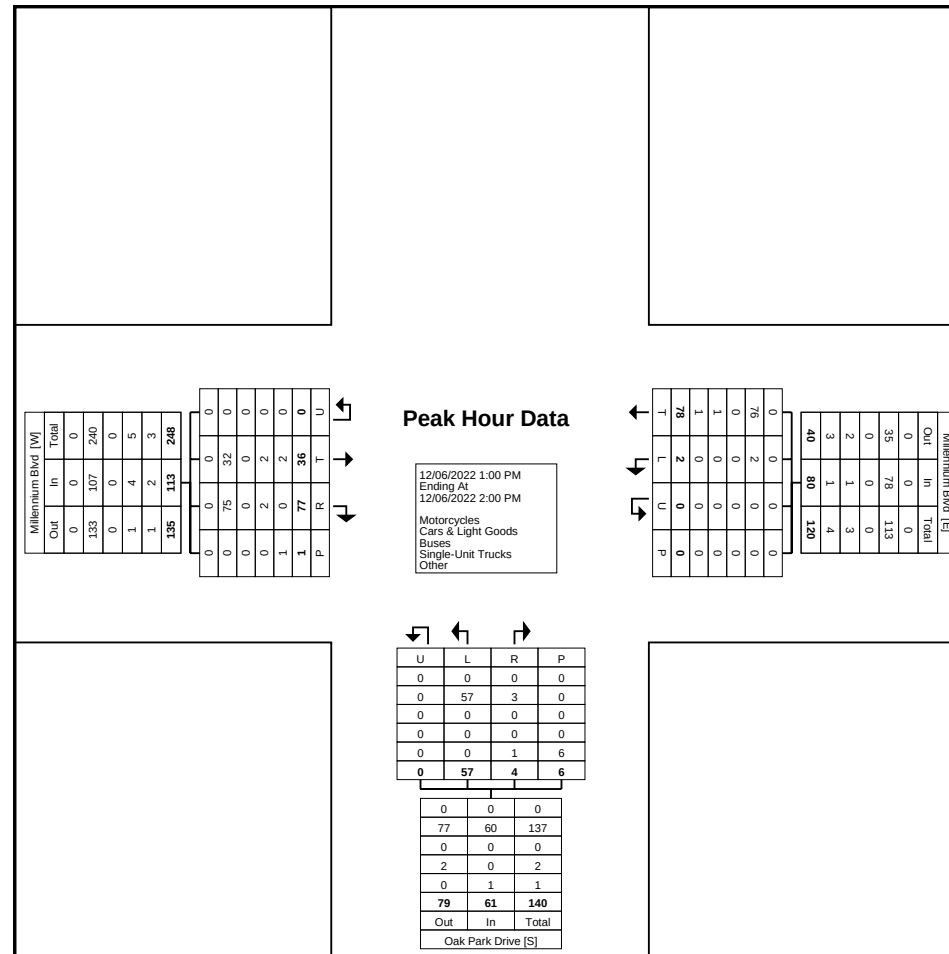
Start Time	Millennium Blvd Eastbound					Millennium Blvd Westbound					Oak Park Drive Northbound					Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
1:00 PM	13	17	0	0	30	0	16	0	0	16	15	0	0	0	15	61
1:15 PM	7	18	0	1	25	2	26	0	0	28	15	2	0	2	17	70
1:30 PM	12	14	0	0	26	0	14	0	0	14	14	0	0	1	14	54
1:45 PM	4	28	0	0	32	0	22	0	0	22	13	2	0	3	15	69
Total	36	77	0	1	113	2	78	0	0	80	57	4	0	6	61	254
Approach %	31.9	68.1	0.0	-	-	2.5	97.5	0.0	-	-	93.4	6.6	0.0	-	-	-
Total %	14.2	30.3	0.0	-	44.5	0.8	30.7	0.0	-	31.5	22.4	1.6	0.0	-	24.0	-
PHF	0.692	0.688	0.000	-	0.883	0.250	0.750	0.000	-	0.714	0.950	0.500	0.000	-	0.897	0.907
Motorcycles	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	32	75	0	-	107	2	76	0	-	78	57	3	0	-	60	245
% Cars & Light Goods	88.9	97.4	-	-	94.7	100.0	97.4	-	-	97.5	100.0	75.0	-	-	98.4	96.5
Buses	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Buses	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Single-Unit Trucks	2	2	0	-	4	0	1	0	-	1	0	0	0	-	0	5
% Single-Unit Trucks	5.6	2.6	-	-	3.5	0.0	1.3	-	-	1.3	0.0	0.0	-	-	0.0	2.0
Articulated Trucks	1	0	0	-	1	0	1	0	-	1	0	0	0	-	0	2
% Articulated Trucks	2.8	0.0	-	-	0.9	0.0	1.3	-	-	1.3	0.0	0.0	-	-	0.0	0.8
Bicycles on Road	1	0	0	-	1	0	0	0	-	0	0	1	0	-	1	2
% Bicycles on Road	2.8	0.0	-	-	0.9	0.0	0.0	-	-	0.0	0.0	25.0	-	-	1.6	0.8
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	0.0	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	1	-	-	-	-	0	-	-	-	-	6	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Oak Park Drive
Site Code: 220328
Start Date: 12/06/2022
Page No: 7



Turning Movement Peak Hour Data Plot (1:00 PM)



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Oak Park Drive
Site Code: 220328
Start Date: 12/06/2022
Page No: 8

Turning Movement Peak Hour Data (4:30 PM)

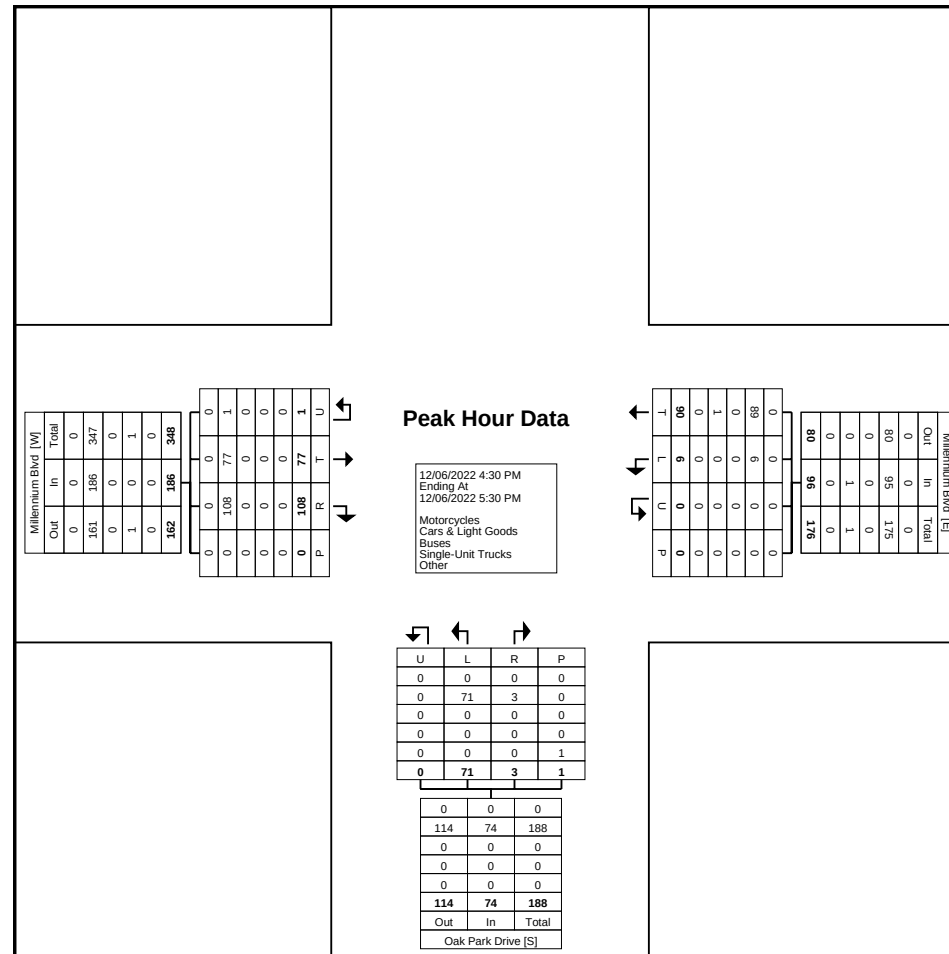
Start Time	Millennium Blvd Eastbound					Millennium Blvd Westbound					Oak Park Drive Northbound					Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
4:30 PM	13	25	0	0	38	1	19	0	0	20	21	0	0	0	21	79
4:45 PM	17	25	0	0	42	2	19	0	0	21	19	1	0	0	20	83
5:00 PM	20	31	1	0	52	2	26	0	0	28	14	2	0	0	16	96
5:15 PM	27	27	0	0	54	1	26	0	0	27	17	0	0	1	17	98
Total	77	108	1	0	186	6	90	0	0	96	71	3	0	1	74	356
Approach %	41.4	58.1	0.5	-	-	6.3	93.8	0.0	-	-	95.9	4.1	0.0	-	-	-
Total %	21.6	30.3	0.3	-	52.2	1.7	25.3	0.0	-	27.0	19.9	0.8	0.0	-	20.8	-
PHF	0.713	0.871	0.250	-	0.861	0.750	0.865	0.000	-	0.857	0.845	0.375	0.000	-	0.881	0.908
Motorcycles	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	77	108	1	-	186	6	89	0	-	95	71	3	0	-	74	355
% Cars & Light Goods	100.0	100.0	100.0	-	100.0	100.0	98.9	-	-	99.0	100.0	100.0	-	-	100.0	99.7
Buses	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Buses	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Single-Unit Trucks	0	0	0	-	0	0	1	0	-	1	0	0	0	-	0	1
% Single-Unit Trucks	0.0	0.0	0.0	-	0.0	0.0	1.1	-	-	1.0	0.0	0.0	-	-	0.0	0.3
Articulated Trucks	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
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Count Name: Millennium Blvd & Oak Park Drive
Site Code: 220328
Start Date: 12/06/2022
Page No: 9



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



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Internal RIM
Park Roadway
Site Code: 220328
Start Date: 12/06/2022
Page No: 1

Turning Movement Data

Start Time	Millennium Blvd Eastbound					Millennium Blvd Westbound					Internal RIM Park Roadway Northbound					Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
7:30 AM	9	1	0	0	10	4	40	0	0	44	9	1	0	1	10	64
7:45 AM	13	1	0	0	14	1	51	0	0	52	1	4	0	1	5	71
Hourly Total	22	2	0	0	24	5	91	0	0	96	10	5	0	2	15	135
8:00 AM	16	2	0	0	18	6	76	0	0	82	8	4	0	1	12	112
8:15 AM	36	0	0	0	36	0	59	0	0	59	5	1	0	0	6	101
8:30 AM	29	1	0	0	30	1	61	0	0	62	1	2	0	2	3	95
8:45 AM	27	4	1	0	32	2	45	0	0	47	0	3	0	0	3	82
Hourly Total	108	7	1	0	116	9	241	0	0	250	14	10	0	3	24	390
9:00 AM	23	6	1	0	30	2	49	1	0	52	0	2	0	1	2	84
9:15 AM	15	0	0	0	15	1	35	0	0	36	0	2	0	0	2	53
9:30 AM	21	1	0	0	22	5	35	1	0	41	3	1	0	3	4	67
9:45 AM	18	0	0	0	18	3	35	0	0	38	3	2	0	0	5	61
Hourly Total	77	7	1	0	85	11	154	2	0	167	6	7	0	4	13	265
10:00 AM	23	2	0	0	25	0	34	0	0	34	5	1	0	2	6	65
10:15 AM	16	1	0	0	17	1	19	1	0	21	3	0	0	0	3	41
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	39	3	0	0	42	1	53	1	0	55	8	1	0	2	9	106
12:00 PM	26	1	0	1	27	2	37	0	0	39	5	5	0	0	10	76
12:15 PM	27	2	0	0	29	2	24	0	1	26	4	3	0	1	7	62
12:30 PM	23	3	0	0	26	4	28	0	0	32	0	2	0	0	2	60
12:45 PM	11	2	1	0	14	2	30	0	0	32	5	1	0	0	6	52
Hourly Total	87	8	1	1	96	10	119	0	1	129	14	11	0	1	25	250
1:00 PM	26	1	0	0	27	1	30	0	0	31	2	4	0	0	6	64
1:15 PM	24	1	0	0	25	3	39	0	0	42	7	1	0	2	8	75
1:30 PM	24	1	0	0	25	1	27	0	0	28	5	2	0	0	7	60
1:45 PM	31	1	0	0	32	1	34	0	0	35	2	1	0	1	3	70
Hourly Total	105	4	0	0	109	6	130	0	0	136	16	8	0	3	24	269
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	34	1	0	0	35	7	39	0	0	46	2	2	0	1	4	85
3:15 PM	38	5	0	0	43	5	46	0	0	51	2	3	0	0	5	99
3:30 PM	30	3	0	0	33	6	34	0	0	40	5	2	0	0	7	80
3:45 PM	46	4	0	0	50	3	28	0	0	31	9	5	0	0	14	95
Hourly Total	148	13	0	0	161	21	147	0	0	168	18	12	0	1	30	359
4:00 PM	33	1	0	0	34	1	26	0	0	27	12	4	0	0	16	77
4:15 PM	48	1	0	0	49	2	35	0	0	37	5	5	0	0	10	96
4:30 PM	36	1	0	0	37	4	36	1	0	41	10	0	0	0	10	88

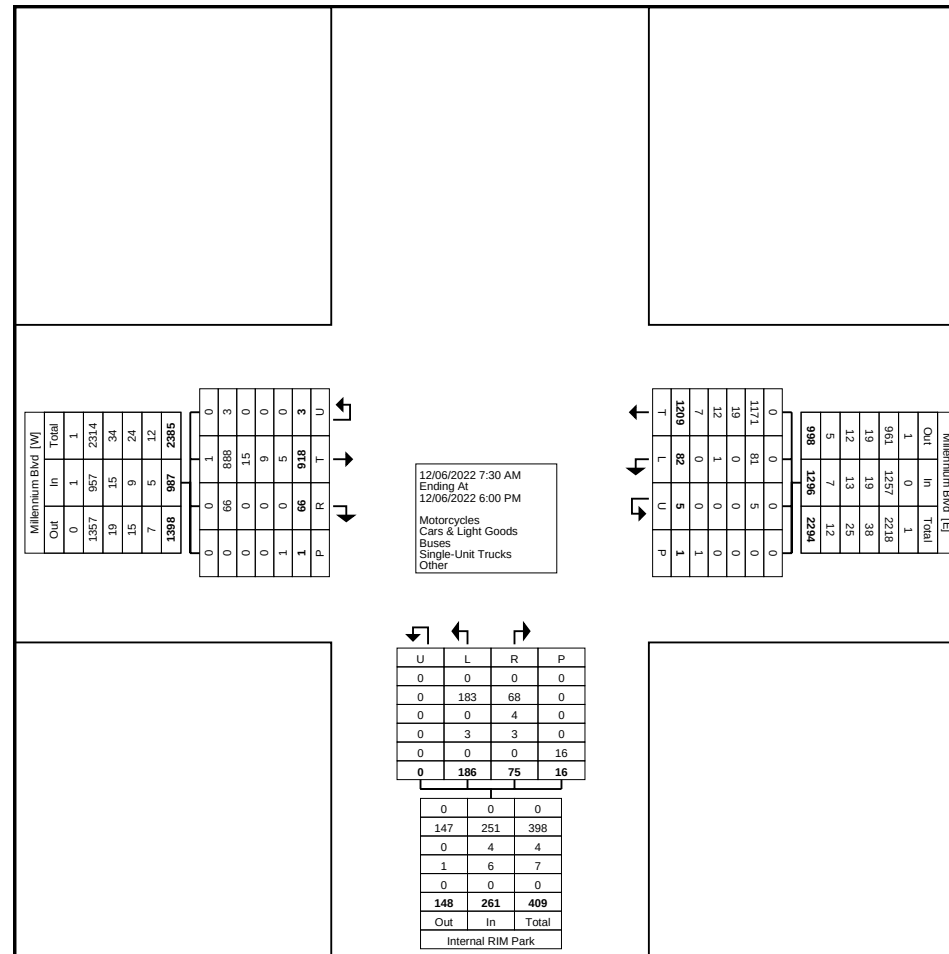
4:45 PM	39	2	0	0	41	3	35	0	0	38	5	2	0	0	7	86
Hourly Total	156	5	0	0	161	10	132	1	0	143	32	11	0	0	43	347
5:00 PM	48	1	0	0	49	2	39	0	0	41	27	3	0	0	30	120
5:15 PM	50	4	0	0	54	2	41	1	0	44	10	3	0	0	13	111
5:30 PM	39	4	0	0	43	3	30	0	0	33	14	1	0	0	15	91
5:45 PM	39	8	0	0	47	2	32	0	0	34	17	3	0	0	20	101
Hourly Total	176	17	0	0	193	9	142	1	0	152	68	10	0	0	78	423
Grand Total	918	66	3	1	987	82	1209	5	1	1296	186	75	0	16	261	2544
Approach %	93.0	6.7	0.3	-	-	6.3	93.3	0.4	-	-	71.3	28.7	0.0	-	-	-
Total %	36.1	2.6	0.1	-	38.8	3.2	47.5	0.2	-	50.9	7.3	2.9	0.0	-	10.3	-
Motorcycles	1	0	0	-	1	0	0	0	-	0	0	0	0	-	0	1
% Motorcycles	0.1	0.0	0.0	-	0.1	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	888	66	3	-	957	81	1171	5	-	1257	183	68	0	-	251	2465
% Cars & Light Goods	96.7	100.0	100.0	-	97.0	98.8	96.9	100.0	-	97.0	98.4	90.7	-	-	96.2	96.9
Buses	15	0	0	-	15	0	19	0	-	19	0	4	0	-	4	38
% Buses	1.6	0.0	0.0	-	1.5	0.0	1.6	0.0	-	1.5	0.0	5.3	-	-	1.5	1.5
Single-Unit Trucks	9	0	0	-	9	1	12	0	-	13	3	3	0	-	6	28
% Single-Unit Trucks	1.0	0.0	0.0	-	0.9	1.2	1.0	0.0	-	1.0	1.6	4.0	-	-	2.3	1.1
Articulated Trucks	3	0	0	-	3	0	5	0	-	5	0	0	0	-	0	8
% Articulated Trucks	0.3	0.0	0.0	-	0.3	0.0	0.4	0.0	-	0.4	0.0	0.0	-	-	0.0	0.3
Bicycles on Road	2	0	0	-	2	0	2	0	-	2	0	0	0	-	0	4
% Bicycles on Road	0.2	0.0	0.0	-	0.2	0.0	0.2	0.0	-	0.2	0.0	0.0	-	-	0.0	0.2
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	-	1	-
% Bicycles on Crosswalk	-	-	-	0.0	-	-	-	-	0.0	-	-	-	-	-	6.3	-
Pedestrians	-	-	-	1	-	-	-	-	1	-	-	-	-	-	15	-
% Pedestrians	-	-	-	100.0	-	-	-	-	100.0	-	-	-	-	-	93.8	-



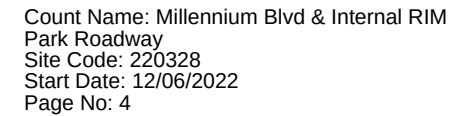
Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsI.com

Count Name: Millennium Blvd & Internal RIM
Park Roadway
Site Code: 220328
Start Date: 12/06/2022
Page No: 3



Turning Movement Data Plot



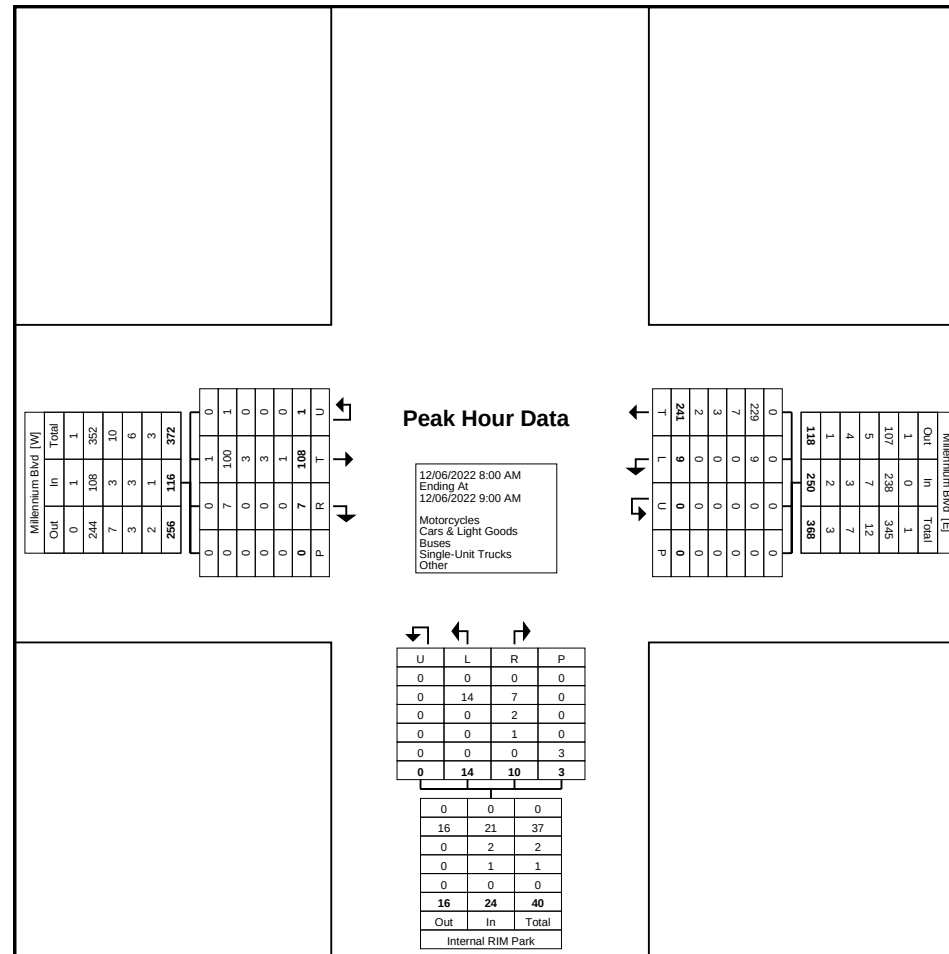
Start Time	Millennium Blvd Eastbound					Millennium Blvd Westbound					Internal RIM Park Roadway Northbound					Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
8:00 AM	16	2	0	0	18	6	76	0	0	82	8	4	0	1	12	112
8:15 AM	36	0	0	0	36	0	59	0	0	59	5	1	0	0	6	101
8:30 AM	29	1	0	0	30	1	61	0	0	62	1	2	0	2	3	95
8:45 AM	27	4	1	0	32	2	45	0	0	47	0	3	0	0	3	82
Total	108	7	1	0	116	9	241	0	0	250	14	10	0	3	24	390
Approach %	93.1	6.0	0.9	-	-	3.6	96.4	0.0	-	-	58.3	41.7	0.0	-	-	-
Total %	27.7	1.8	0.3	-	29.7	2.3	61.8	0.0	-	64.1	3.6	2.6	0.0	-	6.2	-
PHF	0.750	0.438	0.250	-	0.806	0.375	0.793	0.000	-	0.762	0.438	0.625	0.000	-	0.500	0.871
Motorcycles	1	0	0	-	1	0	0	0	-	0	0	0	0	-	0	1
% Motorcycles	0.9	0.0	0.0	-	0.9	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.3
Cars & Light Goods	100	7	1	-	108	9	229	0	-	238	14	7	0	-	21	367
% Cars & Light Goods	92.6	100.0	100.0	-	93.1	100.0	95.0	-	-	95.2	100.0	70.0	-	-	87.5	94.1
Buses	3	0	0	-	3	0	7	0	-	7	0	2	0	-	2	12
% Buses	2.8	0.0	0.0	-	2.6	0.0	2.9	-	-	2.8	0.0	20.0	-	-	8.3	3.1
Single-Unit Trucks	3	0	0	-	3	0	3	0	-	3	0	1	0	-	1	7
% Single-Unit Trucks	2.8	0.0	0.0	-	2.6	0.0	1.2	-	-	1.2	0.0	10.0	-	-	4.2	1.8
Articulated Trucks	1	0	0	-	1	0	2	0	-	2	0	0	0	-	0	3
% Articulated Trucks	0.9	0.0	0.0	-	0.9	0.0	0.8	-	-	0.8	0.0	0.0	-	-	0.0	0.8
Bicycles on Road	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	33.3	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	2	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	66.7	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

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Count Name: Millennium Blvd & Internal RIM
Park Roadway
Site Code: 220328
Start Date: 12/06/2022
Page No: 5



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



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Internal RIM
Park Roadway
Site Code: 220328
Start Date: 12/06/2022
Page No: 6

Turning Movement Peak Hour Data (1:00 PM)

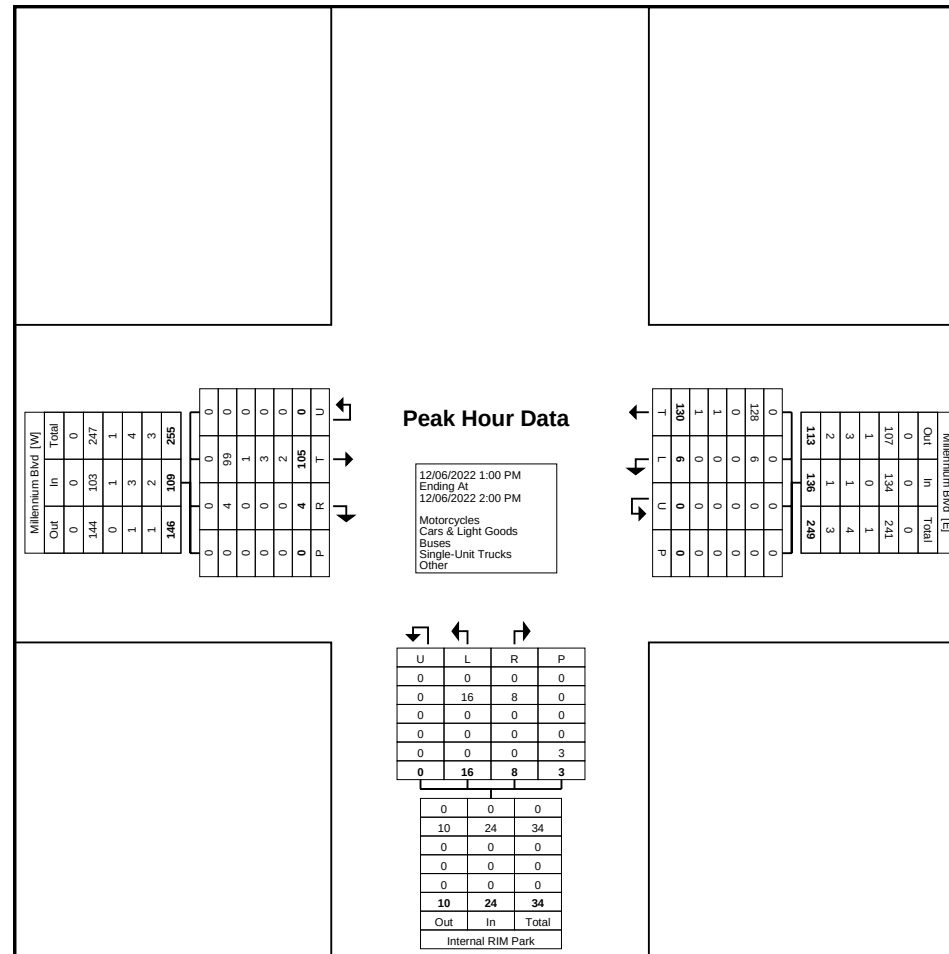
Start Time	Millennium Blvd Eastbound					Millennium Blvd Westbound					Internal RIM Park Roadway Northbound					Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
1:00 PM	26	1	0	0	27	1	30	0	0	31	2	4	0	0	6	64
1:15 PM	24	1	0	0	25	3	39	0	0	42	7	1	0	2	8	75
1:30 PM	24	1	0	0	25	1	27	0	0	28	5	2	0	0	7	60
1:45 PM	31	1	0	0	32	1	34	0	0	35	2	1	0	1	3	70
Total	105	4	0	0	109	6	130	0	0	136	16	8	0	3	24	269
Approach %	96.3	3.7	0.0	-	-	4.4	95.6	0.0	-	-	66.7	33.3	0.0	-	-	-
Total %	39.0	1.5	0.0	-	40.5	2.2	48.3	0.0	-	50.6	5.9	3.0	0.0	-	8.9	-
PHF	0.847	1.000	0.000	-	0.852	0.500	0.833	0.000	-	0.810	0.571	0.500	0.000	-	0.750	0.897
Motorcycles	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	99	4	0	-	103	6	128	0	-	134	16	8	0	-	24	261
% Cars & Light Goods	94.3	100.0	-	-	94.5	100.0	98.5	-	-	98.5	100.0	100.0	-	-	100.0	97.0
Buses	1	0	0	-	1	0	0	0	-	0	0	0	0	-	0	1
% Buses	1.0	0.0	-	-	0.9	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.4
Single-Unit Trucks	3	0	0	-	3	0	1	0	-	1	0	0	0	-	0	4
% Single-Unit Trucks	2.9	0.0	-	-	2.8	0.0	0.8	-	-	0.7	0.0	0.0	-	-	0.0	1.5
Articulated Trucks	1	0	0	-	1	0	1	0	-	1	0	0	0	-	0	2
% Articulated Trucks	1.0	0.0	-	-	0.9	0.0	0.8	-	-	0.7	0.0	0.0	-	-	0.0	0.7
Bicycles on Road	1	0	0	-	1	0	0	0	-	0	0	0	0	-	0	1
% Bicycles on Road	1.0	0.0	-	-	0.9	0.0	0.0	-	-	0.0	0.0	0.0	-	-	0.0	0.4
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	3	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-



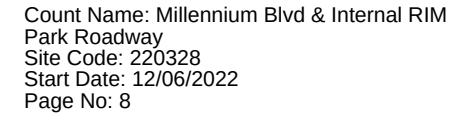
Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Internal RIM
Park Roadway
Site Code: 220328
Start Date: 12/06/2022
Page No: 7



Turning Movement Peak Hour Data Plot (1:00 PM)



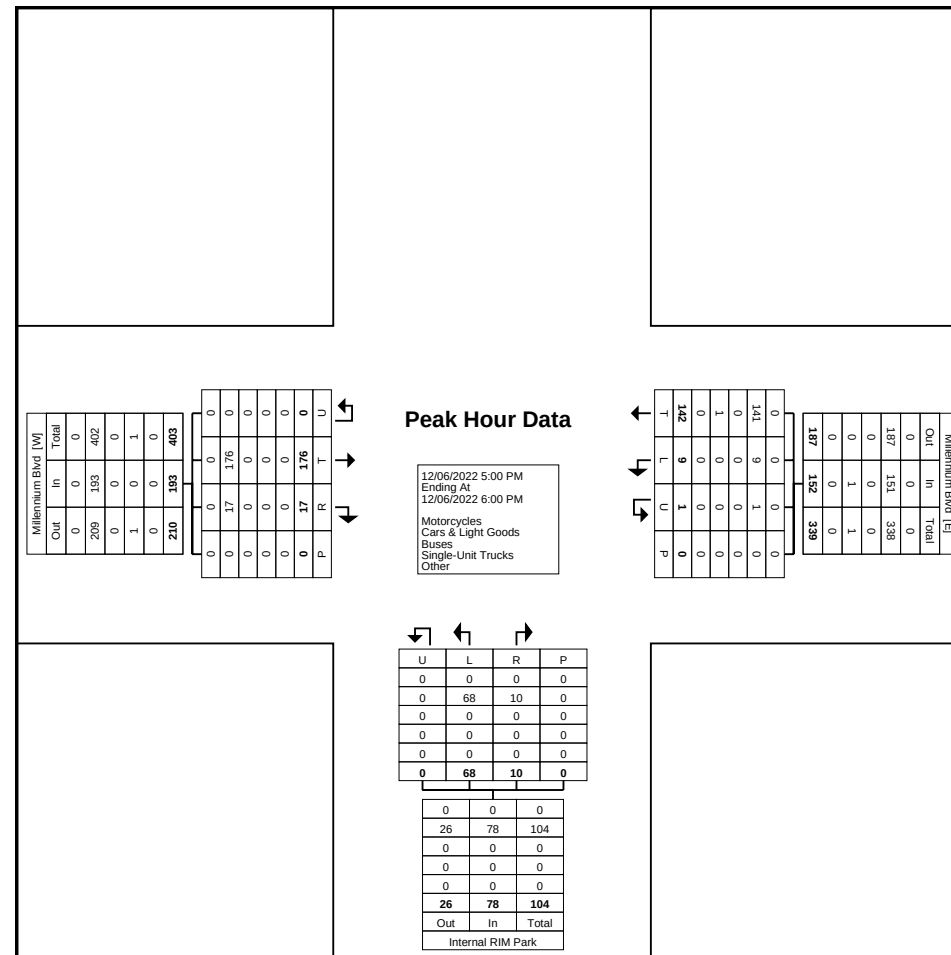
Start Time	Millennium Blvd Eastbound					Millennium Blvd Westbound					Internal RIM Park Roadway Northbound					Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	
5:00 PM	48	1	0	0	49	2	39	0	0	41	27	3	0	0	30	120
5:15 PM	50	4	0	0	54	2	41	1	0	44	10	3	0	0	13	111
5:30 PM	39	4	0	0	43	3	30	0	0	33	14	1	0	0	15	91
5:45 PM	39	8	0	0	47	2	32	0	0	34	17	3	0	0	20	101
Total	176	17	0	0	193	9	142	1	0	152	68	10	0	0	78	423
Approach %	91.2	8.8	0.0	-	-	5.9	93.4	0.7	-	-	87.2	12.8	0.0	-	-	-
Total %	41.6	4.0	0.0	-	45.6	2.1	33.6	0.2	-	35.9	16.1	2.4	0.0	-	18.4	-
PHF	0.880	0.531	0.000	-	0.894	0.750	0.866	0.250	-	0.864	0.630	0.833	0.000	-	0.650	0.881
Motorcycles	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0
Cars & Light Goods	176	17	0	-	193	9	141	1	-	151	68	10	0	-	78	422
% Cars & Light Goods	100.0	100.0	-	-	100.0	100.0	99.3	100.0	-	99.3	100.0	100.0	-	-	100.0	99.8
Buses	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Buses	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0
Single-Unit Trucks	0	0	0	-	0	0	1	0	-	1	0	0	0	-	0	1
% Single-Unit Trucks	0.0	0.0	-	-	0.0	0.0	0.7	0.0	-	0.7	0.0	0.0	-	-	0.0	0.2
Articulated Trucks	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Road	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
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Count Name: Millennium Blvd & Internal RIM
Park Roadway
Site Code: 220328
Start Date: 12/06/2022
Page No: 9



Turning Movement Peak Hour Data Plot (5:00 PM)



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Crossgate Blvd
Site Code: 220328
Start Date: 12/06/2022
Page No: 1

Turning Movement Data

Start Time	Millenium Blvd Eastbound					Millenium Blvd Westbound				Crossgate Blvd Northbound				Southbound Approach Southbound		Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	App. Total	Left	Right	U-Turn	App. Total	Peds	App. Total	
7:30 AM	5	3	0	0	8	0	18	0	18	8	0	0	8	0	0	34
7:45 AM	10	0	0	0	10	0	18	0	18	10	0	0	10	1	0	38
Hourly Total	15	3	0	0	18	0	36	0	36	18	0	0	18	1	0	72
8:00 AM	8	6	0	0	14	1	28	0	29	17	0	0	17	0	0	60
8:15 AM	15	7	0	0	22	0	19	1	20	7	1	0	8	0	0	50
8:30 AM	9	4	1	0	14	0	20	0	20	10	0	0	10	0	0	44
8:45 AM	12	3	0	1	15	1	15	0	16	7	0	0	7	1	0	38
Hourly Total	44	20	1	1	65	2	82	1	85	41	1	0	42	1	0	192
9:00 AM	3	7	1	0	11	1	18	0	19	6	0	0	6	0	0	36
9:15 AM	4	2	0	0	6	0	12	0	12	6	0	0	6	1	0	24
9:30 AM	5	5	2	0	12	0	15	0	15	6	0	0	6	1	0	33
9:45 AM	8	5	0	0	13	0	19	0	19	4	0	0	4	0	0	36
Hourly Total	20	19	3	0	42	1	64	0	65	22	0	0	22	2	0	129
10:00 AM	6	3	0	0	9	0	14	0	14	1	0	0	1	0	0	24
10:15 AM	7	0	0	0	7	0	11	0	11	2	0	0	2	0	0	20
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	13	3	0	0	16	0	25	0	25	3	0	0	3	0	0	44
12:00 PM	12	3	0	0	15	0	14	0	14	7	0	0	7	0	0	36
12:15 PM	6	6	0	0	12	0	5	0	5	2	0	0	2	0	0	19
12:30 PM	8	2	0	0	10	0	10	0	10	4	0	0	4	0	0	24
12:45 PM	4	1	1	0	6	1	13	0	14	2	0	0	2	0	0	22
Hourly Total	30	12	1	0	43	1	42	0	43	15	0	0	15	0	0	101
1:00 PM	10	2	1	0	13	0	11	0	11	4	0	0	4	0	0	28
1:15 PM	7	1	0	0	8	0	20	0	20	6	0	0	6	0	0	34
1:30 PM	8	4	0	0	12	0	8	0	8	5	0	0	5	0	0	25
1:45 PM	3	3	0	0	6	0	17	0	17	5	0	0	5	0	0	28
Hourly Total	28	10	1	0	39	0	56	0	56	20	0	0	20	0	0	115
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	14	3	0	2	17	1	22	0	23	10	0	0	10	0	0	50
3:15 PM	9	7	0	0	16	0	20	0	20	6	0	0	6	0	0	42
3:30 PM	8	6	0	1	14	1	15	0	16	7	0	0	7	1	0	37
3:45 PM	10	13	0	0	23	0	16	0	16	2	0	0	2	0	0	41
Hourly Total	41	29	0	3	70	2	73	0	75	25	0	0	25	1	0	170
4:00 PM	11	6	0	0	17	0	16	0	16	1	0	0	1	0	0	34
4:15 PM	9	9	0	0	18	0	21	0	21	5	0	0	5	0	0	44
4:30 PM	10	2	0	0	12	2	16	0	18	4	0	0	4	0	0	34

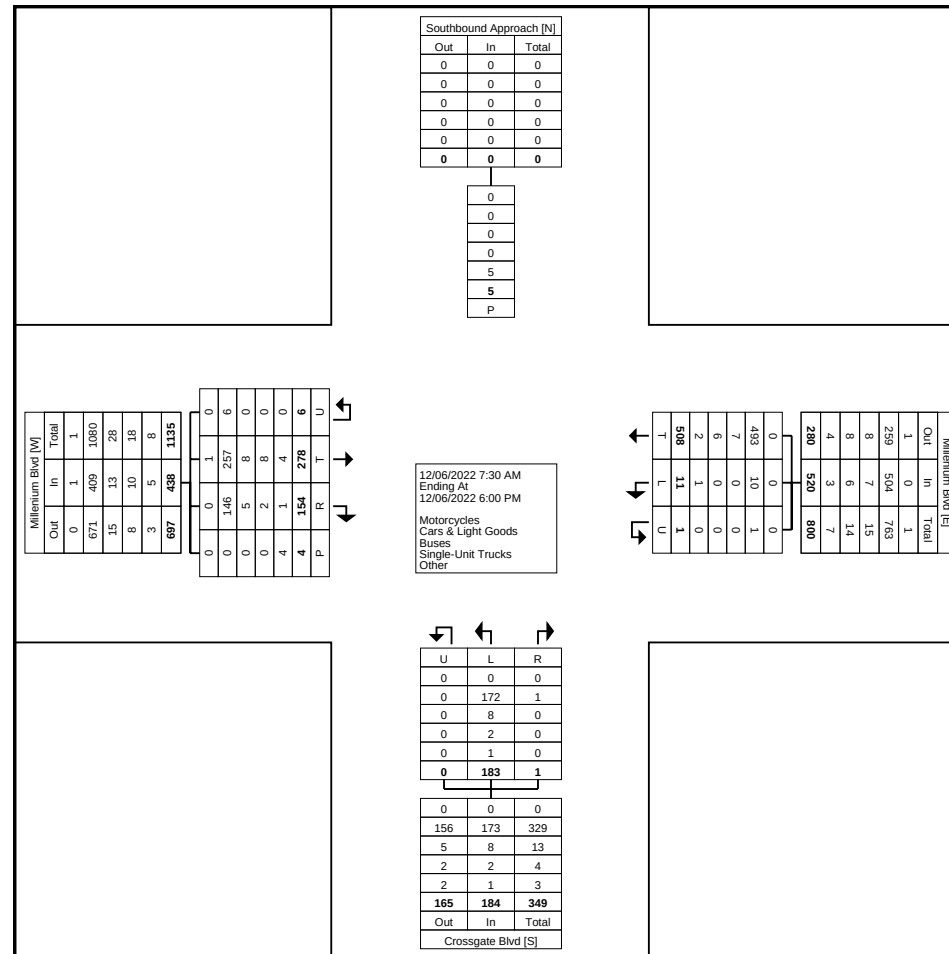
4:45 PM	11	8	0	0	19	0	10	0	10	11	0	0	11	0	0	40
Hourly Total	41	25	0	0	66	2	63	0	65	21	0	0	21	0	0	152
5:00 PM	11	11	0	0	22	1	23	0	24	6	0	0	6	0	0	52
5:15 PM	17	10	0	0	27	1	19	0	20	7	0	0	7	0	0	54
5:30 PM	12	7	0	0	19	0	16	0	16	2	0	0	2	0	0	37
5:45 PM	6	5	0	0	11	1	9	0	10	3	0	0	3	0	0	24
Hourly Total	46	33	0	0	79	3	67	0	70	18	0	0	18	0	0	167
Grand Total	278	154	6	4	438	11	508	1	520	183	1	0	184	5	0	1142
Approach %	63.5	35.2	1.4	-	-	2.1	97.7	0.2	-	99.5	0.5	0.0	-	-	-	-
Total %	24.3	13.5	0.5	-	38.4	1.0	44.5	0.1	45.5	16.0	0.1	0.0	16.1	-	0.0	-
Motorcycles	1	0	0	-	1	0	0	0	0	0	0	0	0	-	0	1
% Motorcycles	0.4	0.0	0.0	-	0.2	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	-	-	0.1
Cars & Light Goods	257	146	6	-	409	10	493	1	504	172	1	0	173	-	0	1086
% Cars & Light Goods	92.4	94.8	100.0	-	93.4	90.9	97.0	100.0	96.9	94.0	100.0	-	94.0	-	-	95.1
Buses	8	5	0	-	13	0	7	0	7	8	0	0	8	-	0	28
% Buses	2.9	3.2	0.0	-	3.0	0.0	1.4	0.0	1.3	4.4	0.0	-	4.3	-	-	2.5
Single-Unit Trucks	8	2	0	-	10	0	6	0	6	2	0	0	2	-	0	18
% Single-Unit Trucks	2.9	1.3	0.0	-	2.3	0.0	1.2	0.0	1.2	1.1	0.0	-	1.1	-	-	1.6
Articulated Trucks	2	0	0	-	2	0	1	0	1	1	0	0	1	-	0	4
% Articulated Trucks	0.7	0.0	0.0	-	0.5	0.0	0.2	0.0	0.2	0.5	0.0	-	0.5	-	-	0.4
Bicycles on Road	2	1	0	-	3	1	1	0	2	0	0	0	0	-	0	5
% Bicycles on Road	0.7	0.6	0.0	-	0.7	9.1	0.2	0.0	0.4	0.0	0.0	-	0.0	-	-	0.4
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	0.0	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	4	-	-	-	-	-	-	-	-	-	5	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-



Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@pts1.com

Count Name: Millennium Blvd & Crossgate Blvd
Site Code: 220328
Start Date: 12/06/2022
Page No: 3



Turning Movement Data Plot



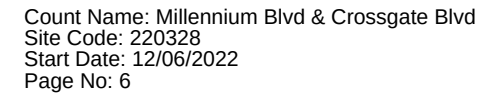
Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsl.com

Count Name: Millennium Blvd & Crossgate Blvd
Site Code: 220328
Start Date: 12/06/2022
Page No: 4

Turning Movement Peak Hour Data (7:45 AM)

Start Time	Millenium Blvd Eastbound					Millenium Blvd Westbound				Crossgate Blvd Northbound				Southbound Approach Southbound		Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	App. Total	Left	Right	U-Turn	App. Total	Peds	App. Total	
7:45 AM	10	0	0	0	10	0	18	0	18	10	0	0	10	1	0	38
8:00 AM	8	6	0	0	14	1	28	0	29	17	0	0	17	0	0	60
8:15 AM	15	7	0	0	22	0	19	1	20	7	1	0	8	0	0	50
8:30 AM	9	4	1	0	14	0	20	0	20	10	0	0	10	0	0	44
Total	42	17	1	0	60	1	85	1	87	44	1	0	45	1	0	192
Approach %	70.0	28.3	1.7	-	-	1.1	97.7	1.1	-	97.8	2.2	0.0	-	-	-	-
Total %	21.9	8.9	0.5	-	31.3	0.5	44.3	0.5	45.3	22.9	0.5	0.0	23.4	-	0.0	-
PHF	0.700	0.607	0.250	-	0.682	0.250	0.759	0.250	0.750	0.647	0.250	0.000	0.662	-	0.000	0.800
Motorcycles	1	0	0	-	1	0	0	0	0	0	0	0	0	-	0	1
% Motorcycles	2.4	0.0	0.0	-	1.7	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	-	-	0.5
Cars & Light Goods	34	14	1	-	49	1	81	1	83	41	1	0	42	-	0	174
% Cars & Light Goods	81.0	82.4	100.0	-	81.7	100.0	95.3	100.0	95.4	93.2	100.0	-	93.3	-	-	90.6
Buses	5	1	0	-	6	0	2	0	2	3	0	0	3	-	0	11
% Buses	11.9	5.9	0.0	-	10.0	0.0	2.4	0.0	2.3	6.8	0.0	-	6.7	-	-	5.7
Single-Unit Trucks	2	1	0	-	3	0	1	0	1	0	0	0	0	-	0	4
% Single-Unit Trucks	4.8	5.9	0.0	-	5.0	0.0	1.2	0.0	1.1	0.0	0.0	-	0.0	-	-	2.1
Articulated Trucks	0	0	0	-	0	0	1	0	1	0	0	0	0	-	0	1
% Articulated Trucks	0.0	0.0	0.0	-	0.0	0.0	1.2	0.0	1.1	0.0	0.0	-	0.0	-	-	0.5
Bicycles on Road	0	1	0	-	1	0	0	0	0	0	0	0	0	-	0	1
% Bicycles on Road	0.0	5.9	0.0	-	1.7	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	-	-	0.5
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	0	-	-	-	-	-	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-



Turning Movement Peak Hour Data Plot (1:00 PM)

Start Time	Millenium Blvd Eastbound					Millenium Blvd Westbound				Crossgate Blvd Northbound				Southbound Approach Southbound		Int. Total
	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	App. Total	Left	Right	U-Turn	App. Total	Peds	App. Total	
4:45 PM	11	8	0	0	19	0	10	0	10	11	0	0	11	0	0	40
5:00 PM	11	11	0	0	22	1	23	0	24	6	0	0	6	0	0	52
5:15 PM	17	10	0	0	27	1	19	0	20	7	0	0	7	0	0	54
5:30 PM	12	7	0	0	19	0	16	0	16	2	0	0	2	0	0	37
Total	51	36	0	0	87	2	68	0	70	26	0	0	26	0	0	183
Approach %	58.6	41.4	0.0	-	-	2.9	97.1	0.0	-	100.0	0.0	0.0	-	-	-	-
Total %	27.9	19.7	0.0	-	47.5	1.1	37.2	0.0	38.3	14.2	0.0	0.0	14.2	-	0.0	-
PHF	0.750	0.818	0.000	-	0.806	0.500	0.739	0.000	0.729	0.591	0.000	0.000	0.591	-	0.000	0.847
Motorcycles	0	0	0	-	0	0	0	0	0	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	-	-	0.0	0.0	0.0	-	0.0	0.0	-	-	0.0	-	-	0.0
Cars & Light Goods	51	36	0	-	87	2	67	0	69	26	0	0	26	-	0	182
% Cars & Light Goods	100.0	100.0	-	-	100.0	100.0	98.5	-	98.6	100.0	-	-	100.0	-	-	99.5
Buses	0	0	0	-	0	0	0	0	0	0	0	0	0	-	0	0
% Buses	0.0	0.0	-	-	0.0	0.0	0.0	-	0.0	0.0	-	-	0.0	-	-	0.0
Single-Unit Trucks	0	0	0	-	0	0	1	0	1	0	0	0	0	-	0	1
% Single-Unit Trucks	0.0	0.0	-	-	0.0	0.0	1.5	-	1.4	0.0	-	-	0.0	-	-	0.5
Articulated Trucks	0	0	0	-	0	0	0	0	0	0	0	0	0	-	0	0
% Articulated Trucks	0.0	0.0	-	-	0.0	0.0	0.0	-	0.0	0.0	-	-	0.0	-	-	0.0
Bicycles on Road	0	0	0	-	0	0	0	0	0	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	-	-	0.0	0.0	0.0	-	0.0	0.0	-	-	0.0	-	-	0.0
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	0	-	-	-	-	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

Appendix C

Existing Traffic Operations Reports



Lanes, Volumes, Timings
1: University Avenue & Park Road

Existing AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	36	4	280	41	10	259
Future Volume (vph)	36	4	280	41	10	259
Ideal Flow (vphpl)	1765	1765	1775	1775	1775	1900
Storage Length (m)	0.0	0.0		0.0	25.0	
Storage Lanes	1	0		0	1	
Taper Length (m)	7.5				100.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Ped Bike Factor						
Frt	0.986		0.981			
Flt Protected	0.957				0.950	
Satd. Flow (prot)	1647	0	3161	0	1668	3500
Flt Permitted	0.957				0.950	
Satd. Flow (perm)	1647	0	3161	0	1668	3500
Link Speed (k/h)	50		50		50	
Link Distance (m)	177.0		207.9		202.5	
Travel Time (s)	12.7		15.0		14.6	
Confl. Peds. (#/hr)				5	5	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	4%	0%	0%	2%
Adj. Flow (vph)	36	4	280	41	10	259
Shared Lane Traffic (%)						
Lane Group Flow (vph)	40	0	321	0	10	259
Sign Control	Stop		Free		Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	20.3%			ICU Level of Service A		
Analysis Period (min)	15					

HCM 6th TWSC
1: University Avenue & Park Road

Existing AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	0.9					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔		↕↕		↕	↕↕
Traffic Vol, veh/h	36	4	280	41	10	259
Future Vol, veh/h	36	4	280	41	10	259
Conflicting Peds, #/hr	0	0	0	5	5	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	25	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	4	0	0	2
Mvmt Flow	36	4	280	41	10	259

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	456	166	0	0	326
Stage 1	306	-	-	-	-
Stage 2	150	-	-	-	-
Critical Hdwy	6.8	6.9	-	-	4.1
Critical Hdwy Stg 1	5.8	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2
Pot Cap-1 Maneuver	538	856	-	-	1245
Stage 1	726	-	-	-	-
Stage 2	868	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	532	853	-	-	1240
Mov Cap-2 Maneuver	532	-	-	-	-
Stage 1	723	-	-	-	-
Stage 2	861	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12	0	0.3
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	553	1240
HCM Lane V/C Ratio	-	-	0.072	0.008
HCM Control Delay (s)	-	-	12	7.9
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	0.2	0

Lanes, Volumes, Timings
2: University Avenue & Millennium Boulevard

Existing AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Volume (vph)	176	85	209	69	41	93
Future Volume (vph)	176	85	209	69	41	93
Ideal Flow (vphpl)	1775	1750	1775	1775	1775	1900
Storage Length (m)	0.0	80.0		0.0	105.0	
Storage Lanes	1	1		0	1	
Taper Length (m)	7.5				80.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Frt		0.850	0.963			
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1651	1414	3111	0	1588	3466
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1651	1414	3111	0	1588	3466
Link Speed (k/h)	50		50		50	
Link Distance (m)	517.3		202.5		179.3	
Travel Time (s)	37.2		14.6		12.9	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	1%	4%	3%	4%	5%	3%
Adj. Flow (vph)	176	85	209	69	41	93
Shared Lane Traffic (%)						
Lane Group Flow (vph)	176	85	278	0	41	93
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 32.3%
Analysis Period (min) 15

HCM 6th TWSC
2: University Avenue & Millennium Boulevard

Existing AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	5.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Vol, veh/h	176	85	209	69	41	93
Future Vol, veh/h	176	85	209	69	41	93
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	80	-	-	105	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	4	3	4	5	3
Mvmt Flow	176	85	209	69	41	93

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	373	139	0	0	278
Stage 1	244	-	-	-	-
Stage 2	129	-	-	-	-
Critical Hdwy	6.82	6.98	-	-	4.2
Critical Hdwy Stg 1	5.82	-	-	-	-
Critical Hdwy Stg 2	5.82	-	-	-	-
Follow-up Hdwy	3.51	3.34	-	-	2.25
Pot Cap-1 Maneuver	604	877	-	-	1260
Stage 1	777	-	-	-	-
Stage 2	886	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	584	877	-	-	1260
Mov Cap-2 Maneuver	584	-	-	-	-
Stage 1	777	-	-	-	-
Stage 2	857	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12.4	0	2.4
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	584	877	1260	-
HCM Lane V/C Ratio	-	-	0.301	0.097	0.033	-
HCM Control Delay (s)	-	-	13.8	9.5	8	-
HCM Lane LOS	-	-	B	A	A	-
HCM 95th %tile Q(veh)	-	-	1.3	0.3	0.1	-

Lanes, Volumes, Timings
3: RIM Park Roadway & Millennium Boulevard

Existing AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Volume (vph)	108	7	9	241	14	10
Future Volume (vph)	108	7	9	241	14	10
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt	0.992				0.944	
Flt Protected				0.998	0.972	
Satd. Flow (prot)	1560	0	0	1598	1537	0
Flt Permitted				0.998	0.972	
Satd. Flow (perm)	1560	0	0	1598	1537	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	517.3			180.2	165.5	
Travel Time (s)	37.2			13.0	11.9	
Confl. Peds. (#/hr)		3	3			
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	4%	0%	0%	2%	0%	10%
Adj. Flow (vph)	108	7	9	241	14	10
Shared Lane Traffic (%)						
Lane Group Flow (vph)	115	0	0	250	24	0
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 31.8%
Analysis Period (min) 15
ICU Level of Service A

HCM 6th TWSC
3: RIM Park Roadway & Millennium Boulevard

Existing AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	0.8					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Vol, veh/h	108	7	9	241	14	10
Future Vol, veh/h	108	7	9	241	14	10
Conflicting Peds, #/hr	0	3	3	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	100	100	100	100	100	100
Heavy Vehicles, %	4	0	0	2	0	10
Mvmt Flow	108	7	9	241	14	10

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	118	0	374
Stage 1	-	-	-	-	115
Stage 2	-	-	-	-	259
Critical Hdwy	-	-	4.1	-	6.4
Critical Hdwy Stg 1	-	-	-	-	5.4
Critical Hdwy Stg 2	-	-	-	-	5.4
Follow-up Hdwy	-	-	2.2	-	3.5
Pot Cap-1 Maneuver	-	-	1483	-	631
Stage 1	-	-	-	-	915
Stage 2	-	-	-	-	789
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1480	-	625
Mov Cap-2 Maneuver	-	-	-	-	625
Stage 1	-	-	-	-	913
Stage 2	-	-	-	-	783

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	10.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	720	-	-	1480	-
HCM Lane V/C Ratio	0.033	-	-	0.006	-
HCM Control Delay (s)	10.2	-	-	7.4	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

Lanes, Volumes, Timings

4: Oak Park Drive & Millennium Boulevard

Existing AM Peak Hour

(220328) 400 Millennium Blvd, Waterloo TIS

	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	65	54	0	124	124	0
Future Volume (vph)	65	54	0	124	124	0
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt	0.939					
Flt Protected					0.950	
Satd. Flow (prot)	1468	0	0	1600	1626	0
Flt Permitted					0.950	
Satd. Flow (perm)	1468	0	0	1600	1626	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	180.2			180.1	133.5	
Travel Time (s)	13.0			13.0	9.6	
Confl. Peds. (#/hr)		3	3			
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	3%	6%	0%	2%	2%	0%
Adj. Flow (vph)	65	54	0	124	124	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	119	0	0	124	124	0
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 22.5%

ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

4: Oak Park Drive & Millennium Boulevard

Existing AM Peak Hour

(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	3.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	65	54	0	124	124	0
Future Vol, veh/h	65	54	0	124	124	0
Conflicting Peds, #/hr	0	3	3	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	100	100	100	100	100	100
Heavy Vehicles, %	3	6	0	2	2	0
Mvmt Flow	65	54	0	124	124	0

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	122	0	219
Stage 1	-	-	-	-	95
Stage 2	-	-	-	-	124
Critical Hdwy	-	-	4.1	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.2	-	3.518
Pot Cap-1 Maneuver	-	-	1478	-	769
Stage 1	-	-	-	-	929
Stage 2	-	-	-	-	902
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1475	-	767
Mov Cap-2 Maneuver	-	-	-	-	767
Stage 1	-	-	-	-	927
Stage 2	-	-	-	-	902

Approach	EB	WB	NB
HCM Control Delay, s	0	0	10.6
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	767	-	-	1475	-
HCM Lane V/C Ratio	0.162	-	-	-	-
HCM Control Delay (s)	10.6	-	-	0	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.6	-	-	0	-

Lanes, Volumes, Timings

6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	3	0	1	23	1	4	1	37	6	2	64	1
Future Volume (vph)	3	0	1	23	1	4	1	37	6	2	64	1
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.966			0.981			0.982			0.998	
Flt Protected		0.964			0.961			0.999			0.999	
Satd. Flow (prot)	0	1319	0	0	1445	0	0	1467	0	0	1486	0
Flt Permitted		0.964			0.961			0.999			0.999	
Satd. Flow (perm)	0	1319	0	0	1445	0	0	1467	0	0	1486	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		184.2			132.2			241.1			137.5	
Travel Time (s)		13.3			9.5			17.4			9.9	
Confl. Peds. (#/hr)			1	1			1					1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	33%	0%	0%	0%	0%	3%	0%	0%	3%	0%
Adj. Flow (vph)	3	0	1	23	1	4	1	37	6	2	64	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	4	0	0	28	0	0	44	0	0	67	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 16.0%

ICU Level of Service A

Analysis Period (min) 15

Existing AM Peak Hour

HCM 6th TWSC

6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

Intersection												
Int Delay, s/veh	2.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	3	0	1	23	1	4	1	37	6	2	64	1
Future Vol, veh/h	3	0	1	23	1	4	1	37	6	2	64	1
Conflicting Peds, #/hr	0	0	1	1	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	33	0	0	0	0	3	0	0	3	0
Mvmt Flow	3	0	1	23	1	4	1	37	6	2	64	1

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	115	115	67	112	112	40	66	0	0	43	0	0
Stage 1	70	70	-	42	42	-	-	-	-	-	-	-
Stage 2	45	45	-	70	70	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.53	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.597	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	867	779	916	870	782	1037	1549	-	-	1579	-	-
Stage 1	945	841	-	978	864	-	-	-	-	-	-	-
Stage 2	974	861	-	945	841	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	861	777	915	867	780	1037	1548	-	-	1579	-	-
Mov Cap-2 Maneuver	861	777	-	867	780	-	-	-	-	-	-	-
Stage 1	943	839	-	977	863	-	-	-	-	-	-	-
Stage 2	968	860	-	942	839	-	-	-	-	-	-	-

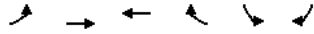
Approach	EB	WB	NB	SB
HCM Control Delay, s	9.1	9.2	0.2	0.2
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1548	-	-	874	884	1579	-	-
HCM Lane V/C Ratio	0.001	-	-	0.005	0.032	0.001	-	-
HCM Control Delay (s)	7.3	0	-	9.1	9.2	7.3	0	-
HCM Lane LOS	A	A	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-

Lanes, Volumes, Timings

Existing AM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	8	32	44	1	1	26
Future Volume (vph)	8	32	44	1	1	26
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997		0.870		
Frt Protected		0.990		0.998		
Satd. Flow (prot)	0	1504	1627	0	1407	0
Frt Permitted		0.990		0.998		
Satd. Flow (perm)	0	1504	1627	0	1407	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		137.5	166.8		179.3	
Travel Time (s)		9.9	12.0		12.9	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	13%	6%	0%	0%	0%	8%
Adj. Flow (vph)	8	32	44	1	1	26
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	40	45	0	27	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 19.1% ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

Existing AM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	2.6					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	8	32	44	1	1	26
Future Vol, veh/h	8	32	44	1	1	26
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	100	100	100	100	100	100
Heavy Vehicles, %	13	6	0	0	0	8
Mvmt Flow	8	32	44	1	1	26

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	45	0	-	0	93
Stage 1	-	-	-	-	45
Stage 2	-	-	-	-	48
Critical Hdwy	4.23	-	-	-	6.4
Critical Hdwy Stg 1	-	-	-	-	5.4
Critical Hdwy Stg 2	-	-	-	-	5.4
Follow-up Hdwy	2.317	-	-	-	3.5
Pot Cap-1 Maneuver	1495	-	-	-	912
Stage 1	-	-	-	-	983
Stage 2	-	-	-	-	980
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	1495	-	-	-	907
Mov Cap-2 Maneuver	-	-	-	-	907
Stage 1	-	-	-	-	978
Stage 2	-	-	-	-	980

Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	8.7
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1495	-	-	-	1004
HCM Lane V/C Ratio	0.005	-	-	-	0.027
HCM Control Delay (s)	7.4	0	-	-	8.7
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Junctions 8
ARCADY 8 - Roundabout Module
Version: 8.0.6.541 [19821,26/11/2015] © Copyright TRL Limited, 2023
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Path: C:\Users\AdamMorrison\Paradigm\Projects - (220328) Millennium\2 Analysis\Arcady

Report generation date: 2023-06-01 11:30:47 AM

Summary of intersection performance

AM							
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
A1 - Existing							
Leg North	0.08	~1	3.31	0.07	A	3.25	A
Leg South	0.05	~1	3.26	0.05	A		
Leg East	0.04	~1	3.12	0.04	A		

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

"D1 - Existing, AM" model duration: 8:00 AM - 9:00 AM

"D2 - Existing, PM" model duration: 5:00 PM - 6:30 PM

"D3 - Background 2036, AM" model duration: 8:00 AM - 9:30 AM

"D4 - Background 2036, PM" model duration: 5:00 PM - 6:30 PM

Run using Junctions 8.0.6.541 at 2023-06-01 11:30:47 AM

File summary

Title	Millenium and Crossgate - 3-Leg
Location	
Site Number	
Date	2023-06-01
Version	
Status	
Identifier	
Client	
Jobnumber	220328
Analyst	AdamMorrison
Description	

Analysis Options

Vehicle Length (m)	Do Queue Variations	Calculate Residual Capacity	Residual Capacity Criteria Type	V/C Ratio Threshold	Average Delay Threshold (s)	Queue Threshold (PCE)
7.50	✓		N/A	0.85	36.00	20.00

Units

Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units
m	kph	PCE	PCE	perHour	s	-Min	perMin

(Default Analysis Set) - Existing, AM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Roundabout Capacity Model	Description	Include In Report	Use Specific Demand Set(s)	Specific Demand Set (s)	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
(Default Analysis Set)	ARCADY		✓				100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Traffic Profile Type	Model Start Time (HH:mm)	Model Finish Time (HH:mm)	Model Time Period Length (min)	Time Segment Length (min)	Results For Central Hour Only	Single Time Segment Only	Locked	Run Automatically	Use Relationship	Relationship
Existing, AM	Existing	AM		PHF	08:00	09:00	60	15				✓		

Intersection Network

Intersections

Intersection	Name	Intersection Type	Leg Order	Grade Separated	Large Roundabout	Do Geometric Delay	Intersection Delay (s)	Intersection LOS
1	(untitled)	Roundabout	North,South,East				3.25	A

Intersection Network Options

Driving Side	Lighting
Right	Normal/unknown

Legs

Legs

Leg	Leg	Name	Description
North	North	Millennium Boulevard	
South	South	Millennium Boulevard	
East	East	Crossgate Boulevard	

Capacity Options

Leg	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
North	0.00	99999.00		0.00
South	0.00	99999.00		0.00
East	0.00	99999.00		0.00

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	I' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
North	3.50	4.50	30.00	20.00	40.00	25.00	
South	3.50	4.50	30.00	20.00	40.00	25.00	
East	3.50	4.50	30.00	20.00	40.00	25.00	

Slope / Intercept / Capacity

Leg Intercept Adjustments

Leg	Type	Reason	Direct Intercept Adjustment (PCE/hr)	Percentage Intercept Adjustment (%)
North	Percentage			90.00
South	Percentage			90.00
East	Percentage			90.00

Roundabout Slope and Intercept used in model

Leg	Enter slope and intercept directly	Entered slope	Entered intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
North		(calculated)	(calculated)	0.579	1221.701
South		(calculated)	(calculated)	0.579	1221.701
East		(calculated)	(calculated)	0.579	1221.701

The slope and intercept shown above include any corrections and adjustments.

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		✓	✓	Truck Percentages	2.00				✓	✓

Entry Flows

General Flows Data

Leg	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)
North	PHF	✓	86.00	100.000
South	PHF	✓	59.00	100.000
East	PHF	✓	45.00	100.000

Peak Hour Factor Data

Leg	Hourly Volume (PCE/hr)	Peak Hour Factor	Peak Time Segment
North	86.00	1.00	SecondQuarter
South	59.00	1.00	SecondQuarter
East	45.00	1.00	SecondQuarter

Turning Proportions

Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

	To			
From		North	South	East
	North	0.000	85.000	1.000
	South	42.000	0.000	17.000
	East	1.000	44.000	0.000

Turning Proportions (PCE) - Intersection 1 (for whole period)

	To			
From		North	South	East
	North	0.00	0.99	0.01
	South	0.71	0.00	0.29
	East	0.02	0.98	0.00

Vehicle Mix

Average PCE Per Vehicle - Intersection 1 (for whole period)

	To			
		North	South	East
	North	1.000	1.020	1.000

From	South	1.050	1.000	1.060
	East	1.000	1.000	1.000

Truck Percentages - Intersection 1 (for whole period)

From	To			
		North	South	East
	North	0.0	2.0	0.0
	South	5.0	0.0	6.0
	East	0.0	0.0	0.0

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Total Queueing Delay (PCE-min)	Inclusive Average Queueing Delay (s)
North	0.07	3.31	0.08	~1	A	86.00	86.00	4.71	3.28	0.08	4.71	3.28
South	0.05	3.26	0.05	~1	A	59.00	59.00	3.19	3.24	0.05	3.19	3.24
East	0.04	3.12	0.04	~1	A	45.00	45.00	2.33	3.11	0.04	2.33	3.11

Main Results for each time segment

Main results: (08:00-08:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	86.00	21.50	85.69	42.84	43.85	0.00	1196.32	813.90	0.072	0.00	0.08	3.305	A
South	59.00	14.75	58.79	128.54	1.00	0.00	1221.12	1216.22	0.048	0.00	0.05	3.260	A
East	45.00	11.25	44.84	17.93	41.85	0.00	1197.48	720.62	0.038	0.00	0.04	3.122	A

Main results: (08:15-08:30)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	86.00	21.50	86.00	43.00	44.00	0.00	1196.24	813.90	0.072	0.08	0.08	3.305	A
South	59.00	14.75	59.00	129.00	1.00	0.00	1221.12	1216.22	0.048	0.05	0.05	3.260	A
East	45.00	11.25	45.00	18.00	42.00	0.00	1197.39	720.62	0.038	0.04	0.04	3.123	A

Main results: (08:30-08:45)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	86.00	21.50	86.00	43.00	44.00	0.00	1196.24	813.90	0.072	0.08	0.08	3.305	A
South	59.00	14.75	59.00	129.00	1.00	0.00	1221.12	1216.22	0.048	0.05	0.05	3.260	A
East	45.00	11.25	45.00	18.00	42.00	0.00	1197.39	720.62	0.038	0.04	0.04	3.123	A

Main results: (08:45-09:00)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	86.00	21.50	86.00	43.00	44.00	0.00	1196.24	813.90	0.072	0.08	0.08	3.305	A
South	59.00	14.75	59.00	129.00	1.00	0.00	1221.12	1216.22	0.048	0.05	0.05	3.260	A
East	45.00	11.25	45.00	18.00	42.00	0.00	1197.39	720.62	0.038	0.04	0.04	3.123	A

Queueing Delay Results for each time segment

Queueing Delay results: (08:00-08:15)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.16	0.08	3.305	A	A
South	0.78	0.05	3.260	A	A
East	0.57	0.04	3.122	A	A

Queueing Delay results: (08:15-08:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.18	0.08	3.305	A	A
South	0.80	0.05	3.260	A	A
East	0.58	0.04	3.123	A	A

Queueing Delay results: (08:30-08:45)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.18	0.08	3.305	A	A
South	0.80	0.05	3.260	A	A
East	0.59	0.04	3.123	A	A

Queueing Delay results: (08:45-09:00)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.18	0.08	3.305	A	A
South	0.80	0.05	3.260	A	A
East	0.59	0.04	3.123	A	A

Queue Variation Results for each time segment

Queue Variation results: (08:00-08:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.08	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.05	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.04	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (08:15-08:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.08	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.05	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.04	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (08:30-08:45)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.08	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.05	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.04	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (08:45-09:00)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.08	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.05	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.04	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Lanes, Volumes, Timings
1: University Avenue & Park Road

Existing PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	61	17	296	102	26	386
Future Volume (vph)	61	17	296	102	26	386
Ideal Flow (vphpl)	1765	1765	1775	1775	1775	1900
Storage Length (m)	0.0	0.0		0.0	25.0	
Storage Lanes	1	0		0	1	
Taper Length (m)	7.5				100.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Ped Bike Factor						
Frt	0.971		0.962			
Flt Protected	0.962				0.950	
Satd. Flow (prot)	1630	0	3185	0	1668	3535
Flt Permitted	0.962				0.950	
Satd. Flow (perm)	1630	0	3185	0	1668	3535
Link Speed (k/h)	50		50		50	
Link Distance (m)	177.0		207.9		202.5	
Travel Time (s)	12.7		15.0		14.6	
Confl. Peds. (#/hr)				5	5	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	1%	0%	0%	1%
Adj. Flow (vph)	61	17	296	102	26	386
Shared Lane Traffic (%)						
Lane Group Flow (vph)	78	0	398	0	26	386
Sign Control	Stop		Free		Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	30.6%			ICU Level of Service A		
Analysis Period (min)	15					

HCM 6th TWSC
1: University Avenue & Park Road

Existing PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	1.5					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	61	17	296	102	26	386
Future Vol, veh/h	61	17	296	102	26	386
Conflicting Peds, #/hr	0	0	0	5	5	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	25	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	1	0	0	1
Mvmt Flow	61	17	296	102	26	386

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	597	204	0	0	403
Stage 1	352	-	-	-	-
Stage 2	245	-	-	-	-
Critical Hdwy	6.8	6.9	-	-	4.1
Critical Hdwy Stg 1	5.8	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2
Pot Cap-1 Maneuver	439	809	-	-	1167
Stage 1	689	-	-	-	-
Stage 2	779	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	428	806	-	-	1162
Mov Cap-2 Maneuver	428	-	-	-	-
Stage 1	686	-	-	-	-
Stage 2	762	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	14	0	0.5
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	477	1162
HCM Lane V/C Ratio	-	-	0.164	0.022
HCM Control Delay (s)	-	-	14	8.2
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	0.6	0.1

Lanes, Volumes, Timings

2: University Avenue & Millennium Boulevard

Existing PM Peak Hour

(220328) 400 Millennium Blvd, Waterloo TIS

	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↩	↩	↕	↕	↩	↕
Traffic Volume (vph)	130	71	169	139	97	283
Future Volume (vph)	130	71	169	139	97	283
Ideal Flow (vphpl)	1775	1750	1775	1775	1775	1900
Storage Length (m)	0.0	80.0		0.0	105.0	
Storage Lanes	1	1		0	1	
Taper Length (m)	7.5				80.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Ped Bike Factor						
Frt		0.850	0.932			
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	1456	3075	0	1668	3535
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1668	1456	3075	0	1668	3535
Link Speed (k/h)	50		50		50	
Link Distance (m)	517.3		202.5		179.3	
Travel Time (s)	37.2		14.6		12.9	
Confl. Peds. (#/hr)	1					
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	2%	0%	0%	1%
Adj. Flow (vph)	130	71	169	139	97	283
Shared Lane Traffic (%)						
Lane Group Flow (vph)	130	71	308	0	97	283
Sign Control	Stop		Free		Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 33.2%

ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

2: University Avenue & Millennium Boulevard

Existing PM Peak Hour

(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	4.2					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↩	↩	↕	↕	↩	↕
Traffic Vol, veh/h	130	71	169	139	97	283
Future Vol, veh/h	130	71	169	139	97	283
Conflicting Peds, #/hr	1	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	80	-	-	105	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	1	2	0	0	1
Mvmt Flow	130	71	169	139	97	283

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	576	154	0	0	308
Stage 1	239	-	-	-	-
Stage 2	337	-	-	-	-
Critical Hdwy	6.8	6.92	-	-	4.1
Critical Hdwy Stg 1	5.8	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-
Follow-up Hdwy	3.5	3.31	-	-	2.2
Pot Cap-1 Maneuver	453	868	-	-	1264
Stage 1	784	-	-	-	-
Stage 2	701	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	418	868	-	-	1264
Mov Cap-2 Maneuver	418	-	-	-	-
Stage 1	784	-	-	-	-
Stage 2	646	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	14.7	0	2.1
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	418	868	1264	-
HCM Lane V/C Ratio	-	-	0.311	0.082	0.077	-
HCM Control Delay (s)	-	-	17.5	9.5	8.1	-
HCM Lane LOS	-	-	C	A	A	-
HCM 95th %tile Q(veh)	-	-	1.3	0.3	0.2	-

Lanes, Volumes, Timings

3: RIM Park Roadway & Millennium Boulevard

Existing PM Peak Hour

(220328) 400 Millennium Blvd, Waterloo TIS

	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Volume (vph)	176	17	9	142	68	10
Future Volume (vph)	176	17	9	142	68	10
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.988			0.983		
Flt Protected				0.997	0.958	
Satd. Flow (prot)	1612	0	0	1612	1644	0
Flt Permitted				0.997	0.958	
Satd. Flow (perm)	1612	0	0	1612	1644	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	517.3			180.2	165.5	
Travel Time (s)	37.2			13.0	11.9	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%
Adj. Flow (vph)	176	17	9	142	68	10
Shared Lane Traffic (%)						
Lane Group Flow (vph)	193	0	0	151	78	0
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 28.5%

ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

3: RIM Park Roadway & Millennium Boulevard

Existing PM Peak Hour

(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	2.2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Vol, veh/h	176	17	9	142	68	10
Future Vol, veh/h	176	17	9	142	68	10
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	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	1	0	0
Mvmt Flow	176	17	9	142	68	10

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	193	0	345
Stage 1	-	-	-	-	185
Stage 2	-	-	-	-	160
Critical Hdwy	-	-	4.1	-	6.4
Critical Hdwy Stg 1	-	-	-	-	5.4
Critical Hdwy Stg 2	-	-	-	-	5.4
Follow-up Hdwy	-	-	2.2	-	3.5
Pot Cap-1 Maneuver	-	-	1392	-	656
Stage 1	-	-	-	-	852
Stage 2	-	-	-	-	874
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1392	-	651
Mov Cap-2 Maneuver	-	-	-	-	651
Stage 1	-	-	-	-	852
Stage 2	-	-	-	-	868

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	11.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	672	-	-	1392	-
HCM Lane V/C Ratio	0.116	-	-	0.006	-
HCM Control Delay (s)	11.1	-	-	7.6	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Lanes, Volumes, Timings

4: Oak Park Drive & Millennium Boulevard

Existing PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	77	108	6	90	71	3
Future Volume (vph)	77	108	6	90	71	3
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt	0.921				0.995	
Flt Protected				0.997	0.954	
Satd. Flow (prot)	1503	0	0	1612	1657	0
Flt Permitted				0.997	0.954	
Satd. Flow (perm)	1503	0	0	1612	1657	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	180.2			180.1	133.5	
Travel Time (s)	13.0			13.0	9.6	
Confl. Peds. (#/hr)		1	1			
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%
Adj. Flow (vph)	77	108	6	90	71	3
Shared Lane Traffic (%)						
Lane Group Flow (vph)	185	0	0	96	74	0
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	23.5%			ICU Level of Service A		
Analysis Period (min)	15					

HCM 6th TWSC

4: Oak Park Drive & Millennium Boulevard

Existing PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	2.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	77	108	6	90	71	3
Future Vol, veh/h	77	108	6	90	71	3
Conflicting Peds, #/hr	0	1	1	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	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	1	0	0
Mvmt Flow	77	108	6	90	71	3

Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	186	0	234	132
Stage 1	-	-	-	-	132	-
Stage 2	-	-	-	-	102	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1401	-	759	923
Stage 1	-	-	-	-	899	-
Stage 2	-	-	-	-	927	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1400	-	754	922
Mov Cap-2 Maneuver	-	-	-	-	754	-
Stage 1	-	-	-	-	898	-
Stage 2	-	-	-	-	922	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.5		10.2	
HCM LOS					B	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	760	-	-	1400	-	
HCM Lane V/C Ratio	0.097	-	-	0.004	-	
HCM Control Delay (s)	10.2	-	-	7.6	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	0.3	-	-	0	-	

Lanes, Volumes, Timings

6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	7	1	4	10	2	0	1	24	16	2	61	7
Future Volume (vph)	7	1	4	10	2	0	1	24	16	2	61	7
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.955						0.947			0.986	
Flt Protected		0.972			0.960			0.999			0.999	
Satd. Flow (prot)	0	1423	0	0	1471	0	0	1417	0	0	1484	0
Flt Permitted		0.972			0.960			0.999			0.999	
Satd. Flow (perm)	0	1423	0	0	1471	0	0	1417	0	0	1484	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		184.2			132.2			241.1			137.5	
Travel Time (s)		13.3			9.5			17.4			9.9	
Confl. Peds. (#/hr)	1		1	1		1			2	2		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	6%	0%	2%	0%
Adj. Flow (vph)	7	1	4	10	2	0	1	24	16	2	61	7
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	12	0	0	12	0	0	41	0	0	70	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 16.0%

ICU Level of Service A

Analysis Period (min) 15

Existing PM Peak Hour

HCM 6th TWSC

6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

Intersection												
Int Delay, s/veh	1.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	7	1	4	10	2	0	1	24	16	2	61	7
Future Vol, veh/h	7	1	4	10	2	0	1	24	16	2	61	7
Conflicting Peds, #/hr	1	0	1	1	0	1	0	0	2	2	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	0	0	0	0	0	6	0	2	0
Mvmt Flow	7	1	4	10	2	0	1	24	16	2	61	7

Major/Minor	Minor2	Minor1	Major1	Major2								
Conflicting Flow All	105	113	66	108	108	35	68	0	0	42	0	0
Stage 1	69	69	-	36	36	-	-	-	-	-	-	-
Stage 2	36	44	-	72	72	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	880	781	1003	876	786	1044	1546	-	-	1580	-	-
Stage 1	946	841	-	985	869	-	-	-	-	-	-	-
Stage 2	985	862	-	943	839	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	876	778	1002	868	783	1042	1546	-	-	1578	-	-
Mov Cap-2 Maneuver	876	778	-	868	783	-	-	-	-	-	-	-
Stage 1	945	840	-	982	866	-	-	-	-	-	-	-
Stage 2	981	859	-	936	838	-	-	-	-	-	-	-

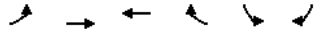
Approach	EB	WB	NB	SB
HCM Control Delay, s	9	9.3	0.2	0.2
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1546	-	-	904	853	1578	-	-
HCM Lane V/C Ratio	0.001	-	-	0.013	0.014	0.001	-	-
HCM Control Delay (s)	7.3	0	-	9	9.3	7.3	0	-
HCM Lane LOS	A	A	-	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0	0	0	-	-

Lanes, Volumes, Timings

Existing PM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	2	41	32	2	3	33
Future Volume (vph)	2	41	32	2	3	33
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.992		0.876		
Flt Protected		0.998		0.996		
Satd. Flow (prot)	0	1628	1491	0	1523	0
Flt Permitted		0.998		0.996		
Satd. Flow (perm)	0	1628	1491	0	1523	0
Link Speed (k/h)		50	50	50		
Link Distance (m)		137.5	166.8	179.3		
Travel Time (s)		9.9	12.0	12.9		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	6%	50%	0%	0%
Adj. Flow (vph)	2	41	32	2	3	33
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	43	34	0	36	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 14.4% ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

Existing PM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	2.9					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	2	41	32	2	3	33
Future Vol, veh/h	2	41	32	2	3	33
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	100	100	100	100	100	100
Heavy Vehicles, %	0	0	6	50	0	0
Mvmt Flow	2	41	32	2	3	33

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	34	0	-	0	78
Stage 1	-	-	-	-	33
Stage 2	-	-	-	-	45
Critical Hdwy	4.1	-	-	-	6.4
Critical Hdwy Stg 1	-	-	-	-	5.4
Critical Hdwy Stg 2	-	-	-	-	5.4
Follow-up Hdwy	2.2	-	-	-	3.5
Pot Cap-1 Maneuver	1591	-	-	-	930
Stage 1	-	-	-	-	995
Stage 2	-	-	-	-	983
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	1591	-	-	-	929
Mov Cap-2 Maneuver	-	-	-	-	929
Stage 1	-	-	-	-	994
Stage 2	-	-	-	-	983

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	8.6
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1591	-	-	-	1035
HCM Lane V/C Ratio	0.001	-	-	-	0.035
HCM Control Delay (s)	7.3	0	-	-	8.6
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Junctions 8							
ARCADY 8 - Roundabout Module							
Version: 8.0.6.541 [19821,26/11/2015] © Copyright TRL Limited, 2023							
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Filename: Millenium and Crossgate - 3-Leg.arc8
Path: C:\Users\AdamMorrison\Paradigm\Projects - (220328) Millennium\2 Analysis\Arcady
Report generation date: 2023-06-01 11:32:08 AM

Summary of intersection performance

PM							
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
A1 - Existing							
Leg North	0.07	~1	3.25	0.06	A	3.21	A
Leg South	0.09	~1	3.20	0.08	A		
Leg East	0.02	~1	3.10	0.02	A		

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

"D1 - Existing, AM" model duration: 8:00 AM - 9:00 AM
"D2 - Existing, PM " model duration: 5:00 PM - 6:30 PM
"D3 - Background 2036, AM" model duration: 8:00 AM - 9:30 AM
"D4 - Background 2036, PM" model duration: 5:00 PM - 6:30 PM

Run using Junctions 8.0.6.541 at 2023-06-01 11:32:08 AM

File summary

Title	Millenium and Crossgate - 3-Leg
Location	
Site Number	
Date	2023-06-01
Version	
Status	
Identifier	
Client	
Jobnumber	220328
Analyst	AdamMorrison
Description	

Analysis Options

Vehicle Length (m)	Do Queue Variations	Calculate Residual Capacity	Residual Capacity Criteria Type	V/C Ratio Threshold	Average Delay Threshold (s)	Queue Threshold (PCE)
7.50	✓		N/A	0.85	36.00	20.00

Units

Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units
m	kph	PCE	PCE	perHour	s	-Min	perMin

(Default Analysis Set) - Existing, PM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Roundabout Capacity Model	Description	Include In Report	Use Specific Demand Set(s)	Specific Demand Set (s)	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
(Default Analysis Set)	ARCADY		✓				100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Traffic Profile Type	Model Start Time (HH:mm)	Model Finish Time (HH:mm)	Model Time Period Length (min)	Time Segment Length (min)	Results For Central Hour Only	Single Time Segment Only	Locked	Run Automatically	Use Relationship	Relationship
Existing, PM	Existing	PM		ONE HOUR	17:00	18:30	90	15				✓		

Intersection Network

Intersections

Intersection	Name	Intersection Type	Leg Order	Grade Separated	Large Roundabout	Do Geometric Delay	Intersection Delay (s)	Intersection LOS
1	(untitled)	Roundabout	North,South,East				3.21	A

Intersection Network Options

Driving Side	Lighting
Right	Normal/unknown

Legs

Legs

Leg	Leg	Name	Description
North	North	Millennium Boulevard	
South	South	Millennium Boulevard	
East	East	Crossgate Boulevard	

Capacity Options

Leg	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
North	0.00	99999.00		0.00
South	0.00	99999.00		0.00
East	0.00	99999.00		0.00

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	I' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
North	3.50	4.50	30.00	20.00	40.00	25.00	
South	3.50	4.50	30.00	20.00	40.00	25.00	
East	3.50	4.50	30.00	20.00	40.00	25.00	

Slope / Intercept / Capacity

Leg Intercept Adjustments

Leg	Type	Reason	Direct Intercept Adjustment (PCE/hr)	Percentage Intercept Adjustment (%)
North	Percentage			90.00
South	Percentage			90.00
East	Percentage			90.00

Roundabout Slope and Intercept used in model

Leg	Enter slope and intercept directly	Entered slope	Entered intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
North		(calculated)	(calculated)	0.579	1221.701
South		(calculated)	(calculated)	0.579	1221.701
East		(calculated)	(calculated)	0.579	1221.701

The slope and intercept shown above include any corrections and adjustments.

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		✓	✓	Truck Percentages	2.00				✓	✓

Entry Flows

General Flows Data

Leg	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)
North	ONE HOUR	✓	70.00	100.000
South	ONE HOUR	✓	87.00	100.000
East	ONE HOUR	✓	26.00	100.000

Turning Proportions

Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

	To			
		North	South	East
From	North	0.000	68.000	2.000
	South	51.000	0.000	36.000
	East	0.000	26.000	0.000

Turning Proportions (PCE) - Intersection 1 (for whole period)

	To			
		North	South	East
From	North	0.00	0.97	0.03
	South	0.59	0.00	0.41
	East	0.00	1.00	0.00

Vehicle Mix

Average PCE Per Vehicle - Intersection 1 (for whole period)

	To			
		North	South	East
From	North	1.000	1.020	1.000
	South	1.000	1.000	1.000
	East	1.000	1.000	1.000

Truck Percentages - Intersection 1 (for whole period)

	To			
		North	South	East

From	North	0.0	2.0	0.0
	South	0.0	0.0	0.0
	East	0.0	0.0	0.0

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Total Queueing Delay (PCE-min)	Inclusive Average Queueing Delay (s)
North	0.06	3.25	0.07	~1	A	64.23	96.35	5.14	3.20	0.06	5.14	3.20
South	0.08	3.20	0.09	~1	A	79.83	119.75	6.28	3.15	0.07	6.28	3.15
East	0.02	3.10	0.02	~1	A	23.86	35.79	1.83	3.07	0.02	1.83	3.07

Main Results for each time segment

Main results: (17:00-17:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	52.70	13.17	52.51	38.26	19.51	0.00	1210.41	752.08	0.044	0.00	0.05	3.169	A
South	65.50	16.37	65.27	70.52	1.50	0.00	1220.83	1209.26	0.054	0.00	0.06	3.115	A
East	19.57	4.89	19.51	28.51	38.26	0.00	1199.56	811.43	0.016	0.00	0.02	3.050	A

Main results: (17:15-17:30)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	62.93	15.73	62.89	45.82	23.36	0.00	1208.18	752.08	0.052	0.05	0.06	3.203	A
South	78.21	19.55	78.16	84.45	1.80	0.00	1220.66	1209.26	0.064	0.06	0.07	3.150	A
East	23.37	5.84	23.36	34.14	45.82	0.00	1195.18	811.43	0.020	0.02	0.02	3.071	A

Main results: (17:30-17:45)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	77.07	19.27	77.02	56.11	28.61	0.00	1205.14	752.08	0.064	0.06	0.07	3.252	A
South	95.79	23.95	95.72	103.42	2.20	0.00	1220.43	1209.26	0.078	0.07	0.08	3.200	A
East	28.63	7.16	28.61	41.81	56.11	0.00	1189.22	811.43	0.024	0.02	0.02	3.101	A

Main results: (17:45-18:00)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	77.07	19.27	77.07	56.15	28.63	0.00	1205.13	752.08	0.064	0.07	0.07	3.252	A
South	95.79	23.95	95.79	103.50	2.20	0.00	1220.43	1209.26	0.078	0.08	0.09	3.200	A
East	28.63	7.16	28.63	41.84	56.15	0.00	1189.20	811.43	0.024	0.02	0.02	3.101	A

Main results: (18:00-18:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	62.93	15.73	62.98	45.89	23.39	0.00	1208.16	752.08	0.052	0.07	0.06	3.206	A
South	78.21	19.55	78.28	84.57	1.80	0.00	1220.66	1209.26	0.064	0.09	0.07	3.150	A
East	23.37	5.84	23.39	34.19	45.89	0.00	1195.14	811.43	0.020	0.02	0.02	3.071	A

Main results: (18:15-18:30)

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Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	52.70	13.17	52.74	38.42	19.59	0.00	1210.36	752.08	0.044	0.06	0.05	3.169	A
South	65.50	16.37	65.55	70.82	1.51	0.00	1220.83	1209.26	0.054	0.07	0.06	3.117	A
East	19.57	4.89	19.59	28.63	38.42	0.00	1199.46	811.43	0.016	0.02	0.02	3.052	A

Queueing Delay Results for each time segment

Queueing Delay results: (17:00-17:15)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	0.68	0.05	3.169	A	A
South	0.83	0.06	3.115	A	A
East	0.24	0.02	3.050	A	A

Queueing Delay results: (17:15-17:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	0.83	0.06	3.203	A	A
South	1.01	0.07	3.150	A	A
East	0.30	0.02	3.071	A	A

Queueing Delay results: (17:30-17:45)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.03	0.07	3.252	A	A
South	1.26	0.08	3.200	A	A
East	0.36	0.02	3.101	A	A

Queueing Delay results: (17:45-18:00)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.04	0.07	3.252	A	A
South	1.27	0.08	3.200	A	A
East	0.37	0.02	3.101	A	A

Queueing Delay results: (18:00-18:15)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	0.85	0.06	3.206	A	A
South	1.04	0.07	3.150	A	A
East	0.30	0.02	3.071	A	A

Queueing Delay results: (18:15-18:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	0.71	0.05	3.169	A	A
South	0.86	0.06	3.117	A	A
East	0.25	0.02	3.052	A	A

Queue Variation Results for each time segment

Queue Variation results: (17:00-17:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.05	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.06	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.02	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (17:15-17:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.06	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.07	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.02	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (17:30-17:45)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.07	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.08	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.02	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (17:45-18:00)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.07	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.09	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.02	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (18:00-18:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.06	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.07	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.02	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (18:15-18:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.05	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.06	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.02	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Appendix D

Internal Trip Capture



NCHRP 8-51 Internal Trip Capture Estimation Tool					
Project Name:	220328 (400 Millennium Blvd)			Organization:	Paradigm
Project Location:	Waterloo			Performed By:	
Scenario Description:	Total Traffic			Date:	30-May-23
Analysis Year:	2036			Checked By:	
Analysis Period:	AM Street Peak Hour			Date:	

Table 1-A: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)						
Land Use	Development Data (For Information Only)			Estimated Vehicle-Trips		
	ITE LUCs ¹	Quantity	Units	Total	Entering	Exiting
Office				0		
Retail	822	11,033		26	16	10
Restaurant				0		
Cinema/Entertainment				0		
Residential	210,215,220		623	261	62	199
Hotel				0		
All Other Land Uses ²				0		
Total				287	78	209

Table 2-A: Mode Split and Vehicle Occupancy Estimates						
Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.	% Transit	% Non-Motorized	Veh. Occ.	% Transit	% Non-Motorized
Office	1.00			1.00		
Retail	1.00			1.00		
Restaurant						
Cinema/Entertainment						
Residential	1.00			1.00		
Hotel						
All Other Land Uses ²						

Table 3-A: Average Land Use Interchange Distances (Feet Walking Distance)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-A: Internal Person-Trip Origin-Destination Matrix*						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	0		0	0	1	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	2	0	0		0
Hotel	0	0	0	0	0	

Table 5-A: Computations Summary			
	Total	Entering	Exiting
All Person-Trips	287	78	209
Internal Capture Percentage	2%	4%	1%
External Vehicle-Trips ³	281	75	206
External Transit-Trips ⁴	0	0	0
External Non-Motorized Trips ⁴	0	0	0

Table 6-A: Internal Trip Capture Percentages by Land Use		
Land Use	Entering Trips	Exiting Trips
Office	N/A	N/A
Retail	13%	10%
Restaurant	N/A	N/A
Cinema/Entertainment	N/A	N/A
Residential	2%	1%
Hotel	N/A	N/A

¹Land Use Codes (LUCs) from *Trip Generation Informational Report*, published by the Institute of Transportation Engineers.

²Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator

³Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A

⁴Person-Trips

*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas Transportation Institute

Project Name:	220328 (400 Millennium Blvd)
Analysis Period:	AM Street Peak Hour

Table 7-A: Conversion of Vehicle-Trip Ends to Person-Trip Ends						
Land Use	Table 7-A (D): Entering Trips			Table 7-A (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	0	0	1.00	0	0
Retail	1.00	16	16	1.00	10	10
Restaurant	1.00	0	0	1.00	0	0
Cinema/Entertainment	1.00	0	0	1.00	0	0
Residential	1.00	62	62	1.00	199	199
Hotel	1.00	0	0	1.00	0	0

Table 8-A (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	3		1	0	1	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	4	2	40	0		0
Hotel	0	0	0	0	0	

Table 8-A (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		5	0	0	0	0
Retail	0		0	0	1	0
Restaurant	0	1		0	3	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	3	0	0		0
Hotel	0	1	0	0	0	

Table 9-A (D): Internal and External Trips Summary (Entering Trips)						
Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles ¹	Transit ²	Non-Motorized ²
Office	0	0	0	0	0	0
Retail	2	14	16	14	0	0
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	1	61	62	61	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses ³	0	0	0	0	0	0

Table 9-A (O): Internal and External Trips Summary (Exiting Trips)						
Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles ¹	Transit ²	Non-Motorized ²
Office	0	0	0	0	0	0
Retail	1	9	10	9	0	0
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	2	197	199	197	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses ³	0	0	0	0	0	0

¹Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A

²Person-Trips

³Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator

*Indicates computation that has been rounded to the nearest whole number.

NCHRP 8-51 Internal Trip Capture Estimation Tool					
Project Name:	220328 (400 Millennium Blvd)			Organization:	Paradigm
Project Location:	Waterloo			Performed By:	
Scenario Description:	Total Traffic			Date:	30-May-23
Analysis Year:	2036			Checked By:	
Analysis Period:	PM Street Peak Hour			Date:	

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)						
Land Use	Development Data (For Information Only)			Estimated Vehicle-Trips		
	ITE LUCs ¹	Quantity	Units	Total	Entering	Exiting
Office				0		
Retail	822	11,033		83	42	41
Restaurant				0		
Cinema/Entertainment				0		
Residential	210,215,220		623	343	210	133
Hotel				0		
All Other Land Uses ²				0		
Total				426	252	174

Table 2-P: Mode Split and Vehicle Occupancy Estimates						
Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.	% Transit	% Non-Motorized	Veh. Occ.	% Transit	% Non-Motorized
Office	1.00			1.00		
Retail	1.00			1.00		
Restaurant						
Cinema/Entertainment						
Residential	1.00			1.00		
Hotel						
All Other Land Uses ²						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail					0	
Restaurant						
Cinema/Entertainment						
Residential		0				
Hotel						

Table 4-P: Internal Person-Trip Origin-Destination Matrix*						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	0		0	0	11	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	4	0	0		0
Hotel	0	0	0	0	0	

Table 5-P: Computations Summary			
	Total	Entering	Exiting
All Person-Trips	426	252	174
Internal Capture Percentage	7%	6%	9%
External Vehicle-Trips ³	396	237	159
External Transit-Trips ⁴	0	0	0
External Non-Motorized Trips ⁴	0	0	0

Table 6-P: Internal Trip Capture Percentages by Land Use		
Land Use	Entering Trips	Exiting Trips
Office	N/A	N/A
Retail	10%	27%
Restaurant	N/A	N/A
Cinema/Entertainment	N/A	N/A
Residential	5%	3%
Hotel	N/A	N/A

¹Land Use Codes (LUCs) from *Trip Generation Informational Report*, published by the Institute of Transportation Engineers.

²Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator

³Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P

⁴Person-Trips

*Indicates computation that has been rounded to the nearest whole number.

Project Name:	220328 (400 Millennium Blvd)
Analysis Period:	PM Street Peak Hour

Table 7-P: Conversion of Vehicle-Trip Ends to Person-Trip Ends						
Land Use	Table 7-P (D): Entering Trips			Table 7-P (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	0	0	1.00	0	0
Retail	1.00	42	42	1.00	41	41
Restaurant	1.00	0	0	1.00	0	0
Cinema/Entertainment	1.00	0	0	1.00	0	0
Residential	1.00	210	210	1.00	133	133
Hotel	1.00	0	0	1.00	0	0

Table 8-P (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	1		12	2	11	2
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	5	56	28	0		4
Hotel	0	0	0	0	0	

Table 8-P (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		3	0	0	8	0
Retail	0		0	0	97	0
Restaurant	0	21		0	34	0
Cinema/Entertainment	0	2	0		8	0
Residential	0	4	0	0		0
Hotel	0	1	0	0	0	

Table 9-P (D): Internal and External Trips Summary (Entering Trips)						
Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles ¹	Transit ²	Non-Motorized ²
Office	0	0	0	0	0	0
Retail	4	38	42	38	0	0
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	11	199	210	199	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses ³	0	0	0	0	0	0

Table 9-P (O): Internal and External Trips Summary (Exiting Trips)						
Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles ¹	Transit ²	Non-Motorized ²
Office	0	0	0	0	0	0
Retail	11	30	41	30	0	0
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	4	129	133	129	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses ³	0	0	0	0	0	0

¹Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P

²Person-Trips

³Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator

*Indicates computation that has been rounded to the nearest whole number.

Row: 2006 GTA zone of origin - gta06_orig Row: 2006 GTA zone of destination - gta06_dest Row: 2006 GTA zone of origin - gta06_orig Row: 2006 GTA zone of destination - gta06_dest
 Column: 2006 GTA zone of destination - gta06_d Column: 2006 GTA zone of origin - gta06_orig Column: 2006 GTA zone of destination - gta06_d Column: 2006 GTA zone of origin - gta06_orig
 Table: No. of trips made by person - n_pers_trip Table: No. of trips made by person - n_pers_trip Table: No. of trips made by person - n_pers_trip Table: No. of trips made by person - n_pers_trip

RowG:
 ColG:(7002,7062)
 TblG:(0-99)

RowG:
 ColG:(7002,7062)
 TblG:(0-99)

RowG:
 ColG:(7002,7062)
 TblG:(0-99)

RowG:
 ColG:(7002,7062)
 TblG:(0-99)

Filters:
 (Start time of trip - start_time In 700-900)

Filters:
 (Start time of trip - start_time In 700-900)

Filters:
 (Start time of trip - start_time In 1600-1800)

Filters:
 (Start time of trip - start_time In 1600-1800)

Trip 2016
 Table: 1

Trip 2016
 Table: 1

Trip 2016
 Table: 1

Trip 2016
 Table: 1

	1
6015	6
7002	592
7004	86
7005	85
7011	21
7012	48
7019	24
7057	14
7059	17
7062	30
7097	22
7098	227
7103	20
7115	14
7142	22
7191	40
7207	48
7234	20
7245	17
7248	31
7316	53
7478	12
7535	22
7560	18
7572	19
8329	31
8960	15

	1
442	26
3707	28
5193	20
7001	48
7,002	622
7,003	157
7006	22
7008	76
7009	19
7016	33
7017	54
7019	81
7020	14
7021	71
7032	26
7033	20
7039	70
7040	41
7,042	153
7052	79
7053	33
7059	14
7,082	114
7,097	104
7,098	404
7103	47
7,112	110
7117	50
7119	26
7130	66
7135	21
7141	20
7,147	124
7149	47
7153	26
7155	21
7181	24
7192	33
7193	79
7201	14
7212	94
7214	44
7222	95
7234	41
7235	94
7237	24
7248	70
7249	15
7254	14
7261	18
7264	76
7273	23
7286	22
7299	24
7303	14
7316	27
7353	26
7356	25
7392	36
7393	22
7422	85
7451	26
7458	47
7466	85
7478	75
7547	20
7553	26
7557	14
7,570	111
7572	19
8042	16
8142	20
8191	33
8192	47
8317	47

	1
56	18
3707	28
5193	20
7,001	104
7,002	413
7,003	137
7005	26
7006	29
7008	52
7009	19
7011	16
7012	15
7,013	184
7015	19
7016	33
7017	24
7019	81
7020	22
7021	94
7023	17
7024	10
7032	26
7033	20
7039	70
7040	41
7,042	129
7052	79
7057	23
7,059	148
7061	30
7097	53
7098	14
7103	33
7105	12
7108	14
7109	13
7112	18
7117	50
7130	38
7135	21
7141	67
7,147	124
7149	47
7153	12
7155	21
7170	50
7181	24
7182	14
7193	79
7201	14
7212	70
7214	84
7219	47
7222	22
7225	33
7236	20
7248	70
7249	15
7252	20
7259	18
7266	14
7272	13
7284	29
7286	22
7299	24
7355	20
7392	36
7393	22
7451	26
7458	29
7459	10
8042	16
8142	20
8169	26
8191	33
9066	24

	1
5198	23
7,001	121
7,002	401
7004	29
7,008	111
7010	99
7013	90
7020	22
7036	47
7,059	121
7062	12
7097	31
7,103	110
7106	12
7108	14
7109	17
7129	9
7191	40
7225	25
7228	24
7236	17
7253	21
7282	14
7302	7
7316	6
7414	15
7466	32
7535	22
7547	22
7548	18
7570	42
8162	17

Appendix E

2036 Background Traffic Operations Reports



Lanes, Volumes, Timings
1: University Avenue & Park Road

2036 Background AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↕↕	↕	↕	↕↕
Traffic Volume (vph)	47	5	362	53	13	335
Future Volume (vph)	47	5	362	53	13	335
Ideal Flow (vphpl)	1765	1765	1775	1775	1775	1900
Storage Length (m)	0.0	0.0		0.0	25.0	
Storage Lanes	1	0		0	1	
Taper Length (m)	7.5				100.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Ped Bike Factor						
Frt	0.987		0.981			
Flt Protected	0.957				0.950	
Satd. Flow (prot)	1649	0	3161	0	1668	3500
Flt Permitted	0.957				0.950	
Satd. Flow (perm)	1649	0	3161	0	1668	3500
Link Speed (k/h)	50		50		50	
Link Distance (m)	177.0		207.9		202.5	
Travel Time (s)	12.7		15.0		14.6	
Confl. Peds. (#/hr)				5	5	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	4%	0%	0%	2%
Adj. Flow (vph)	47	5	362	53	13	335
Shared Lane Traffic (%)						
Lane Group Flow (vph)	52	0	415	0	13	335
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization 22.7%	ICU Level of Service A					
Analysis Period (min) 15						

HCM 6th TWSC
1: University Avenue & Park Road

2036 Background AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	1					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↕↕	↕	↕	↕↕
Traffic Vol, veh/h	47	5	362	53	13	335
Future Vol, veh/h	47	5	362	53	13	335
Conflicting Peds, #/hr	0	0	0	5	5	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	25	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	4	0	0	2
Mvmt Flow	47	5	362	53	13	335

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	588	213	0	0	420
Stage 1	394	-	-	-	-
Stage 2	194	-	-	-	-
Critical Hdwy	6.8	6.9	-	-	4.1
Critical Hdwy Stg 1	5.8	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2
Pot Cap-1 Maneuver	445	798	-	-	1150
Stage 1	656	-	-	-	-
Stage 2	826	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	438	795	-	-	1146
Mov Cap-2 Maneuver	438	-	-	-	-
Stage 1	653	-	-	-	-
Stage 2	817	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	13.9	0	0.3
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	458	1146
HCM Lane V/C Ratio	-	-	0.114	0.011
HCM Control Delay (s)	-	-	13.9	8.2
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	0.4	0

Lanes, Volumes, Timings
2: University Avenue & Millennium Boulevard

2036 Background AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↩	↩	↕	↕	↩	↕
Traffic Volume (vph)	228	110	270	89	53	120
Future Volume (vph)	228	110	270	89	53	120
Ideal Flow (vphpl)	1775	1750	1775	1775	1775	1900
Storage Length (m)	0.0	80.0		0.0	105.0	
Storage Lanes	1	1		0	1	
Taper Length (m)	7.5				80.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Frt		0.850	0.963			
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1651	1414	3111	0	1588	3466
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1651	1414	3111	0	1588	3466
Link Speed (k/h)	50		50		50	
Link Distance (m)	517.3		202.5		179.3	
Travel Time (s)	37.2		14.6		12.9	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	1%	4%	3%	4%	5%	3%
Adj. Flow (vph)	228	110	270	89	53	120
Shared Lane Traffic (%)						
Lane Group Flow (vph)	228	110	359	0	53	120
Sign Control	Stop		Free		Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 37.9%
Analysis Period (min) 15

HCM 6th TWSC
2: University Avenue & Millennium Boulevard

2036 Background AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	6.6					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↩	↩	↕	↕	↩	↕
Traffic Vol, veh/h	228	110	270	89	53	120
Future Vol, veh/h	228	110	270	89	53	120
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	80	-	-	105	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	4	3	4	5	3
Mvmt Flow	228	110	270	89	53	120

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	481	180	0	0	359
Stage 1	315	-	-	-	-
Stage 2	166	-	-	-	-
Critical Hdwy	6.82	6.98	-	-	4.2
Critical Hdwy Stg 1	5.82	-	-	-	-
Critical Hdwy Stg 2	5.82	-	-	-	-
Follow-up Hdwy	3.51	3.34	-	-	2.25
Pot Cap-1 Maneuver	517	826	-	-	1175
Stage 1	716	-	-	-	-
Stage 2	849	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	494	826	-	-	1175
Mov Cap-2 Maneuver	494	-	-	-	-
Stage 1	716	-	-	-	-
Stage 2	811	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15.7	0	2.5
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	494	826	1175	-
HCM Lane V/C Ratio	-	-	0.462	0.133	0.045	-
HCM Control Delay (s)	-	-	18.4	10	8.2	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	2.4	0.5	0.1	-

Lanes, Volumes, Timings
3: RIM Park Roadway & Millennium Boulevard

2036 Background AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Volume (vph)	140	9	12	312	18	13
Future Volume (vph)	140	9	12	312	18	13
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt	0.992				0.943	
Flt Protected				0.998	0.972	
Satd. Flow (prot)	1560	0	0	1598	1535	0
Flt Permitted				0.998	0.972	
Satd. Flow (perm)	1560	0	0	1598	1535	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	517.3			180.2	165.5	
Travel Time (s)	37.2			13.0	11.9	
Confl. Peds. (#/hr)		3	3			
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	4%	0%	0%	2%	0%	10%
Adj. Flow (vph)	140	9	12	312	18	13
Shared Lane Traffic (%)						
Lane Group Flow (vph)	149	0	0	324	31	0
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 40.1%
Analysis Period (min) 15
ICU Level of Service A

HCM 6th TWSC
3: RIM Park Roadway & Millennium Boulevard

2036 Background AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	0.9					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Vol, veh/h	140	9	12	312	18	13
Future Vol, veh/h	140	9	12	312	18	13
Conflicting Peds, #/hr	0	3	3	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	100	100	100	100	100	100
Heavy Vehicles, %	4	0	0	2	0	10
Mvmt Flow	140	9	12	312	18	13

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	152	0	484
Stage 1	-	-	-	-	148
Stage 2	-	-	-	-	336
Critical Hdwy	-	-	4.1	-	6.4
Critical Hdwy Stg 1	-	-	-	-	5.4
Critical Hdwy Stg 2	-	-	-	-	5.4
Follow-up Hdwy	-	-	2.2	-	3.5
Pot Cap-1 Maneuver	-	-	1441	-	545
Stage 1	-	-	-	-	884
Stage 2	-	-	-	-	728
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1438	-	538
Mov Cap-2 Maneuver	-	-	-	-	538
Stage 1	-	-	-	-	882
Stage 2	-	-	-	-	721

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	10.9
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	642	-	-	1438	-
HCM Lane V/C Ratio	0.048	-	-	0.008	-
HCM Control Delay (s)	10.9	-	-	7.5	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Lanes, Volumes, Timings
4: Oak Park Drive & Millennium Boulevard

2036 Background AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	EBT	EBR	WBL	WBT	NBL	NBR
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Volume (vph)	84	70	0	160	160	0
Future Volume (vph)	84	70	0	160	160	0
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt	0.939					
Flt Protected					0.950	
Satd. Flow (prot)	1468	0	0	1600	1626	0
Flt Permitted					0.950	
Satd. Flow (perm)	1468	0	0	1600	1626	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	180.2			180.1	133.5	
Travel Time (s)	13.0			13.0	9.6	
Confl. Peds. (#/hr)		3	3			
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	3%	6%	0%	2%	2%	0%
Adj. Flow (vph)	84	70	0	160	160	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	154	0	0	160	160	0
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	26.7%
Analysis Period (min)	15
ICU Level of Service	A

HCM 6th TWSC
4: Oak Park Drive & Millennium Boulevard

2036 Background AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	3.9					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Vol, veh/h	84	70	0	160	160	0
Future Vol, veh/h	84	70	0	160	160	0
Conflicting Peds, #/hr	0	3	3	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	100	100	100	100	100	100
Heavy Vehicles, %	3	6	0	2	2	0
Mvmt Flow	84	70	0	160	160	0

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	0	157
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	-	4.1
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	-	2.2
Pot Cap-1 Maneuver	-	-	1435
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	1432
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	11.6
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	707	-	-	1432	-
HCM Lane V/C Ratio	0.226	-	-	-	-
HCM Control Delay (s)	11.6	-	-	0	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.9	-	-	0	-

Lanes, Volumes, Timings
 6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	4	0	1	30	1	5	1	48	8	3	83	1
Future Volume (vph)	4	0	1	30	1	5	1	48	8	3	83	1
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.973			0.981			0.981			0.998	
Flt Protected		0.962			0.960			0.999			0.998	
Satd. Flow (prot)	0	1346	0	0	1444	0	0	1465	0	0	1484	0
Flt Permitted		0.962			0.960			0.999			0.998	
Satd. Flow (perm)	0	1346	0	0	1444	0	0	1465	0	0	1484	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		184.2			132.2			241.1			137.5	
Travel Time (s)		13.3			9.5			17.4			9.9	
Confl. Peds. (#/hr)			1	1			1					1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	33%	0%	0%	0%	0%	3%	0%	0%	3%	0%
Adj. Flow (vph)	4	0	1	30	1	5	1	48	8	3	83	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	5	0	0	36	0	0	57	0	0	87	0
Sign Control		Stop			Stop			Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	17.9%											
Analysis Period (min)	15											
ICU Level of Service A												

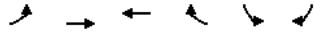
HCM 6th TWSC
 6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

Intersection												
Int Delay, s/veh	2.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	0	1	30	1	5	1	48	8	3	83	1
Future Vol, veh/h	4	0	1	30	1	5	1	48	8	3	83	1
Conflicting Peds, #/hr	0	0	1	1	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	33	0	0	0	0	3	0	0	3	0
Mvmt Flow	4	0	1	30	1	5	1	48	8	3	83	1
Major/Minor												
	Minor2	Minor1			Major1			Major2				
Conflicting Flow All	148	149	86	145	145	52	85	0	0	56	0	0
Stage 1	91	91	-	54	54	-	-	-	-	-	-	-
Stage 2	57	58	-	91	91	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.53	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.597	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	825	746	894	828	750	1021	1524	-	-	1562	-	-
Stage 1	921	823	-	963	854	-	-	-	-	-	-	-
Stage 2	960	851	-	921	823	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	818	743	893	825	747	1021	1523	-	-	1562	-	-
Mov Cap-2 Maneuver	818	743	-	825	747	-	-	-	-	-	-	-
Stage 1	919	821	-	962	853	-	-	-	-	-	-	-
Stage 2	953	850	-	917	821	-	-	-	-	-	-	-
Approach												
	EB	WB			NB			SB				
HCM Control Delay, s	9.4	9.5			0.1			0.3				
HCM LOS	A	A										
Minor Lane/Major Mvmt												
	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	1523	-	-	832	845	1562	-	-				
HCM Lane V/C Ratio	0.001	-	-	0.006	0.043	0.002	-	-				
HCM Control Delay (s)	7.4	0	-	9.4	9.5	7.3	0	-				
HCM Lane LOS	A	A	-	A	A	A	A	-				
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-				

Lanes, Volumes, Timings

2036 Background AM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	↔
Traffic Volume (vph)	10	41	57	1	1	34
Future Volume (vph)	10	41	57	1	1	34
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998		0.869		
Flt Protected		0.990		0.999		
Satd. Flow (prot)	0	1504	1628	0	1406	0
Flt Permitted		0.990		0.999		
Satd. Flow (perm)	0	1504	1628	0	1406	0
Link Speed (k/h)		50	50	50		
Link Distance (m)		137.5	166.8	179.3		
Travel Time (s)		9.9	12.0	12.9		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	13%	6%	0%	0%	0%	8%
Adj. Flow (vph)	10	41	57	1	1	34
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	51	58	0	35	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 19.8% ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

2036 Background AM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	2.7					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	↔
Traffic Vol, veh/h	10	41	57	1	1	34
Future Vol, veh/h	10	41	57	1	1	34
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	100	100	100	100	100	100
Heavy Vehicles, %	13	6	0	0	0	8
Mvmt Flow	10	41	57	1	1	34

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	58	0	119
Stage 1	-	-	58
Stage 2	-	-	61
Critical Hdwy	4.23	-	6.4
Critical Hdwy Stg 1	-	-	5.4
Critical Hdwy Stg 2	-	-	5.4
Follow-up Hdwy	2.317	-	3.372
Pot Cap-1 Maneuver	1479	-	882
Stage 1	-	-	970
Stage 2	-	-	967
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1479	-	876
Mov Cap-2 Maneuver	-	-	876
Stage 1	-	-	963
Stage 2	-	-	967

Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	8.8
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1479	-	-	-	987
HCM Lane V/C Ratio	0.007	-	-	-	0.035
HCM Control Delay (s)	7.5	0	-	-	8.8
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Junctions 8
ARCADY 8 - Roundabout Module
Version: 8.0.6.541 [19821,26/11/2015] © Copyright TRL Limited, 2023
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Filename: Millenium and Crossgate - 3-Leg.arc8

Path: C:\Users\AdamMorrison\Paradigm\Projects - (220328) Millennium\2 Analysis\Arcady

Report generation date: 2023-06-01 11:32:22 AM

Summary of intersection performance

	AM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	A1 - Background 2036						
Leg North	0.12	~1	3.45	0.10	A	3.36	A
Leg South	0.08	~1	3.33	0.07	A		
Leg East	0.06	~1	3.20	0.05	A		

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

"D1 - Existing, AM" model duration: 8:00 AM - 9:00 AM

"D2 - Existing, PM" model duration: 5:00 PM - 6:30 PM

"D3 - Background 2036, AM" model duration: 8:00 AM - 9:30 AM

"D4 - Background 2036, PM" model duration: 5:00 PM - 6:30 PM

Run using Junctions 8.0.6.541 at 2023-06-01 11:32:21 AM

File summary

Title	Millenium and Crossgate - 3-Leg
Location	
Site Number	
Date	2023-06-01
Version	
Status	
Identifier	
Client	
Jobnumber	220328
Analyst	AdamMorrison
Description	

Analysis Options

Vehicle Length (m)	Do Queue Variations	Calculate Residual Capacity	Residual Capacity Criteria Type	V/C Ratio Threshold	Average Delay Threshold (s)	Queue Threshold (PCE)
7.50	✓		N/A	0.85	36.00	20.00

Units

Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units
m	kph	PCE	PCE	perHour	s	-Min	perMin

(Default Analysis Set) - Background 2036, AM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Roundabout Capacity Model	Description	Include In Report	Use Specific Demand Set(s)	Specific Demand Set(s)	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
(Default Analysis Set)	ARCADY		✓				100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Traffic Profile Type	Model Start Time (HH:mm)	Model Finish Time (HH:mm)	Model Time Period Length (min)	Time Segment Length (min)	Results For Central Hour Only	Single Time Segment Only	Locked	Run Automatically	Use Relationship	Relationship
Background 2036, AM	Background 2036	AM		ONE HOUR	08:00	09:30	90	15				✓		

Intersection Network

Intersections

Intersection	Name	Intersection Type	Leg Order	Grade Separated	Large Roundabout	Do Geometric Delay	Intersection Delay (s)	Intersection LOS
1	(untitled)	Roundabout	North,South,East				3.36	A

Intersection Network Options

Driving Side	Lighting
Right	Normal/unknown

Legs

Legs

Leg	Leg	Name	Description
North	North	Millennium Boulevard	
South	South	Millennium Boulevard	
East	East	Crossgate Boulevard	

Capacity Options

Leg	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
North	0.00	99999.00		0.00
South	0.00	99999.00		0.00
East	0.00	99999.00		0.00

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	I' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
North	3.50	4.50	30.00	20.00	40.00	25.00	
South	3.50	4.50	30.00	20.00	40.00	25.00	
East	3.50	4.50	30.00	20.00	40.00	25.00	

Slope / Intercept / Capacity

Leg Intercept Adjustments

Leg	Type	Reason	Direct Intercept Adjustment (PCE/hr)	Percentage Intercept Adjustment (%)
North	Percentage			90.00
South	Percentage			90.00
East	Percentage			90.00

Roundabout Slope and Intercept used in model

Leg	Enter slope and intercept directly	Entered slope	Entered intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
North		(calculated)	(calculated)	0.579	1221.701
South		(calculated)	(calculated)	0.579	1221.701
East		(calculated)	(calculated)	0.579	1221.701

The slope and intercept shown above include any corrections and adjustments.

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		✓	✓	Truck Percentages	2.00				✓	✓

Entry Flows

General Flows Data

Leg	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)
North	ONE HOUR	✓	111.00	100.000
South	ONE HOUR	✓	76.00	100.000
East	ONE HOUR	✓	58.00	100.000

Turning Proportions

Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

	To			
		North	South	East
	From North	0.000	110.000	1.000
	From South	54.000	0.000	22.000
	From East	1.000	57.000	0.000

Turning Proportions (PCE) - Intersection 1 (for whole period)

	To			
		North	South	East
	From North	0.00	0.99	0.01
	From South	0.71	0.00	0.29
	From East	0.02	0.98	0.00

Vehicle Mix

Average PCE Per Vehicle - Intersection 1 (for whole period)

	To			
		North	South	East
	From North	1.000	1.020	1.000
	From South	1.050	1.000	1.060
	From East	1.000	1.000	1.000

Truck Percentages - Intersection 1 (for whole period)

	To			
		North	South	East
	From North	0.0	2.0	0.0
	From South	5.0	0.0	6.0
	From East	0.0	0.0	0.0

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Total Queueing Delay (PCE-min)	Inclusive Average Queueing Delay (s)
North	0.10	3.45	0.12	~1	A	101.86	152.78	8.57	3.37	0.10	8.57	3.37
South	0.07	3.33	0.08	~1	A	69.74	104.61	5.72	3.28	0.06	5.72	3.28
East	0.05	3.20	0.06	~1	A	53.22	79.83	4.19	3.15	0.05	4.19	3.15

Main Results for each time segment

Main results: (08:00-08:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	83.57	20.89	83.26	41.26	42.76	0.00	1196.95	811.58	0.070	0.00	0.08	3.296	A
South	57.22	14.30	57.01	125.28	0.75	0.00	1221.27	1217.47	0.047	0.00	0.05	3.255	A
East	43.67	10.92	43.51	17.25	40.51	0.00	1198.26	721.05	0.036	0.00	0.04	3.117	A

Main results: (08:15-08:30)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	99.79	24.95	99.72	49.41	51.21	0.00	1192.06	811.58	0.084	0.08	0.09	3.360	A
South	68.32	17.08	68.28	150.03	0.90	0.00	1221.18	1217.47	0.056	0.05	0.06	3.287	A
East	52.14	13.04	52.11	20.66	48.51	0.00	1193.62	721.05	0.044	0.04	0.05	3.153	A

Main results: (08:30-08:45)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	122.21	30.55	122.12	60.51	62.71	0.00	1185.40	811.58	0.103	0.09	0.12	3.452	A
South	83.68	20.92	83.62	183.73	1.10	0.00	1221.06	1217.47	0.069	0.06	0.08	3.331	A
East	63.86	15.96	63.81	25.31	59.41	0.00	1187.32	721.05	0.054	0.05	0.06	3.203	A

Main results: (08:45-09:00)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	122.21	30.55	122.21	60.56	62.76	0.00	1185.38	811.58	0.103	0.12	0.12	3.452	A
South	83.68	20.92	83.68	183.87	1.10	0.00	1221.06	1217.47	0.069	0.08	0.08	3.331	A
East	63.86	15.96	63.86	25.32	59.45	0.00	1187.29	721.05	0.054	0.06	0.06	3.203	A

Main results: (09:00-09:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	99.79	24.95	99.88	49.49	51.28	0.00	1192.02	811.58	0.084	0.12	0.09	3.363	A
South	68.32	17.08	68.38	150.27	0.90	0.00	1221.18	1217.47	0.056	0.08	0.06	3.289	A
East	52.14	13.04	52.18	20.69	48.59	0.00	1193.58	721.05	0.044	0.06	0.05	3.155	A

Main results: (09:15-09:30)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	83.57	20.89	83.63	41.44	42.94	0.00	1196.85	811.58	0.070	0.09	0.08	3.297	A
South	57.22	14.30	57.26	125.82	0.75	0.00	1221.26	1217.47	0.047	0.06	0.05	3.258	A
East	43.67	10.92	43.70	17.33	40.68	0.00	1198.15	721.05	0.036	0.05	0.04	3.120	A

Queueing Delay Results for each time segment

Queueing Delay results: (08:00-08:15)

Leg	Queueing Total Delay (PCE-	Queueing Rate Of Delay (PCE-	Average Delay Per Arriving Vehicle	Unsignalised Level Of	Signalised Level Of
-----	----------------------------	------------------------------	------------------------------------	-----------------------	---------------------

	min)	min/min)	(s)	Service	Service
North	1.12	0.07	3.296	A	A
South	0.76	0.05	3.255	A	A
East	0.56	0.04	3.117	A	A

Queueing Delay results: (08:15-08:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.38	0.09	3.360	A	A
South	0.92	0.06	3.287	A	A
East	0.68	0.05	3.153	A	A

Queueing Delay results: (08:30-08:45)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.73	0.12	3.452	A	A
South	1.14	0.08	3.331	A	A
East	0.84	0.06	3.203	A	A

Queueing Delay results: (08:45-09:00)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.75	0.12	3.452	A	A
South	1.16	0.08	3.331	A	A
East	0.85	0.06	3.203	A	A

Queueing Delay results: (09:00-09:15)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.42	0.09	3.363	A	A
South	0.95	0.06	3.289	A	A
East	0.70	0.05	3.155	A	A

Queueing Delay results: (09:15-09:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.17	0.08	3.297	A	A
South	0.79	0.05	3.258	A	A
East	0.58	0.04	3.120	A	A

Queue Variation Results for each time segment

Queue Variation results: (08:00-08:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.08	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.05	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.04	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (08:15-08:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.09	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.06	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.05	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (08:30-08:45)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.12	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

South	0.08	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.06	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (08:45-09:00)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.12	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.08	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.06	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (09:00-09:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.09	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.06	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.05	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (09:15-09:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.08	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.05	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.04	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Lanes, Volumes, Timings
1: University Avenue & Park Road

2036 Background PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↕↕	↕	↕	↕↕
Traffic Volume (vph)	79	22	383	132	34	499
Future Volume (vph)	79	22	383	132	34	499
Ideal Flow (vphpl)	1765	1765	1775	1775	1775	1900
Storage Length (m)	0.0	0.0		0.0	25.0	
Storage Lanes	1	0		0	1	
Taper Length (m)	7.5				100.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Ped Bike Factor						
Frt	0.971		0.962			
Flt Protected	0.962				0.950	
Satd. Flow (prot)	1630	0	3185	0	1668	3535
Flt Permitted	0.962				0.950	
Satd. Flow (perm)	1630	0	3185	0	1668	3535
Link Speed (k/h)	50		50		50	
Link Distance (m)	177.0		207.9		202.5	
Travel Time (s)	12.7		15.0		14.6	
Confl. Peds. (#/hr)				5	5	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	1%	0%	0%	1%
Adj. Flow (vph)	79	22	383	132	34	499
Shared Lane Traffic (%)						
Lane Group Flow (vph)	101	0	515	0	34	499
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	35.5%					
ICU Level of Service	A					
Analysis Period (min)	15					

HCM 6th TWSC
1: University Avenue & Park Road

2036 Background PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	1.8					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↕↕	↕	↕	↕↕
Traffic Vol, veh/h	79	22	383	132	34	499
Future Vol, veh/h	79	22	383	132	34	499
Conflicting Peds, #/hr	0	0	0	5	5	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	25	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	1	0	0	1
Mvmt Flow	79	22	383	132	34	499

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	772	263	0	0	520
Stage 1	454	-	-	-	-
Stage 2	318	-	-	-	-
Critical Hdwy	6.8	6.9	-	-	4.1
Critical Hdwy Stg 1	5.8	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2
Pot Cap-1 Maneuver	340	742	-	-	1056
Stage 1	612	-	-	-	-
Stage 2	716	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	328	739	-	-	1052
Mov Cap-2 Maneuver	328	-	-	-	-
Stage 1	610	-	-	-	-
Stage 2	693	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	18.2	0	0.5
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	373	1052
HCM Lane V/C Ratio	-	-	0.271	0.032
HCM Control Delay (s)	-	-	18.2	8.5
HCM Lane LOS	-	-	C	A
HCM 95th %tile Q(veh)	-	-	1.1	0.1

Lanes, Volumes, Timings
2: University Avenue & Millennium Boulevard

2036 Background PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	168	92	219	180	125	366
Future Volume (vph)	168	92	219	180	125	366
Ideal Flow (vphpl)	1775	1750	1775	1775	1775	1900
Storage Length (m)	0.0	80.0		0.0	105.0	
Storage Lanes	1	1		0	1	
Taper Length (m)	7.5				80.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Ped Bike Factor						
Frt		0.850	0.932			
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	1456	3074	0	1668	3535
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1668	1456	3074	0	1668	3535
Link Speed (k/h)	50		50			50
Link Distance (m)	517.3		202.5			179.3
Travel Time (s)	37.2		14.6			12.9
Confl. Peds. (#/hr)	1					
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	1%	2%	0%	0%	1%
Adj. Flow (vph)	168	92	219	180	125	366
Shared Lane Traffic (%)						
Lane Group Flow (vph)	168	92	399	0	125	366
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	40.0%			ICU Level of Service A		
Analysis Period (min)	15					

HCM 6th TWSC
2: University Avenue & Millennium Boulevard

2036 Background PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	5.9					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖↗		↖	↗
Traffic Vol, veh/h	168	92	219	180	125	366
Future Vol, veh/h	168	92	219	180	125	366
Conflicting Peds, #/hr	1	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	80	-	-	105	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	1	2	0	0	1
Mvmt Flow	168	92	219	180	125	366

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	743	200	0	0	399
Stage 1	309	-	-	-	-
Stage 2	434	-	-	-	-
Critical Hdwy	6.8	6.92	-	-	4.1
Critical Hdwy Stg 1	5.8	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-
Follow-up Hdwy	3.5	3.31	-	-	2.2
Pot Cap-1 Maneuver	355	811	-	-	1171
Stage 1	724	-	-	-	-
Stage 2	627	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	317	811	-	-	1171
Mov Cap-2 Maneuver	317	-	-	-	-
Stage 1	724	-	-	-	-
Stage 2	559	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	22	0	2.1
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	317	811	1171	-
HCM Lane V/C Ratio	-	-	0.53	0.113	0.107	-
HCM Control Delay (s)	-	-	28.5	10	8.4	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	2.9	0.4	0.4	-

Lanes, Volumes, Timings
3: RIM Park Roadway & Millennium Boulevard

2036 Background PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	→	↖	↗	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↖	↖
Traffic Volume (vph)	228	22	12	184	88	13
Future Volume (vph)	228	22	12	184	88	13
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.988				0.983	
Flt Protected				0.997	0.958	
Satd. Flow (prot)	1612	0	0	1612	1644	0
Flt Permitted				0.997	0.958	
Satd. Flow (perm)	1612	0	0	1612	1644	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	517.3			180.2	165.5	
Travel Time (s)	37.2			13.0	11.9	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%
Adj. Flow (vph)	228	22	12	184	88	13
Shared Lane Traffic (%)						
Lane Group Flow (vph)	250	0	0	196	101	0
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization 35.3%	ICU Level of Service A					
Analysis Period (min) 15						

HCM 6th TWSC
3: RIM Park Roadway & Millennium Boulevard

2036 Background PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	2.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↖	↖
Traffic Vol, veh/h	228	22	12	184	88	13
Future Vol, veh/h	228	22	12	184	88	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	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	1	0	0
Mvmt Flow	228	22	12	184	88	13

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	0	250
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	-	4.1
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	-	2.2
Pot Cap-1 Maneuver	-	-	1327
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	1327
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	12.4
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	589	-	-	1327	-
HCM Lane V/C Ratio	0.171	-	-	0.009	-
HCM Control Delay (s)	12.4	-	-	7.7	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.6	-	-	0	-

Lanes, Volumes, Timings
4: Oak Park Drive & Millennium Boulevard

2036 Background PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	→	↖	↗	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↖	
Traffic Volume (vph)	100	140	8	116	92	4
Future Volume (vph)	100	140	8	116	92	4
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt	0.921				0.994	
Flt Protected				0.997	0.954	
Satd. Flow (prot)	1503	0	0	1612	1655	0
Flt Permitted				0.997	0.954	
Satd. Flow (perm)	1503	0	0	1612	1655	0
Link Speed (k/h)	50			50	50	
Link Distance (m)	180.2			180.1	133.5	
Travel Time (s)	13.0			13.0	9.6	
Confl. Peds. (#/hr)		1	1			
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%
Adj. Flow (vph)	100	140	8	116	92	4
Shared Lane Traffic (%)						
Lane Group Flow (vph)	240	0	0	124	96	0
Sign Control	Free			Free	Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	28.4%			ICU Level of Service A		
Analysis Period (min)	15					

HCM 6th TWSC
4: Oak Park Drive & Millennium Boulevard

2036 Background PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	2.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↰			↰	↰	
Traffic Vol, veh/h	100	140	8	116	92	4
Future Vol, veh/h	100	140	8	116	92	4
Conflicting Peds, #/hr	0	1	1	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	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	1	0	0
Mvmt Flow	100	140	8	116	92	4
Major/Minor						
	Major1	Major2	Minor1			
Conflicting Flow All	0	0	241	0	303	171
Stage 1	-	-	-	-	171	-
Stage 2	-	-	-	-	132	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1337	-	693	878
Stage 1	-	-	-	-	864	-
Stage 2	-	-	-	-	899	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1336	-	688	877
Mov Cap-2 Maneuver	-	-	-	-	688	-
Stage 1	-	-	-	-	863	-
Stage 2	-	-	-	-	894	-
Approach	EB	WB		NB		
HCM Control Delay, s	0	0.5		11		
HCM LOS				B		
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	694	-	-	1336	-	
HCM Lane V/C Ratio	0.138	-	-	0.006	-	
HCM Control Delay (s)	11	-	-	7.7	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	0.5	-	-	0	-	

Lanes, Volumes, Timings
 6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	9	1	5	13	3	0	1	31	21	3	79	9
Future Volume (vph)	9	1	5	13	3	0	1	31	21	3	79	9
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.955						0.947			0.987	
Flt Protected		0.971			0.961			0.999			0.998	
Satd. Flow (prot)	0	1421	0	0	1473	0	0	1416	0	0	1484	0
Flt Permitted		0.971			0.961			0.999			0.998	
Satd. Flow (perm)	0	1421	0	0	1473	0	0	1416	0	0	1484	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		184.2			132.2			241.1			137.5	
Travel Time (s)		13.3			9.5			17.4			9.9	
Confl. Peds. (#/hr)	1		1	1		1			2	2		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	6%	0%	2%	0%
Adj. Flow (vph)	9	1	5	13	3	0	1	31	21	3	79	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	15	0	0	16	0	0	53	0	0	91	0
Sign Control		Stop			Stop			Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	18.0%											
Analysis Period (min)	15											
ICU Level of Service A												

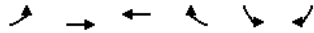
HCM 6th TWSC
 6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

Intersection												
Int Delay, s/veh	1.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	9	1	5	13	3	0	1	31	21	3	79	9
Future Vol, veh/h	9	1	5	13	3	0	1	31	21	3	79	9
Conflicting Peds, #/hr	1	0	1	1	0	1	0	0	2	2	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	0	0	0	0	0	6	0	2	0
Mvmt Flow	9	1	5	13	3	0	1	31	21	3	79	9
Major/Minor												
	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	136	146	85	140	140	45	88	0	0	54	0	0
Stage 1	90	90	-	46	46	-	-	-	-	-	-	-
Stage 2	46	56	-	94	94	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	840	749	980	835	755	1031	1520	-	-	1564	-	-
Stage 1	922	824	-	973	861	-	-	-	-	-	-	-
Stage 2	973	852	-	918	821	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	835	745	979	826	751	1029	1520	-	-	1562	-	-
Mov Cap-2 Maneuver	835	745	-	826	751	-	-	-	-	-	-	-
Stage 1	921	822	-	970	858	-	-	-	-	-	-	-
Stage 2	968	849	-	910	819	-	-	-	-	-	-	-
Approach												
	EB		WB		NB		SB					
HCM Control Delay, s	9.2		9.5		0.1		0.2					
HCM LOS	A		A									
Minor Lane/Major Mvmt												
	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	1520	-	-	871	811	1562	-	-				
HCM Lane V/C Ratio	0.001	-	-	0.017	0.02	0.002	-	-				
HCM Control Delay (s)	7.4	0	-	9.2	9.5	7.3	0	-				
HCM Lane LOS	A	A	-	A	A	A	A	-				
HCM 95th %tile Q(veh)	0	-	-	0.1	0.1	0	-	-				

Lanes, Volumes, Timings

2036 Background PM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	3	53	41	3	4	43
Future Volume (vph)	3	53	41	3	4	43
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.991		0.876		
Flt Protected		0.997		0.996		
Satd. Flow (prot)	0	1627	1483	0	1523	0
Flt Permitted		0.997		0.996		
Satd. Flow (perm)	0	1627	1483	0	1523	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		137.5	166.8		179.3	
Travel Time (s)		9.9	12.0		12.9	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	6%	50%	0%	0%
Adj. Flow (vph)	3	53	41	3	4	43
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	56	44	0	47	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 16.0% ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

2036 Background PM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	2.9					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	3	53	41	3	4	43
Future Vol, veh/h	3	53	41	3	4	43
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	100	100	100	100	100	100
Heavy Vehicles, %	0	0	6	50	0	0
Mvmt Flow	3	53	41	3	4	43

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	44	0	102
Stage 1	-	-	43
Stage 2	-	-	59
Critical Hdwy	4.1	-	6.4
Critical Hdwy Stg 1	-	-	5.4
Critical Hdwy Stg 2	-	-	5.4
Follow-up Hdwy	2.2	-	3.5
Pot Cap-1 Maneuver	1577	-	901
Stage 1	-	-	985
Stage 2	-	-	969
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1577	-	899
Mov Cap-2 Maneuver	-	-	899
Stage 1	-	-	983
Stage 2	-	-	969

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	8.7
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1577	-	-	-	1020
HCM Lane V/C Ratio	0.002	-	-	-	0.046
HCM Control Delay (s)	7.3	0	-	-	8.7
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Junctions 8
ARCADY 8 - Roundabout Module
Version: 8.0.6.541 [19821,26/11/2015] © Copyright TRL Limited, 2023
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Filename: Millenium and Crossgate - 3-Leg.arc8

Path: C:\Users\AdamMorrison\Paradigm\Projects - (220328) Millennium\2 Analysis\Arcady

Report generation date: 2023-06-01 11:32:40 AM

Summary of intersection performance

	PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	A1 - Background 2036						
Leg North	0.09	~1	3.34	0.08	A	3.29	A
Leg South	0.11	~1	3.29	0.10	A		
Leg East	0.03	~1	3.15	0.03	A		

Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

"D1 - Existing, AM" model duration: 8:00 AM - 9:00 AM

"D2 - Existing, PM" model duration: 5:00 PM - 6:30 PM

"D3 - Background 2036, AM" model duration: 8:00 AM - 9:30 AM

"D4 - Background 2036, PM" model duration: 5:00 PM - 6:30 PM

Run using Junctions 8.0.6.541 at 2023-06-01 11:32:39 AM

File summary

Title	Millenium and Crossgate - 3-Leg
Location	
Site Number	
Date	2023-06-01
Version	
Status	
Identifier	
Client	
Jobnumber	220328
Analyst	AdamMorrison
Description	

Analysis Options

Vehicle Length (m)	Do Queue Variations	Calculate Residual Capacity	Residual Capacity Criteria Type	V/C Ratio Threshold	Average Delay Threshold (s)	Queue Threshold (PCE)
7.50	✓		N/A	0.85	36.00	20.00

Units

Distance Units	Speed Units	Traffic Units Input	Traffic Units Results	Flow Units	Average Delay Units	Total Delay Units	Rate Of Delay Units
m	kph	PCE	PCE	perHour	s	-Min	perMin

(Default Analysis Set) - Background 2036, PM

Data Errors and Warnings

No errors or warnings

Analysis Set Details

Name	Roundabout Capacity Model	Description	Include In Report	Use Specific Demand Set(s)	Specific Demand Set(s)	Locked	Network Flow Scaling Factor (%)	Network Capacity Scaling Factor (%)	Reason For Scaling Factors
(Default Analysis Set)	ARCADY		✓				100.000	100.000	

Demand Set Details

Name	Scenario Name	Time Period Name	Description	Traffic Profile Type	Model Start Time (HH:mm)	Model Finish Time (HH:mm)	Model Time Period Length (min)	Time Segment Length (min)	Results For Central Hour Only	Single Time Segment Only	Locked	Run Automatically	Use Relationship	Relationship
Background 2036, PM	Background 2036	PM		ONE HOUR	17:00	18:30	90	15				✓		

Intersection Network

Intersections

Intersection	Name	Intersection Type	Leg Order	Grade Separated	Large Roundabout	Do Geometric Delay	Intersection Delay (s)	Intersection LOS
1	(untitled)	Roundabout	North,South,East				3.29	A

Intersection Network Options

Driving Side	Lighting
Right	Normal/unknown

Legs

Legs

Leg	Leg	Name	Description
North	North	Millennium Boulevard	
South	South	Millennium Boulevard	
East	East	Crossgate Boulevard	

Capacity Options

Leg	Minimum Capacity (PCE/hr)	Maximum Capacity (PCE/hr)	Assume Flat Start Profile	Initial Queue (PCE)
North	0.00	99999.00		0.00
South	0.00	99999.00		0.00
East	0.00	99999.00		0.00

Roundabout Geometry

Leg	V - Approach road half-width (m)	E - Entry width (m)	I' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit Only
North	3.50	4.50	30.00	20.00	40.00	25.00	
South	3.50	4.50	30.00	20.00	40.00	25.00	
East	3.50	4.50	30.00	20.00	40.00	25.00	

Slope / Intercept / Capacity

Leg Intercept Adjustments

Leg	Type	Reason	Direct Intercept Adjustment (PCE/hr)	Percentage Intercept Adjustment (%)
North	Percentage			90.00
South	Percentage			90.00
East	Percentage			90.00

Roundabout Slope and Intercept used in model

Leg	Enter slope and intercept directly	Entered slope	Entered intercept (PCE/hr)	Final Slope	Final Intercept (PCE/hr)
North		(calculated)	(calculated)	0.579	1221.701
South		(calculated)	(calculated)	0.579	1221.701
East		(calculated)	(calculated)	0.579	1221.701

The slope and intercept shown above include any corrections and adjustments.

Traffic Flows

Demand Set Data Options

Default Vehicle Mix	Vehicle Mix Varies Over Time	Vehicle Mix Varies Over Turn	Vehicle Mix Varies Over Entry	Vehicle Mix Source	PCE Factor for a Truck (PCE)	Default Turning Proportions	Estimate from entry/exit counts	Turning Proportions Vary Over Time	Turning Proportions Vary Over Turn	Turning Proportions Vary Over Entry
		✓	✓	Truck Percentages	2.00				✓	✓

Entry Flows

General Flows Data

Leg	Profile Type	Use Turning Counts	Average Demand Flow (PCE/hr)	Flow Scaling Factor (%)
North	ONE HOUR	✓	91.00	100.000
South	ONE HOUR	✓	113.00	100.000
East	ONE HOUR	✓	34.00	100.000

Turning Proportions

Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

	To			
		North	South	East
	From North	0.000	88.000	3.000
	From South	66.000	0.000	47.000
	From East	0.000	34.000	0.000

Turning Proportions (PCE) - Intersection 1 (for whole period)

	To			
		North	South	East
	From North	0.00	0.97	0.03
	From South	0.58	0.00	0.42
	From East	0.00	1.00	0.00

Vehicle Mix

Average PCE Per Vehicle - Intersection 1 (for whole period)

	To			
		North	South	East
	From North	1.000	1.020	1.000
	From South	1.000	1.000	1.000
	From East	1.000	1.000	1.000

Truck Percentages - Intersection 1 (for whole period)

	To			
		North	South	East
	From North	0.0	2.0	0.0
	From South	0.0	0.0	0.0
	From East	0.0	0.0	0.0

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)	Total Queueing Delay (PCE-min)	Average Queueing Delay (s)	Rate Of Queueing Delay (PCE-min/min)	Inclusive Total Queueing Delay (PCE-min)	Inclusive Average Queueing Delay (s)
North	0.08	3.34	0.09	~1	A	83.50	125.25	6.83	3.27	0.08	6.83	3.27
South	0.10	3.29	0.11	~1	A	103.69	155.54	8.34	3.22	0.09	8.34	3.22
East	0.03	3.15	0.03	~1	A	31.20	46.80	2.42	3.11	0.03	2.42	3.11

Main Results for each time segment

Main results: (17:00-17:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	68.51	17.13	68.27	49.51	25.51	0.00	1206.94	750.84	0.057	0.00	0.06	3.222	A
South	85.07	21.27	84.77	91.52	2.25	0.00	1220.40	1207.37	0.070	0.00	0.07	3.170	A
East	25.60	6.40	25.51	37.51	49.51	0.00	1193.04	813.56	0.021	0.00	0.02	3.082	A

Main results: (17:15-17:30)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	81.81	20.45	81.76	59.30	30.55	0.00	1204.02	750.84	0.068	0.06	0.07	3.269	A
South	101.58	25.40	101.52	109.61	2.70	0.00	1220.14	1207.37	0.083	0.07	0.09	3.217	A
East	30.57	7.64	30.55	44.92	59.30	0.00	1187.38	813.56	0.026	0.02	0.03	3.111	A

Main results: (17:30-17:45)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	100.19	25.05	100.12	72.61	37.41	0.00	1200.05	750.84	0.083	0.07	0.09	3.335	A
South	124.42	31.10	124.32	134.23	3.30	0.00	1219.79	1207.37	0.102	0.09	0.11	3.285	A
East	37.43	9.36	37.41	55.01	72.61	0.00	1179.67	813.56	0.032	0.03	0.03	3.150	A

Main results: (17:45-18:00)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	100.19	25.05	100.19	72.67	37.43	0.00	1200.04	750.84	0.083	0.09	0.09	3.335	A
South	124.42	31.10	124.41	134.32	3.30	0.00	1219.79	1207.37	0.102	0.11	0.11	3.285	A
East	37.43	9.36	37.43	55.05	72.67	0.00	1179.64	813.56	0.032	0.03	0.03	3.151	A

Main results: (18:00-18:15)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	81.81	20.45	81.88	59.38	30.59	0.00	1204.00	750.84	0.068	0.09	0.07	3.272	A
South	101.58	25.40	101.67	109.77	2.70	0.00	1220.14	1207.37	0.083	0.11	0.09	3.218	A
East	30.57	7.64	30.59	44.99	59.38	0.00	1187.33	813.56	0.026	0.03	0.03	3.111	A

Main results: (18:15-18:30)

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Entry Flow (PCE/hr)	Exit Flow (PCE/hr)	Circulating Flow (PCE/hr)	Pedestrian Demand (Ped/hr)	Capacity (PCE/hr)	Saturation Capacity (PCE/hr)	V/C Ratio	Start Queue (PCE)	End Queue (PCE)	Delay (s)	LOS
North	68.51	17.13	68.56	49.73	25.62	0.00	1206.88	750.84	0.057	0.07	0.06	3.223	A
South	85.07	21.27	85.14	91.92	2.26	0.00	1220.39	1207.37	0.070	0.09	0.08	3.170	A
East	25.60	6.40	25.62	37.67	49.73	0.00	1192.92	813.56	0.021	0.03	0.02	3.085	A

Queueing Delay Results for each time segment

Queueing Delay results: (17:00-17:15)

Leg	Queueing Total Delay (PCE-	Queueing Rate Of Delay (PCE-	Average Delay Per Arriving Vehicle	Unsignalised Level Of	Signalised Level Of
-----	----------------------------	------------------------------	------------------------------------	-----------------------	---------------------

	min)	min/min)	(s)	Service	Service
North	0.90	0.06	3.222	A	A
South	1.10	0.07	3.170	A	A
East	0.32	0.02	3.082	A	A

Queueing Delay results: (17:15-17:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.10	0.07	3.269	A	A
South	1.34	0.09	3.217	A	A
East	0.39	0.03	3.111	A	A

Queueing Delay results: (17:30-17:45)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.37	0.09	3.335	A	A
South	1.68	0.11	3.285	A	A
East	0.48	0.03	3.150	A	A

Queueing Delay results: (17:45-18:00)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.39	0.09	3.335	A	A
South	1.70	0.11	3.285	A	A
East	0.49	0.03	3.151	A	A

Queueing Delay results: (18:00-18:15)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	1.13	0.08	3.272	A	A
South	1.38	0.09	3.218	A	A
East	0.40	0.03	3.111	A	A

Queueing Delay results: (18:15-18:30)

Leg	Queueing Total Delay (PCE-min)	Queueing Rate Of Delay (PCE-min/min)	Average Delay Per Arriving Vehicle (s)	Unsignalised Level Of Service	Signalised Level Of Service
North	0.93	0.06	3.223	A	A
South	1.14	0.08	3.170	A	A
East	0.33	0.02	3.085	A	A

Queue Variation Results for each time segment

Queue Variation results: (17:00-17:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.06	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.07	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.02	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (17:15-17:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.07	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.09	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.03	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (17:30-17:45)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.09	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

South	0.11	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.03	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (17:45-18:00)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.09	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.11	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.03	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (18:00-18:15)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.07	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.09	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.03	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Queue Variation results: (18:15-18:30)

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile Message	Marker Message	Probability Of Reaching Or Exceeding Marker	Probability Of Exactly Reaching Marker
North	0.06	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
South	0.08	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A
East	0.02	~1	~1	~1	~1	Percentiles could not be calculated. This may be because the mean queue is very small or very big.		N/A	N/A

Appendix F

2036 Total Traffic Operations Reports



Lanes, Volumes, Timings
1: University Avenue & Park Road

2036 Total AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔		↕↕		↕	↕↕
Traffic Volume (vph)	62	5	409	59	13	467
Future Volume (vph)	62	5	409	59	13	467
Ideal Flow (vphpl)	1765	1765	1775	1775	1775	1900
Storage Length (m)	0.0	0.0		0.0	25.0	
Storage Lanes	1	0		0	1	
Taper Length (m)	7.5				100.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Ped Bike Factor						
Frt	0.990		0.981			
Flt Protected	0.956				0.950	
Satd. Flow (prot)	1652	0	3161	0	1668	3500
Flt Permitted	0.956				0.950	
Satd. Flow (perm)	1652	0	3161	0	1668	3500
Link Speed (k/h)	50		50		50	
Link Distance (m)	177.0		207.9		202.5	
Travel Time (s)	12.7		15.0		14.6	
Confl. Peds. (#/hr)				5	5	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	4%	0%	0%	2%
Adj. Flow (vph)	62	5	409	59	13	467
Shared Lane Traffic (%)						
Lane Group Flow (vph)	67	0	468	0	13	467
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization 24.9%	ICU Level of Service A					
Analysis Period (min) 15						

HCM 6th TWSC
1: University Avenue & Park Road

2036 Total AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	1.2					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔		↕↕		↕	↕↕
Traffic Vol, veh/h	62	5	409	59	13	467
Future Vol, veh/h	62	5	409	59	13	467
Conflicting Peds, #/hr	0	0	0	5	5	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	25	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	4	0	0	2
Mvmt Flow	62	5	409	59	13	467

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	704	239	0	0	473
Stage 1	444	-	-	-	-
Stage 2	260	-	-	-	-
Critical Hdwy	6.8	6.9	-	-	4.1
Critical Hdwy Stg 1	5.8	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2
Pot Cap-1 Maneuver	376	768	-	-	1099
Stage 1	619	-	-	-	-
Stage 2	766	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	370	765	-	-	1095
Mov Cap-2 Maneuver	370	-	-	-	-
Stage 1	617	-	-	-	-
Stage 2	757	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	16.3	0	0.2
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	385	1095
HCM Lane V/C Ratio	-	-	0.174	0.012
HCM Control Delay (s)	-	-	16.3	8.3
HCM Lane LOS	-	-	C	A
HCM 95th %tile Q(veh)	-	-	0.6	0

Lanes, Volumes, Timings
2: University Avenue & Millennium Boulevard

2036 Total AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↕	↕	↖	↗
Traffic Volume (vph)	360	172	270	136	76	120
Future Volume (vph)	360	172	270	136	76	120
Ideal Flow (vphpl)	1775	1750	1775	1775	1775	1900
Storage Length (m)	0.0	80.0		0.0	105.0	
Storage Lanes	1	1		0	1	
Taper Length (m)	7.5				80.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Frt		0.850	0.950			
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1651	1414	3066	0	1588	3466
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1651	1414	3066	0	1588	3466
Link Speed (k/h)	50		50		50	
Link Distance (m)	517.3		202.5		179.3	
Travel Time (s)	37.2		14.6		12.9	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	1%	4%	3%	4%	5%	3%
Adj. Flow (vph)	360	172	270	136	76	120
Shared Lane Traffic (%)						
Lane Group Flow (vph)	360	172	406	0	76	120
Sign Control	Stop		Free		Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 48.5%
Analysis Period (min) 15

HCM 6th TWSC
2: University Avenue & Millennium Boulevard

2036 Total AM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	15.5					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↕	↕	↖	↗
Traffic Vol, veh/h	360	172	270	136	76	120
Future Vol, veh/h	360	172	270	136	76	120
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	80	-	-	105	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	4	3	4	5	3
Mvmt Flow	360	172	270	136	76	120

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	550	203	0	0	406
Stage 1	338	-	-	-	-
Stage 2	212	-	-	-	-
Critical Hdwy	6.82	6.98	-	-	4.2
Critical Hdwy Stg 1	5.82	-	-	-	-
Critical Hdwy Stg 2	5.82	-	-	-	-
Follow-up Hdwy	3.51	3.34	-	-	2.25
Pot Cap-1 Maneuver	467	798	-	-	1128
Stage 1	697	-	-	-	-
Stage 2	806	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	436	798	-	-	1128
Mov Cap-2 Maneuver	436	-	-	-	-
Stage 1	697	-	-	-	-
Stage 2	752	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	31.8	0	3.3
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	436	798	1128	-
HCM Lane V/C Ratio	-	-	0.826	0.216	0.067	-
HCM Control Delay (s)	-	-	41.9	10.7	8.4	-
HCM Lane LOS	-	-	E	B	A	-
HCM 95th %tile Q(veh)	-	-	7.8	0.8	0.2	-

Lanes, Volumes, Timings

3: RIM Park Roadway/Street Two & Millennium Boulevard

2036 Total AM Peak Hour

((220328) 400 Millennium Blvd, Waterloo TIS

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	36	174	9	19	388	0	18	5	14	0	8	118
Future Volume (vph)	36	174	9	19	388	0	18	5	14	0	8	118
Ideal Flow (vphpl)	1900	1650	1650	1650	1650	1900	1765	1900	1765	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.994						0.949			0.874	
Flt Protected		0.992			0.998			0.976				
Satd. Flow (prot)	0	1554	0	0	1598	0	0	1672	0	0	1610	0
Flt Permitted		0.992			0.998			0.976				
Satd. Flow (perm)	0	1554	0	0	1598	0	0	1672	0	0	1610	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		517.3			180.2			165.5			145.3	
Travel Time (s)		37.2			13.0			11.9			10.5	
Confl. Peds. (#/hr)			3	3								
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	4%	0%	0%	2%	2%	0%	2%	10%	2%	2%	2%
Adj. Flow (vph)	36	174	9	19	388	0	18	5	14	0	8	118
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	219	0	0	407	0	0	37	0	0	126	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 48.5%

ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

3: RIM Park Roadway/Street Two & Millennium Boulevard

2036 Total AM Peak Hour

((220328) 400 Millennium Blvd, Waterloo TIS

Intersection												
Int Delay, s/veh	3.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	36	174	9	19	388	0	18	5	14	0	8	118
Future Vol, veh/h	36	174	9	19	388	0	18	5	14	0	8	118
Conflicting Peds, #/hr	0	0	3	3	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	4	0	0	2	2	0	2	10	2	2	2
Mvmt Flow	36	174	9	19	388	0	18	5	14	0	8	118

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	388	0	0	186
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.12	-	-	4.1
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.218	-	-	2.2
Pot Cap-1 Maneuver	1170	-	-	1401
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1170	-	-	1398
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.3	0.4	15.8	12.2
HCM LOS			C	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	369	1170	-	-	1398	-	-	625
HCM Lane V/C Ratio	0.1	0.031	-	-	0.014	-	-	0.202
HCM Control Delay (s)	15.8	8.2	0	-	7.6	0	-	12.2
HCM Lane LOS	C	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.3	0.1	-	-	0	-	-	0.7

Lanes, Volumes, Timings

4: Oak Park Drive/Street Three & Millennium Boulevard

2036 Total AM Peak Hour

(220328) 400 Millennium Blvd, Waterloo TIS

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	23	96	70	0	202	0	160	0	0	0	0	41
Future Volume (vph)	23	96	70	0	202	0	160	0	0	0	0	41
Ideal Flow (vphpl)	1900	1650	1650	1650	1650	1900	1765	1900	1765	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.950									0.865	
Flt Protected		0.994						0.950				
Satd. Flow (prot)	0	1482	0	0	1600	0	0	1750	0	0	1593	0
Flt Permitted		0.994						0.950				
Satd. Flow (perm)	0	1482	0	0	1600	0	0	1750	0	0	1593	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		180.2			180.1			133.5			120.0	
Travel Time (s)		13.0			13.0			9.6			8.6	
Confl. Peds. (#/hr)			3	3								
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	3%	6%	0%	2%	2%	2%	2%	0%	2%	2%	2%
Adj. Flow (vph)	23	96	70	0	202	0	160	0	0	0	0	41
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	189	0	0	202	0	0	160	0	0	41	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 50.9%

ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

4: Oak Park Drive/Street Three & Millennium Boulevard

2036 Total AM Peak Hour

(220328) 400 Millennium Blvd, Waterloo TIS

Intersection												
Int Delay, s/veh	5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	23	96	70	0	202	0	160	0	0	0	0	41
Future Vol, veh/h	23	96	70	0	202	0	160	0	0	0	0	41
Conflicting Peds, #/hr	0	0	3	3	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	3	6	0	2	2	2	2	0	2	2	2
Mvmt Flow	23	96	70	0	202	0	160	0	0	0	0	41

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	202	0	0	169
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.12	-	-	4.1
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.218	-	-	2.2
Pot Cap-1 Maneuver	1370	-	-	1421
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1370	-	-	1418
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.9	0	14.9	9.5
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	522	1370	-	-	1418	-	-	839
HCM Lane V/C Ratio	0.307	0.017	-	-	-	-	-	0.049
HCM Control Delay (s)	14.9	7.7	0	-	0	-	-	9.5
HCM Lane LOS	B	A	A	-	A	-	-	A
HCM 95th %tile Q(veh)	1.3	0.1	-	-	0	-	-	0.2

Lanes, Volumes, Timings

2036 Total AM Peak Hour
6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	4	0	1	30	1	5	1	48	8	3	83	1
Future Volume (vph)	4	0	1	30	1	5	1	48	8	3	83	1
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.973			0.981			0.981			0.998	
Flt Protected		0.962			0.960			0.999			0.998	
Satd. Flow (prot)	0	1346	0	0	1444	0	0	1465	0	0	1484	0
Flt Permitted		0.962			0.960			0.999			0.998	
Satd. Flow (perm)	0	1346	0	0	1444	0	0	1465	0	0	1484	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		184.2			132.2			241.1			137.5	
Travel Time (s)		13.3			9.5			17.4			9.9	
Confl. Peds. (#/hr)			1	1			1					1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	33%	0%	0%	0%	0%	3%	0%	0%	3%	0%
Adj. Flow (vph)	4	0	1	30	1	5	1	48	8	3	83	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	5	0	0	36	0	0	57	0	0	87	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 17.9%

ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

2036 Total AM Peak Hour
6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

Intersection

Int Delay, s/veh 2.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	0	1	30	1	5	1	48	8	3	83	1
Future Vol, veh/h	4	0	1	30	1	5	1	48	8	3	83	1
Conflicting Peds, #/hr	0	0	1	1	0	1	0	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	33	0	0	0	0	3	0	0	3	0
Mvmt Flow	4	0	1	30	1	5	1	48	8	3	83	1

Major/Minor	Minor2	Minor1	Major1	Major2								
Conflicting Flow All	148	149	86	145	145	52	85	0	0	56	0	0
Stage 1	91	91	-	54	54	-	-	-	-	-	-	-
Stage 2	57	58	-	91	91	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.53	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.597	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	825	746	894	828	750	1021	1524	-	-	1562	-	-
Stage 1	921	823	-	963	854	-	-	-	-	-	-	-
Stage 2	960	851	-	921	823	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	818	743	893	825	747	1021	1523	-	-	1562	-	-
Mov Cap-2 Maneuver	818	743	-	825	747	-	-	-	-	-	-	-
Stage 1	919	821	-	962	853	-	-	-	-	-	-	-
Stage 2	953	850	-	917	821	-	-	-	-	-	-	-

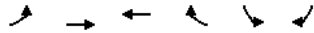
Approach	EB	WB	NB	SB
HCM Control Delay, s	9.4	9.5	0.1	0.3
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1523	-	-	832	845	1562	-	-
HCM Lane V/C Ratio	0.001	-	-	0.006	0.043	0.002	-	-
HCM Control Delay (s)	7.4	0	-	9.4	9.5	7.3	0	-
HCM Lane LOS	A	A	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-

Lanes, Volumes, Timings

2036 Total AM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	10	41	57	1	1	34
Future Volume (vph)	10	41	57	1	1	34
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.869	
Flt Protected		0.990			0.999	
Satd. Flow (prot)	0	1504	1628	0	1406	0
Flt Permitted		0.990			0.999	
Satd. Flow (perm)	0	1504	1628	0	1406	0
Link Speed (k/h)		50			50	
Link Distance (m)		137.5			179.3	
Travel Time (s)		9.9			12.9	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	13%	6%	0%	0%	0%	8%
Adj. Flow (vph)	10	41	57	1	1	34
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	51	58	0	35	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 19.8% ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

2036 Total AM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	2.7					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	10	41	57	1	1	34
Future Vol, veh/h	10	41	57	1	1	34
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	100	100	100	100	100	100
Heavy Vehicles, %	13	6	0	0	0	8
Mvmt Flow	10	41	57	1	1	34

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	58	0	119
Stage 1	-	-	58
Stage 2	-	-	61
Critical Hdwy	4.23	-	6.4
Critical Hdwy Stg 1	-	-	5.4
Critical Hdwy Stg 2	-	-	5.4
Follow-up Hdwy	2.317	-	3.372
Pot Cap-1 Maneuver	1479	-	882
Stage 1	-	-	970
Stage 2	-	-	967
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1479	-	876
Mov Cap-2 Maneuver	-	-	876
Stage 1	-	-	963
Stage 2	-	-	967

Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	8.8
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1479	-	-	-	987
HCM Lane V/C Ratio	0.007	-	-	-	0.035
HCM Control Delay (s)	7.5	0	-	-	8.8
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Lanes, Volumes, Timings
1: University Avenue & Park Road

2036 Total PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	90	22	533	149	34	600
Future Volume (vph)	90	22	533	149	34	600
Ideal Flow (vphpl)	1765	1765	1775	1775	1775	1900
Storage Length (m)	0.0	0.0		0.0	25.0	
Storage Lanes	1	0		0	1	
Taper Length (m)	7.5				100.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Ped Bike Factor						
Frt	0.973		0.967			
Flt Protected	0.961				0.950	
Satd. Flow (prot)	1632	0	3127	0	1668	3500
Flt Permitted	0.961				0.950	
Satd. Flow (perm)	1632	0	3127	0	1668	3500
Link Speed (k/h)	50		50		50	
Link Distance (m)	177.0		207.9		202.5	
Travel Time (s)	12.7		15.0		14.6	
Confl. Peds. (#/hr)				5	5	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	4%	0%	0%	2%
Adj. Flow (vph)	90	22	533	149	34	600
Shared Lane Traffic (%)						
Lane Group Flow (vph)	112	0	682	0	34	600
Sign Control	Stop		Free		Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	41.1%			ICU Level of Service A		
Analysis Period (min)	15					

HCM 6th TWSC
1: University Avenue & Park Road

2036 Total PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	2.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖↗		↕↕		↖↗	↕↕
Traffic Vol, veh/h	90	22	533	149	34	600
Future Vol, veh/h	90	22	533	149	34	600
Conflicting Peds, #/hr	0	0	0	5	5	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	25	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	0	0	4	0	0	2
Mvmt Flow	90	22	533	149	34	600

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	981	346	0	0	687
Stage 1	613	-	-	-	-
Stage 2	368	-	-	-	-
Critical Hdwy	6.8	6.9	-	-	4.1
Critical Hdwy Stg 1	5.8	-	-	-	-
Critical Hdwy Stg 2	5.8	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2
Pot Cap-1 Maneuver	250	656	-	-	916
Stage 1	509	-	-	-	-
Stage 2	676	-	-	-	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	240	653	-	-	912
Mov Cap-2 Maneuver	240	-	-	-	-
Stage 1	507	-	-	-	-
Stage 2	651	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	26.9	0	0.5
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	274	912
HCM Lane V/C Ratio	-	-	0.409	0.037
HCM Control Delay (s)	-	-	26.9	9.1
HCM Lane LOS	-	-	D	A
HCM 95th %tile Q(veh)	-	-	1.9	0.1

Lanes, Volumes, Timings
2: University Avenue & Millennium Boulevard

2036 Total PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↩	↩	↩↩	↩	↩	↩↩
Traffic Volume (vph)	269	141	219	330	197	366
Future Volume (vph)	269	141	219	330	197	366
Ideal Flow (vphpl)	1775	1750	1775	1775	1775	1900
Storage Length (m)	0.0	80.0		0.0	105.0	
Storage Lanes	1	1		0	1	
Taper Length (m)	7.5				80.0	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	0.95
Frt		0.850	0.910			
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1651	1414	2929	0	1588	3466
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1651	1414	2929	0	1588	3466
Link Speed (k/h)	50		50		50	
Link Distance (m)	517.3		202.5		179.3	
Travel Time (s)	37.2		14.6		12.9	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	1%	4%	3%	4%	5%	3%
Adj. Flow (vph)	269	141	219	330	197	366
Shared Lane Traffic (%)						
Lane Group Flow (vph)	269	141	549	0	197	366
Sign Control	Stop		Free		Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 55.5%
Analysis Period (min) 15
ICU Level of Service B

HCM 6th TWSC
2: University Avenue & Millennium Boulevard

2036 Total PM Peak Hour
(220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	40.5					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↩	↩	↩↩	↩	↩	↩↩
Traffic Vol, veh/h	269	141	219	330	197	366
Future Vol, veh/h	269	141	219	330	197	366
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	80	-	-	105	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	1	4	3	4	5	3
Mvmt Flow	269	141	219	330	197	366

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	961	275	0	0	549
Stage 1	384	-	-	-	-
Stage 2	577	-	-	-	-
Critical Hdwy	6.82	6.98	-	-	4.2
Critical Hdwy Stg 1	5.82	-	-	-	-
Critical Hdwy Stg 2	5.82	-	-	-	-
Follow-up Hdwy	3.51	3.34	-	-	2.25
Pot Cap-1 Maneuver	~ 256	717	-	-	996
Stage 1	661	-	-	-	-
Stage 2	528	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	~ 205	717	-	-	996
Mov Cap-2 Maneuver	~ 205	-	-	-	-
Stage 1	661	-	-	-	-
Stage 2	423	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	145.9	0	3.3
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	205	717	996	-
HCM Lane V/C Ratio	-	-	1.312	0.197	0.198	-
HCM Control Delay (s)	-	-	216.5	11.2	9.5	-
HCM Lane LOS	-	-	F	B	A	-
HCM 95th %tile Q(veh)	-	-	14.8	0.7	0.7	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lanes, Volumes, Timings

3: RIM Park Roadway/Street Two & Millennium Boulevard

2036 Total PM Peak Hour

((220328) 400 Millennium Blvd, Waterloo TIS

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	335	22	18	258	0	88	14	16	0	5	76
Future Volume (vph)	115	335	22	18	258	0	88	14	16	0	5	76
Ideal Flow (vphpl)	1900	1650	1650	1650	1650	1900	1765	1900	1765	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.994						0.982			0.873	
Flt Protected		0.988			0.997			0.964				
Satd. Flow (prot)	0	1551	0	0	1597	0	0	1751	0	0	1608	0
Flt Permitted		0.988			0.997			0.964				
Satd. Flow (perm)	0	1551	0	0	1597	0	0	1751	0	0	1608	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		517.3			180.2			165.5			145.3	
Travel Time (s)		37.2			13.0			11.9			10.5	
Confl. Peds. (#/hr)			3	3								
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	4%	0%	0%	2%	2%	0%	2%	10%	2%	2%	2%
Adj. Flow (vph)	115	335	22	18	258	0	88	14	16	0	5	76
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	472	0	0	276	0	0	118	0	0	81	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 69.2%

ICU Level of Service C

Analysis Period (min) 15

HCM 6th TWSC

3: RIM Park Roadway/Street Two & Millennium Boulevard

2036 Total PM Peak Hour

((220328) 400 Millennium Blvd, Waterloo TIS

Intersection												
Int Delay, s/veh	6.5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	115	335	22	18	258	0	88	14	16	0	5	76
Future Vol, veh/h	115	335	22	18	258	0	88	14	16	0	5	76
Conflicting Peds, #/hr	0	0	3	3	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	4	0	0	2	2	0	2	10	2	2	2
Mvmt Flow	115	335	22	18	258	0	88	14	16	0	5	76

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	258	0	0	360
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.12	-	-	4.1
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.218	-	-	2.2
Pot Cap-1 Maneuver	1307	-	-	1210
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1307	-	-	1207
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	2	0.5	35.6	10.9
HCM LOS			E	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	232	1307	-	-	1207	-	-	690
HCM Lane V/C Ratio	0.509	0.088	-	-	0.015	-	-	0.117
HCM Control Delay (s)	35.6	8	0	-	8	0	-	10.9
HCM Lane LOS	E	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	2.6	0.3	-	-	0	-	-	0.4

Lanes, Volumes, Timings

4: Oak Park Drive/Street Three & Millennium Boulevard

2036 Total PM Peak Hour

((220328) 400 Millennium Blvd, Waterloo TIS

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	67	143	140	8	144	0	92	0	4	0	0	52
Future Volume (vph)	67	143	140	8	144	0	92	0	4	0	0	52
Ideal Flow (vphpl)	1900	1650	1650	1650	1650	1900	1765	1900	1765	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.946						0.994			0.865	
Flt Protected		0.991			0.997			0.954				
Satd. Flow (prot)	0	1471	0	0	1597	0	0	1748	0	0	1593	0
Flt Permitted		0.991			0.997			0.954				
Satd. Flow (perm)	0	1471	0	0	1597	0	0	1748	0	0	1593	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		180.2			180.1			133.5			120.0	
Travel Time (s)		13.0			13.0			9.6			8.6	
Confl. Peds. (#/hr)			3	3								
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	3%	6%	0%	2%	2%	2%	2%	0%	2%	2%	2%
Adj. Flow (vph)	67	143	140	8	144	0	92	0	4	0	0	52
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	350	0	0	152	0	0	96	0	0	52	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 54.3%

ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

4: Oak Park Drive/Street Three & Millennium Boulevard

2036 Total PM Peak Hour

((220328) 400 Millennium Blvd, Waterloo TIS

Intersection												
Int Delay, s/veh	4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	67	143	140	8	144	0	92	0	4	0	0	52
Future Vol, veh/h	67	143	140	8	144	0	92	0	4	0	0	52
Conflicting Peds, #/hr	0	0	3	3	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	3	6	0	2	2	2	2	0	2	2	2
Mvmt Flow	67	143	140	8	144	0	92	0	4	0	0	52

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	144	0	0	286
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.12	-	-	4.1
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.218	-	-	2.2
Pot Cap-1 Maneuver	1438	-	-	1288
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1438	-	-	1285
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.5	0.4	16.2	9.2
HCM LOS			C	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	416	1438	-	-	1285	-	-	903
HCM Lane V/C Ratio	0.231	0.047	-	-	0.006	-	-	0.058
HCM Control Delay (s)	16.2	7.6	0	-	7.8	0	-	9.2
HCM Lane LOS	C	A	A	-	A	A	-	A
HCM 95th %tile Q(veh)	0.9	0.1	-	-	0	-	-	0.2

Lanes, Volumes, Timings

6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

2036 Total PM Peak Hour

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	9	1	5	13	3	0	1	31	21	3	79	9
Future Volume (vph)	9	1	5	13	3	0	1	31	21	3	79	9
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.955						0.947			0.987	
Flt Protected		0.971			0.961			0.999			0.998	
Satd. Flow (prot)	0	1280	0	0	1473	0	0	1425	0	0	1472	0
Flt Permitted		0.971			0.961			0.999			0.998	
Satd. Flow (perm)	0	1280	0	0	1473	0	0	1425	0	0	1472	0
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		184.2			132.2			241.1			137.5	
Travel Time (s)		13.3			9.5			17.4			9.9	
Confl. Peds. (#/hr)			1	1			1					1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	33%	0%	0%	0%	0%	3%	0%	0%	3%	0%
Adj. Flow (vph)	9	1	5	13	3	0	1	31	21	3	79	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	15	0	0	16	0	0	53	0	0	91	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 18.2%

ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

6: Millennium Boulevard & Country Squire Road/Cider Mills Drive(220328) 400 Millennium Blvd, Waterloo TIS

2036 Total PM Peak Hour

Intersection												
Int Delay, s/veh	1.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	9	1	5	13	3	0	1	31	21	3	79	9
Future Vol, veh/h	9	1	5	13	3	0	1	31	21	3	79	9
Conflicting Peds, #/hr	0	0	1	1	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	33	0	0	0	0	3	0	0	3	0
Mvmt Flow	9	1	5	13	3	0	1	31	21	3	79	9

Major/Minor	Minor2	Minor1	Major1	Major2								
Conflicting Flow All	136	145	86	138	139	42	89	0	0	52	0	0
Stage 1	91	91	-	44	44	-	-	-	-	-	-	-
Stage 2	45	54	-	94	95	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.53	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.597	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	840	750	894	837	756	1034	1519	-	-	1567	-	-
Stage 1	921	823	-	975	862	-	-	-	-	-	-	-
Stage 2	974	854	-	918	820	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	835	747	893	829	753	1034	1518	-	-	1567	-	-
Mov Cap-2 Maneuver	835	747	-	829	753	-	-	-	-	-	-	-
Stage 1	919	821	-	974	861	-	-	-	-	-	-	-
Stage 2	970	853	-	909	818	-	-	-	-	-	-	-

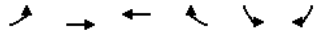
Approach	EB	WB	NB	SB
HCM Control Delay, s	9.3	9.5	0.1	0.2
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1518	-	-	847	814	1567	-	-
HCM Lane V/C Ratio	0.001	-	-	0.018	0.02	0.002	-	-
HCM Control Delay (s)	7.4	0	-	9.3	9.5	7.3	0	-
HCM Lane LOS	A	A	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0.1	0	-	-

Lanes, Volumes, Timings

2036 Total PM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	3	53	41	3	4	43
Future Volume (vph)	3	53	41	3	4	43
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.991			0.876	
Flt Protected		0.997			0.996	
Satd. Flow (prot)	0	1529		0	1419	
Flt Permitted		0.997			0.996	
Satd. Flow (perm)	0	1529		0	1419	
Link Speed (k/h)		50			50	
Link Distance (m)		137.5			179.3	
Travel Time (s)		9.9			12.9	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	13%	6%	0%	0%	0%	8%
Adj. Flow (vph)	3	53	41	3	4	43
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	56	44	0	47	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 16.0% ICU Level of Service A

Analysis Period (min) 15

HCM 6th TWSC

2036 Total PM Peak Hour

7: Millennium Boulevard/Country Squire Road & Glasgow Street (220328) 400 Millennium Blvd, Waterloo TIS

Intersection						
Int Delay, s/veh	3					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	3	53	41	3	4	43
Future Vol, veh/h	3	53	41	3	4	43
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	100	100	100	100	100	100
Heavy Vehicles, %	13	6	0	0	0	8
Mvmt Flow	3	53	41	3	4	43

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	44	0	102
Stage 1	-	-	43
Stage 2	-	-	59
Critical Hdwy	4.23	-	6.4
Critical Hdwy Stg 1	-	-	5.4
Critical Hdwy Stg 2	-	-	5.4
Follow-up Hdwy	2.317	-	3.5
Pot Cap-1 Maneuver	1496	-	901
Stage 1	-	-	985
Stage 2	-	-	969
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1496	-	899
Mov Cap-2 Maneuver	-	-	899
Stage 1	-	-	983
Stage 2	-	-	969

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	8.8
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1496	-	-	-	1000
HCM Lane V/C Ratio	0.002	-	-	-	0.047
HCM Control Delay (s)	7.4	0	-	-	8.8
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Appendix G

OTM Signal Warrants



Signal Justification Calculation

(OTM Book 12 - Justifications 1, 2, 3)



Horizon Year: Existing Traffic
 Region/City/Township: City of Waterloo

Major Street: University Avenue
 Minor Street: Millennium Boulevard

North/South?: Y

Number of Approach Lanes: 2 or more
 Tee Intersection? Y
 Flow Conditions: Restricted

PM Forecast Only? N

Hour	Major Street						Minor Street						Peds Crossing Main Road
	University Avenue						Millennium Boulevard						
	Northbound			Southbound			Eastbound			Westbound			
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
7:30 - 8:30	0	230	53	38	82	0	0	0	0	163	0	87	0
8:30 - 9:30	0	136	78	44	114	0	0	0	0	142	0	49	0
9:30 - 10:30	0	128	56	32	83	0	0	0	0	89	0	53	0
12:00 - 1:00	0	136	57	37	125	0	0	0	0	90	0	43	0
1:00 - 2:00	0	131	69	53	128	0	0	0	0	85	0	61	0
3:00 - 4:00	0	138	112	79	165	0	0	0	0	105	0	60	0
4:00 - 5:00	0	181	135	76	240	0	0	0	0	102	0	63	0
5:00 - 6:00	0	140	136	107	231	0	0	0	0	128	0	80	0

	1A		1B		2A		2B	
Hour	All Approach Lanes		Minor Street Both Approaches		Major Street Both Approaches		Traffic Crossing Major Street	
Threshold	900		255		900		75	
1	653	73%	250	98%	403	45%	163	100%
2	563	63%	191	75%	372	41%	142	100%
3	441	49%	142	56%	299	33%	89	100%
4	488	54%	133	52%	355	39%	90	100%
5	527	59%	146	57%	381	42%	85	100%
6	659	73%	165	65%	494	55%	105	100%
7	797	89%	165	65%	632	70%	102	100%
8	822	91%	208	82%	614	68%	128	100%

8 Hours 100% Fulfilled?

No

No

No

Yes

8 Hours 80% Fulfilled?

No

No

No

Yes

Justification Results

Justification 1 (Minimum Vehicle Volume) No
 Justification 2 (Delay To Cross Traffic) No
 Justification 3 (Volume/Delay Combination) No

Is A Signal Justified? No

Signal Justification Calculation for Forecast Volumes (OTM Book 12 - Justification 7)



Horizon Year: 2036 Background Traffic
Region/City/Township: City of Waterloo

Major Street: University Avenue
Minor Street: Millennium Boulevard

North/South?: Y

Number of Approach Lanes: 2 or more
Tee Intersection?: Y
Flow Conditions: Restricted

PM Forecast Only? N

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	No	Justification for existing intersections with forecast traffic

Time Period	Major Street						Minor Street						Peds Crossing Main Road
	University Avenue						Millennium Boulevard						
	Northbound			Southbound			Eastbound			Westbound			
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour		270	89	53	120					228		110	
PM Peak Hour		219	180	125	366					168		92	
Average Hourly Volume	0	122	67	45	122	0	0	0	0	99	0	51	0

Warrant	AHV
1A - All	505
1B - Minor	150
2A - Major	356
2B - Cross	99

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
					X	
	All Approaches	480	720	600	900	505
% Fulfilled						56.1%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
					X	
	Minor Street Approaches	180	255	180	255	150
% Fulfilled						58.6%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
					X	
	Major Street Approaches	480	720	600	900	356
% Fulfilled						39.5%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
					X	
	Traffic Crossing Major Street	50	75	50	75	99
% Fulfilled						132.0%

Signal Justification Calculation for Forecast Volumes (OTM Book 12 - Justification 7)



Horizon Year: 2036 Total Traffic
Region/City/Township: City of Waterloo

Major Street: University Avenue
Minor Street: Millennium Boulevard

North/South?: Y

Number of Approach Lanes: 2 or more
Tee Intersection?: Y
Flow Conditions: Restricted

PM Forecast Only? N

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	No	Justification for existing intersections with forecast traffic

Time Period	Major Street						Minor Street						Peds Crossing Main Road
	University Avenue						Millennium Boulevard						
	Northbound			Southbound			Eastbound			Westbound			
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour		270	136	76	120					360		172	
PM Peak Hour		219	330	197	366					269		141	
Average Hourly Volume	0	122	117	68	122	0	0	0	0	157	0	78	0

Warrant	AHV
1A - All	664
1B - Minor	236
2A - Major	429
2B - Cross	157

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
					X	
	All Approaches	480	720	600	900	664
% Fulfilled						73.8%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
					X	
	Minor Street Approaches	180	255	180	255	236
% Fulfilled						92.4%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
					X	
	Major Street Approaches	480	720	600	900	429
% Fulfilled						47.6%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
					X	
	Traffic Crossing Major Street	50	75	50	75	157
% Fulfilled						209.7%