40-70 Plains Road East Transportation Impact Assessment

Paradigm Transportation Solutions Limited

December 2020

ptsl.com

Project Summary

Project Number
190488

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Client
Infinity Development Group
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Oakville, ON

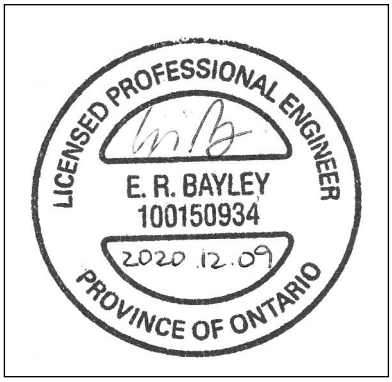
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40-70 Plains Road East
Transportation Impact Assessment

Signatures and Seals



Signature

Engineer's Seal

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Executive Summary

Content

Infinity Development Group has retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Assessment (TIA) for a proposed mid-rise residential development located at 40-70 Plains Road East in the City of Burlington.

This study determines the impacts of the development traffic on the surrounding road network and identifies the recommended improvements to accommodate the site generated traffic.

Development Concept

The subject site is located at 40-70 Plains Road East in the City of Burlington. The site is located with in the City of Burlington's Aldershot Mobility Hub area. The City defines this area as an intensification area.

The proposed 9-storey mid-rise development contains 360 residential condominium units. Construction will occur in two phases and result in one building. Phase 1 is estimated to be built-out by Year 2024 and contains 168 residential condominium units. Phase 2 is estimated to be built-out by Year 2025.

At full build-out the site statistics indicate a total vehicle parking supply of 424 spaces (1.18 spaces per unit).

The proposed site plan consolidates seven existing private driveways to Plains Road East into one driveway. The site driveway is located directly opposite to Cooke Boulevard and forms the fourth leg to the existing signalized intersection.

Conclusions

The main findings and conclusions of this study are as follows:

- **Study Area**: The intersections that form the study area include the Plains Road intersections with Waterdown Road, Cooke Boulevard, and Clearview Avenue/Birchwood Avenue and the Masonry Court intersections with Waterdown Road and Cooke Boulevard.
- **Existing Traffic Conditions**: The intersections within the study area are generally operating with acceptable levels of service during the AM and PM peak hours. Localized congestion is



occurring for select turning movements at the Waterdown Road intersections with Masonry Court and Plains Road.

- **Forecast Traffic**: The forecast traffic volumes near the subject site have been assessed for a five-year horizon (Year 2029) beyond the anticipated opening date of the subject site (Year 2024). The likely future traffic volumes near the subject site are estimated to consist of:
  - Generalized background traffic growth;
  - Build-out of six adjacent development applications including the Aldershot GO parking lot expansion; and
  - Traffic generated by the subject site.
- **Background Traffic Conditions**: The localized congestion previously identified under existing conditions at Waterdown Road with Masonry Court and Plains Road is anticipated to continue to occur. In addition, high levels of delay are forecast to occur on the northbound and southbound approaches of Cooke Boulevard to Masonry Court. To address the forecast capacity issues, the City of Burlington should review the intersections form of traffic control.
- **Site Concept**: The proposed 9-storey mid-rise development contains 360 residential condominium units. Construction will occur in two phases. Phase 1 is estimated to be built-out by Year 2024 and contains 168 residential condominium units. Phase 2 is estimated to be built-out by Year 2025.
- **Site Generated Traffic**: Phase 1 is forecast to generate approximately 57 vehicle trips during the AM peak hour and approximately 73 vehicle trips during the PM peak hour.

  The full build-out of the subject site is forecast to generate approximately 120 vehicle trips during the AM peak hour and approximately 152 vehicle trips during the PM peak hour.
- **Parking Supply**: 424 parking spaces are proposed to accommodate the site's parking demand. Occupant parking is proposed at 410 spaces (1.14 spaces per unit). Visitor parking is proposed at 14 spaces (0.04 spaces per unit).

  Relying on empirical survey data collected for the Burlington market, the forecast parking demand for the subject site is estimated to be less than the parking rates identified in the City-Wide Parking Standard review report.

  The parking demand for the subject site is estimated to be approximately 299 occupant parking spaces and 39 visitor parking spaces. This equates to an overall parking ratio of 0.94 spaces per unit or 338 parking spaces. The site's parking

demand would be fully contained on site. The allocation of parking between occupants and visitors needs to be adjusted to provide for at least 39 spaces. To support the proposed parking supply the integration of TDM measures will be critical to the development's success.

- **Transportation Demand Management**: The site concept plan includes TDM measures intended to assist in mitigating the site's transportation and parking impacts.
- **Total Traffic Conditions**: The intersections within the study area are forecast to operate with levels of service like the background traffic condition. No new intersection capacity are noted to occur as a result of site generated traffic.
- **Remedial Measures**: Improvements to the existing form of two-way stop control should be considered at the intersection of Cooke Boulevard to Masonry Court. The need for traffic control improvements is driven by the forecast background traffic.

  The GO Station parking lot expansion is forecast to add considerable number of new vehicle trips to this intersection. The City of Burlington should review the planned parking lot expansion and its impact on the overall road network.

Recommendations

Based on the findings of this study, it is recommended that:

- Minor pavement marking changes should occur at the Plains Road East intersection with Cooke Boulevard. The existing centre two-way left-turn lane should be redesigned as a left-turn lane. A minimum storage lane length of 15 metres should be provided to accommodate site generated traffic.
- The site's visitor parking supply be increased to provide for at least 39 spaces (0.10 spaces per unit).
- The TDM measures outline in **Section 3.3** be included in the final site plan. Some elements of the TDM plan can be designed directly into the site plan while other elements are amenities that can only be achieved after occupancy.

The City of Burlington monitor the operation of the Masonry Court intersection with Cooke Boulevard to ensure an appropriate form of traffic control is provided to accommodate the future travel demands in the longer term. In the longer term as the Aldershot Intensification area develops, daily traffic volumes through this intersection may further increase and ultimately warrant the installation of traffic control signal.

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1 Introduction

1.1 Overview

Infinity Development Group has retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Assessment (TIA) for a proposed mid-rise residential development located at 40-70 Plains Road East in the City of Burlington. **Figure 1.1** illustrates the location of the subject site.

The lands that form the subject site are currently occupied by seven single-family detached homes with direct access to Plains Road East. A 6-storey mid-rise building at 34 Plains Road East is located immediately west of the subject site.

The subject site is in the City of Burlington's Aldershot GO Mobility Hub area. The City intends to develop the area as an "intensification area." Intensification areas are intended to foster a more pedestrian and transit friendly urban environment through a mixture of dense residential, employment, and retail land uses.

Appendix A contains the pre-study consultation material and response from the City of Burlington. The study generally follows the Halton Region Transportation Impact Study Guidelines[1].

The scope of the study includes:

- Assessment of the current traffic conditions within the study area;
- Estimates of background traffic growth;
- Estimates of additional traffic generated by the subject site;
- Estimates of the site's parking demand;
- Assess the site's loading zone and parking structure access;
- Analyses of the impact of the future traffic on the surrounding road network; and
- Recommendations necessary to mitigate this future traffic in a satisfactory manner;

[1] Halton Region Transportation Impact Study Guidelines. January 2015

1.2 Study Area

The study area intersections assessed in this study include:

- Plains Road East and Waterdown Road (signalized);
- Plains Road East and Cooke Boulevard (signalized);
- Plains Road East and Birchwood Avenue/Clearview Avenue (unsignalized);
- Masonry Court and Waterdown Road (signalized); and
- Masonry Court and Cooke Boulevard.





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paradigm TRANSPORTATION SOLUTIONS LIMITED

Location of Subject Site

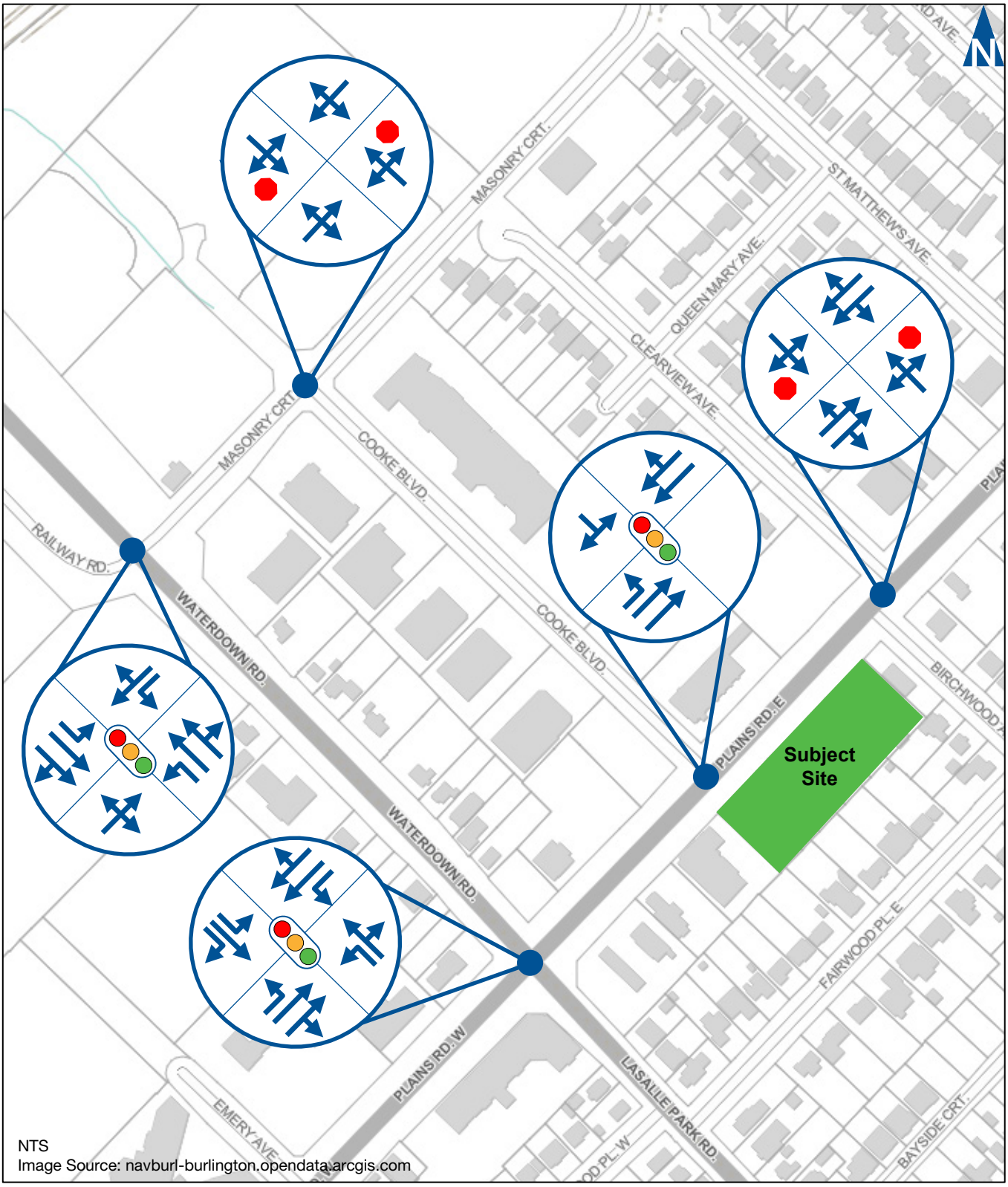
2 Existing Conditions

2.1 Road Network

The roadways of interest within the study area include:

- **Plains Road East**, an east-west five-lane multi-purpose arterial roadway with a centre Two-Way Left-Turn Lane (TWLTL) with a posted speed limit of 60 km/h. Sidewalks are present on both sides of this roadway within the study area. The intersections with Waterdown Road and Cooke Boulevard are signalized and operate with auxiliary turn lanes.
- **Waterdown Road**, a north-south minor arterial roadway with a posted speed limit of 50 km/h. North of Plains Road East the cross-section is five-lanes with a centre TWLTL. South of Plains Road East the cross-section is a basic two-lane. Sidewalks are present on both sides of the roadway within the study area. On-street bicycle lanes are present in both directions on this roadway within the study area. The intersection with Masonry Court is signalized and operate with auxiliary turn lanes.
- **Cooke Boulevard**, a north-south two-lane local roadway with an unposted assumed speed limit of 50 km/h. Sidewalks are present along the east side of this roadway. Parking is restricted at all times along both sides of this roadway. The north leg of Cooke Boulevard at Masonry Court is a private driveway.
- **Masonry Court**, an east-west two-lane local roadway with an unposted, assumed speed limit of 50 km/h. Sidewalks are present on the north side of this roadway. The terminus of Masonry Court is a private driveway to the Aldershot GO station. On-street parking is permitted along the south side of this roadway between Waterdown Road and the Aldershot GO Station driveway. The roadway is identified as a shared use lane through use of sharrow pavement markings.
- **Clearview Avenue/Birchwood Avenue**, are north-south two-lane local roadways with a posted speed limit of 40 km/h. The roadways have basic two-lane rural cross-sections. Sidewalks are not present along these roadways. Clearview Avenue terminates as a cul-du-sac just south of Masonry Court. Birchwood Avenue connections to Townsend Avenue to south.

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



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Existing Lane Configuration & Traffic Control

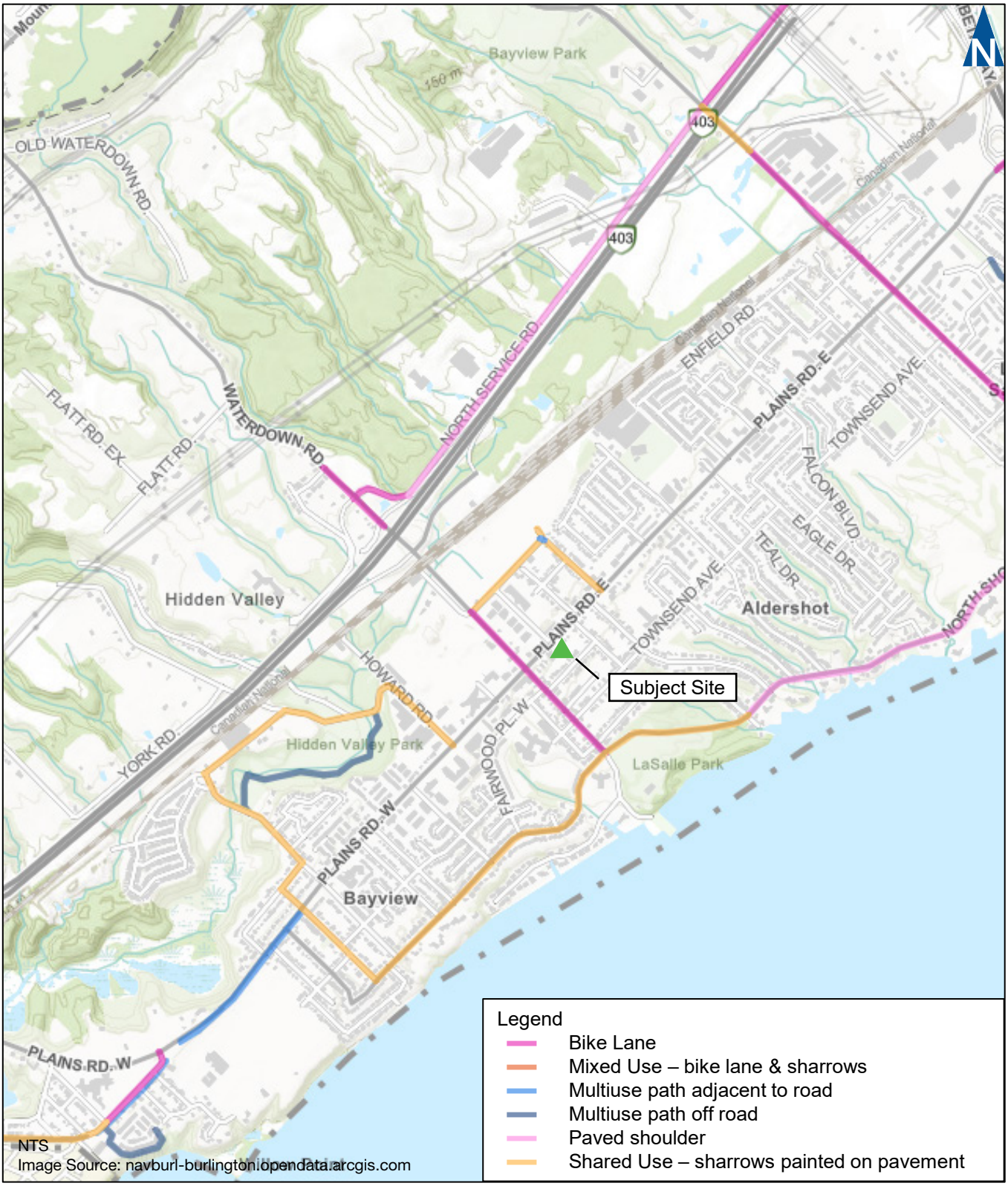
2.2 Cycling Network

The City of Burlington's bicycle network provides a variety of cycling facilities within the immediate area. **Figure 2.2** illustrates the existing cycling network.

Designated on-street bicycle lanes are provided along Waterdown Road between Masonry Court and North Shore Boulevard. St. Matthews Avenue and Masonry Court are designated as shared use environments through use of sharrow pavement markings. A multiuse trail connection between St. Matthews Avenue and Masonry Court is provided at the terminus of St. Matthews Avenue.

The City of Burlington's draft Cycling Plan[2] identifies a Protected Bikeway along Plains Road East through the study area. The implementation of the protected bikeway is identified as a short-term priority.

[2] City of Burlington Cycling Plan – Draft 08/01/2019. Map 5 – Proposed Network. Map 7 – Proposed Project Priority



Existing Cycling Network

40-70 Plains Road East TIA
190488

Figure 2.2

2.3 Transit Service

Transit service in the area is provided by Burlington Transit, Hamilton Street Railway (HSR), GO Transit and Via Rail and is centralized around the Aldershot GO Station. The GO Station offers both GO Transit Bus and GO Transit Train service and functions as a turnaround point for several Burlington Transit and HSR transit routes.

Burlington Transit operates two routes adjacent to the subject site. **Table 2.1** summarizes the existing routes. **Figure 2.2** illustrates the existing transit network. Service headways and schedule

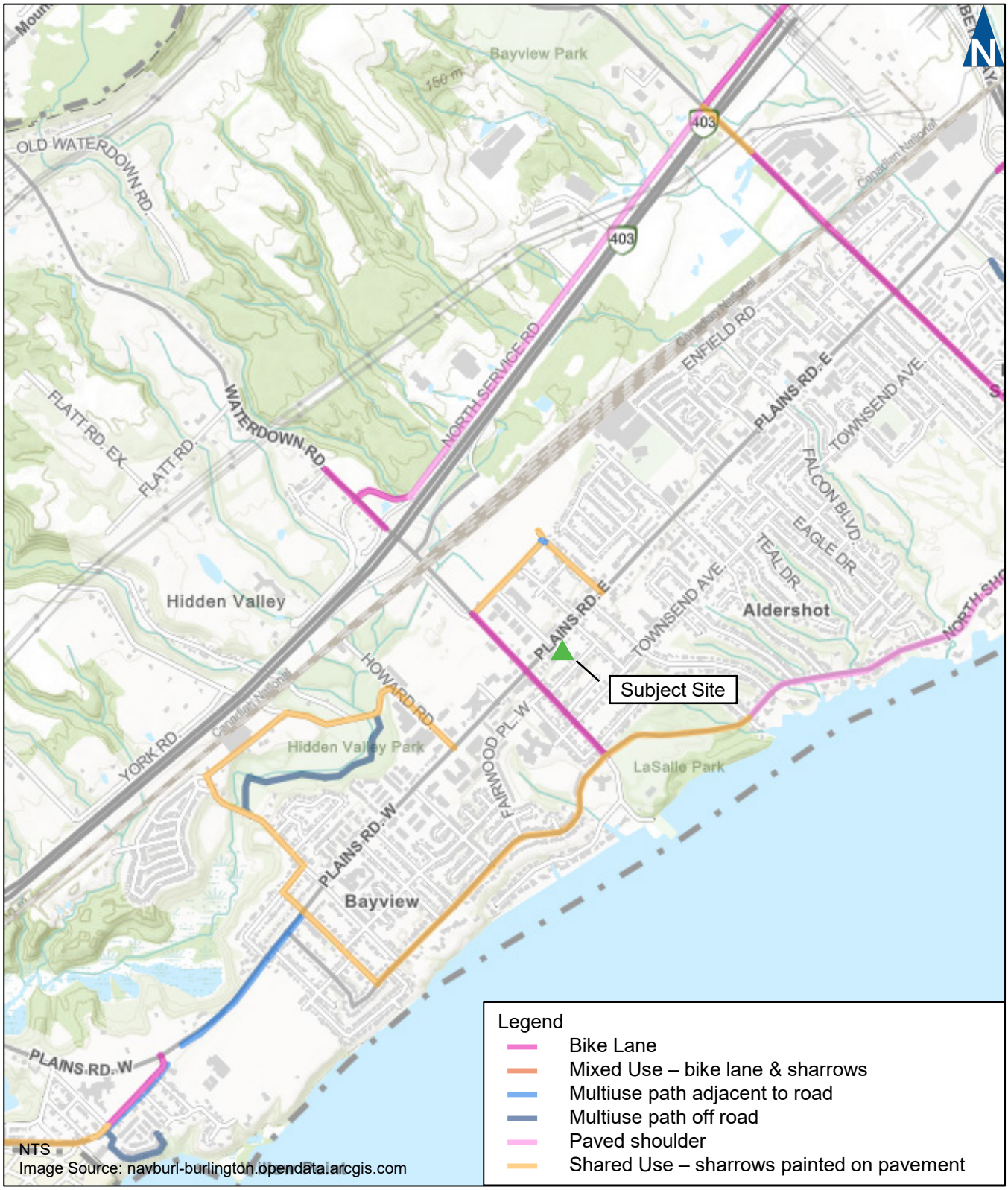
The closest eastbound Burlington Transit stop is located on the southeast quadrant of the Plains Road East intersection with Waterdown Road. The closest westbound stop is located on the northeast quadrant of the Plains Road East intersection with Cooke Boulevard.

The Aldershot GO Station is located approximately 750 metres north of the subject site. The walking distance to the Aldershot GO south parking lot is about 900 metres with sidewalks provided along Cook Boulevard and Masonry Court.

TABLE 2.1: EXISTING TRANSIT ROUTES

Route	Description
Burlington Transit Route 1/101 (Plains-Fairview)*	Offers service 7-days a week between the Appleby GO Station and the City of Hamilton (King & James). Weekday headways range from 15-30 minutes depending on time of day. Weekend headways are in the order of 30-minutes.
Burlington Transit Route 4 (Central)	Offers service 7-days a week between the Appleby GO Station and Aldershot GO Station. Weekday headways are in the order of 30-60 minutes. Weekend headways are in the order of 60-minutes.

* Route 101 is not in service at time of writing due to COVID-19 containment measures. Service headways may vary.



Existing Cycling Network

40-70 Plains Road East TIA
190488

Figure 2.2

2.4 Traffic Volumes

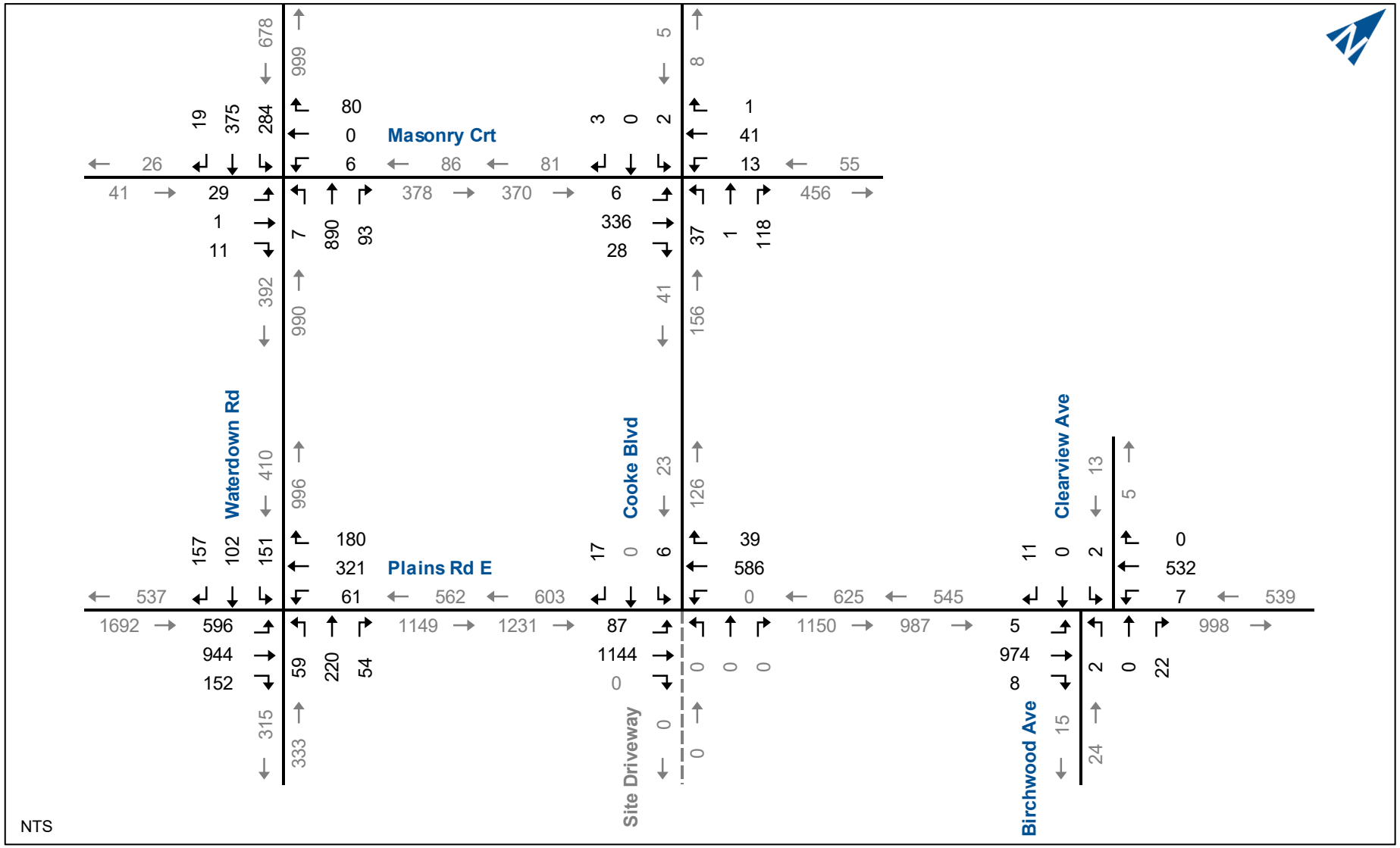
Table 2.2 summarizes the location and date of the existing turning movement count (TMC) data used in the analysis. The data was collected by Pyramid Traffic Incorporated during September 2018 and December 2019.

To account for possible minor traffic increases, a base year condition (year 2020) is forecast using a generalized growth rate of 1% per annum. City staff identified the 1% per annum growth rate during pre-study consultation

Figure 2.4A-B illustrates the existing base year AM and PM peak hour traffic volumes at the study area intersections. **Appendix B** contains the existing data.

TABLE 2.2: EXISTING COUNT DATA SUMMARY

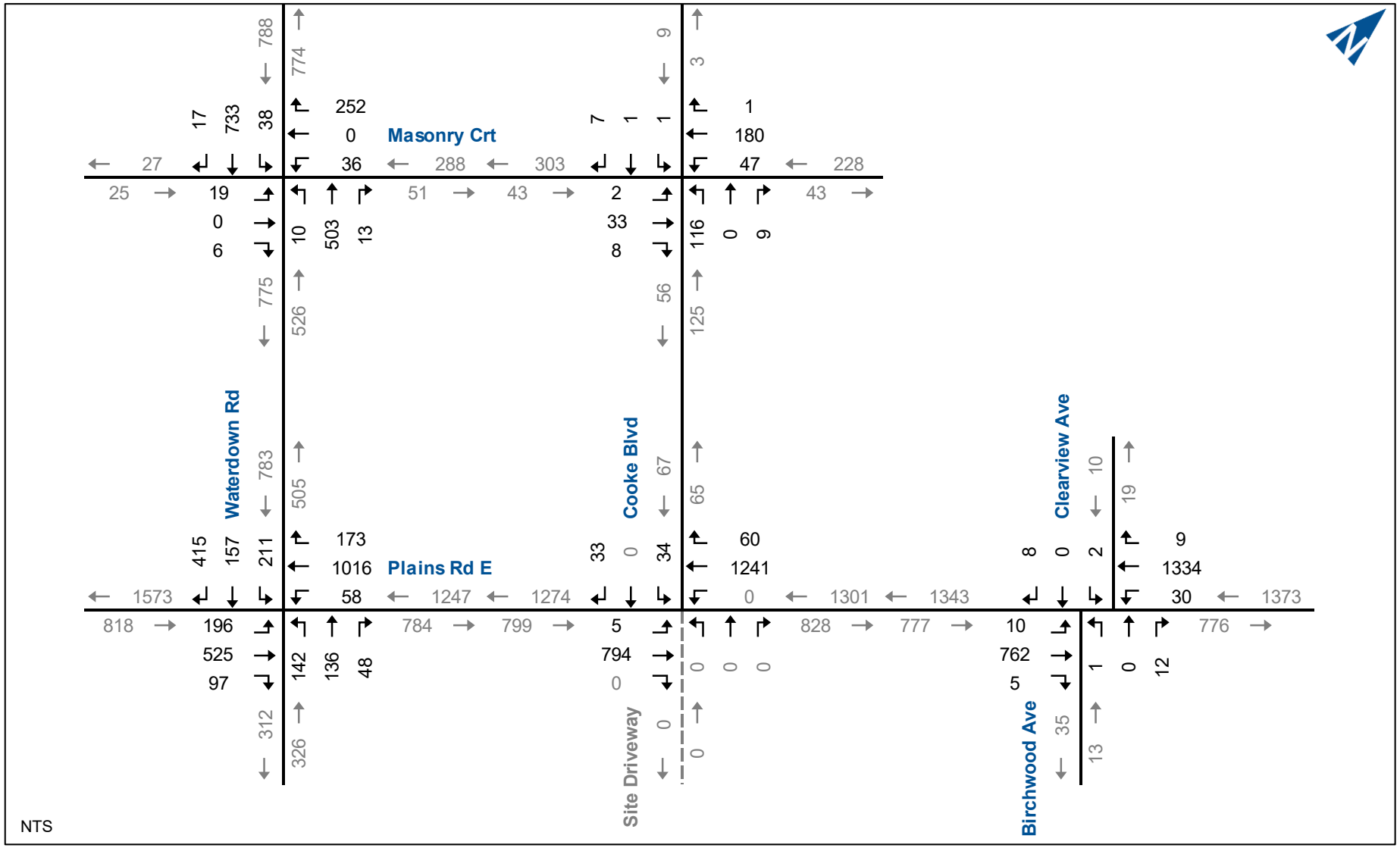
Date	Intersection	Peak Hour	
		AM	PM
September 20, 2018	Plains Road & Waterdown Road	07:15 hr	16:45 hr
	Plains Road & Cooke Boulevard	07:30 hr	16:45 hr
	Masonry Court & Cooke Boulevard	07:00 hr	16:45 hr
	Masonry Court & Waterdown Road	07:00 hr	16:30 hr
December 10, 2019	Plains Road & Birchwood/Clearview	07:45 hr	16:45 hr



Base Year Traffic Volume – AM Peak Hour

40-70 Plains Road East TIA
190488

Figure 2.4A



Base Year Traffic Volume – PM Peak Hour

40-70 Plains Road East TIA
190488

Figure 2.4B

2.5 Traffic Operations

Intersection level of service (LOS) is a recognized method of quantifying the efficiency of traffic flow 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 desiring to make a movement, compared to the estimated capacity for that movement. The capacity is based on several criteria related to the opposing traffic flows. 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 at signalized intersections (50 seconds at unsignalized), the movement is considered to have a LOS F and remedial measures are usually implemented if they are feasible.

The operations of the intersections in the study area were evaluated using the existing lane configuration, traffic control, existing traffic volumes and signal timings. The intersection analysis considered three separate measures of performance:

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

Synchro 9 assessed the traffic conditions and performance. In accordance with the Halton Region's TIS Guidelines[3], the following criteria were used in the determination of critical movements:

- Volume/capacity (V/C) ratios for overall intersection operations, through movements or shared through/turning movements increased to 0.85 or above.
- V/C ratios for exclusive movements that will exceed 0.95.
- 95th percentile queue lengths for individual movements exceeds available lane storage; and
- Level of service (LOS), based on average delay per vehicle, on individual movements exceeds LOS D.

Table 2.3 summarizes the base year level of service conditions and notes:

[3] Halton Region Transportation Impact Study Guidelines – January 2015

AM Peak Hour

- Plains Road at Waterdown Road:
  - Eastbound left-turn operating with a v/c ratio greater than 1.00 and a queue length greater than the current available storage. Queue length is forecast to extend into the upstream Emery Avenue intersection.
  - Overall intersection operations in LOS D with a v/c ratio of less than 0.95.
- Plains Road at Cooke Boulevard
  - No capacity issues.
- Plains Road East at Clearview Avenue/Birchwood Avenue
  - No capacity issues.
- Waterdown Road at Masonry Court
  - Southbound left-turn operating with a queue length greater than the current available storage.
- Cooke Boulevard at Masonry Court
  - No capacity issues.

PM Peak Hour

- Plains Road at Waterdown Road:
  - Eastbound left-turn operating with a queue length greater than the current available storage.
  - Westbound queue length spilling back into the Cooke Boulevard intersection.
  - Northbound left-turn operating with a queue length greater than the current available storage.
  - Southbound right-turn operating with a queue length greater than the current available storage.
- Plains Road at Cooke Boulevard
  - No capacity issues.
- Plains Road East at Clearview Avenue/Birchwood Avenue
  - No capacity issues.
- Waterdown Road at Masonry Court
  - Southbound left-turn operating with a queue length greater than the current available storage.
- Cooke Boulevard at Masonry Court

- No capacity issues.

Appendix C contains the supporting detailed Synchro 9 output.

TABLE 2.3: EXISTING OPERATIONS

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	Plains Rd E & Waterdown Rd	TCS	LOS	F	C	>	D	C	D	>	D	C	D	>	D	D	C	C	D	D
			Delay	86	23	>	45	33	40	>	40	34	43	>	42	43	32	31	36	43
			V/C	1.07	0.69	>		0.39	0.59	>		0.20	0.68	>		0.75	0.23	0.12		0.94
			Q	225	145	>		14	65	>		18	84	>		42	33	16		
			Ex	30	165	>		40	120	>		30	95	>		315	315	40		
			Avail.	-195	20	>		26	55	>		12	11	>		273	282	24		
	Plains Rd E & Cooke Boulevard	TCS	LOS	A	A		A		A	>	A					D		>	D	A
			Delay	2	2		2		3	>	3					38		>	38	3
			V/C	0.15	0.40				0.25	>						0.09		>		0.40
			Q	6	37				30	>						6		>		
			Ex	40	120				120	>						315		>		
			Avail.	34	83				90	>						309		>		
	Plains Rd E & Clearview Ave/Birchwood Ave	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	B	>	B	
			Delay	<	0	>	0	<	0	>	0	<	12	>	12	<	11	>	11	
			V/C	<	0.31	>		<	0.16	>		<	0.05	>		<	0.02	>		
			Q	<	0	>		<	0	>		<	1	>		<	1	>		
			Ex	<	120	>		<	90	>		<	120	>		<	180	>		
			Avail.	<	120	>		<	90	>		<	119	>		<	179	>		
	Waterdown Rd & Masonry Crt	TCS	LOS	<	D	>	D	D	D	>	D	A	B	>	B	A	A	>	A	B
			Delay	<	43	>	43	39	39	>	39	9	13	>	13	9	3	>	5	12
			V/C	<	0.30	>		0.03	0.06	>		0.02	0.52	>		0.59	0.16	>		0.55
			Q	<	16	>		5	0	>		3	103	>		36	16	>		
			Ex	<	-	>		15	120	>		20	315	>		15	345	>		
			Avail.	<	-	>		10	120	>		17	212	>		-21	329	>		
	Cooke Blvd & Masonry Crt	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	B	>	B	
			Delay	<	0	>	0	<	2	>	2	<	15	>	15	<	12	>	12	
			V/C	<	0.00	>		<	0.01	>		<	0.34	>		<	0.01	>		
			Q	<	0	>		<	0	>		<	12	>		<	0	>		
			Ex	<	120	>		<	300	>		<	315	>		<	-	>		
			Avail.	<	120	>		<	300	>		<	303	>		<	-	>		
PM Peak Hour	Plains Rd E & Waterdown Rd	TCS	LOS	D	B	>	C	B	C	>	C	D	D	>	D	D	C	D	D	C
			Delay	50	17	>	25	11	26	>	26	44	46	>	45	38	33	36	36	30
			V/C	0.84	0.36	>		0.16	0.78	>		0.59	0.60	>		0.74	0.37	0.50		0.79
			Q	63	65	>		5	181	>		37	59	>		56	48	55		
			Ex	30	165	>		40	120	>		30	95	>		315	315	40		
			Avail.	-33	100	>		35	-61	>		-7	36	>		259	267	-15		
	Plains Rd E & Cooke Boulevard	TCS	LOS	A	A		A		A	>	A					D		>	D	A
			Delay	3	2		2		4	>	4					47		>	47	5
			V/C	0.02	0.27				0.48	>						0.26		>		0.46
			Q	0	24				81	>						20		>		
			Ex	40	120				120	>						315		>		
			Avail.	40	96				40	>						295		>		
	Plains Rd E & Clearview Ave/Birchwood Ave	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	C	>	C	
			Delay	<	1	>	1	<	1	>	1	<	11	>	11	<	19	>	19	
			V/C	<	0.24	>		<	0.41	>		<	0.02	>		<	0.04	>		
			Q	<	1	>		<	1	>		<	1	>		<	1	>		
			Ex	<	120	>		<	90	>		<	120	>		<	180	>		
			Avail.	<	120	>		<	89	>		<	119	>		<	179	>		
	Waterdown Rd & Masonry Crt	TCS	LOS	<	D	>	D	D	D	>	D	A	A	>	A	A	A	>	A	B
			Delay	<	44	>	44	45	44	>	44	6	7	>	7	3	3	>	3	12
			V/C	<	0.07	>		0.25	0.17	>		0.03	0.21	>		0.07	0.28	>		0.29
			Q	<	1	>		18	0	>		2	49	>		4	31	>		
			Ex	<	-	>		15	120	>		20	315	>		15	345	>		
			Avail.	<	-	>		-3	120	>		19	266	>		11	314	>		
	Cooke Blvd & Masonry Crt	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	B	>	B	
			Delay	<	0	>	0	<	2	>	2	<	14	>	14	<	11	>	11	
			V/C	<	0.00	>		<	0.04	>		<	0.28	>		<	0.02	>		
			Q	<	0	>		<	1	>		<	9	>		<	0	>		
			Ex	<	120	>		<	300	>		<	315	>		<	-	>		
			Avail.	<	120	>		<	299	>		<	306	>		<	-	>		

Avail. - Available Storage
Delay - Average Delay per Vehicle in Seconds
Ex. - Existing Available Storage (Turn lane or segment length)
LOS - Level of Service
MOE - Measure of Effectiveness
Q - 95th Percentile Queue Length
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
V/C - Volume to Capacity Ratio
< - Shared Left-turn
> - Shared Right-turn

3 Development Concept

3.1 Site Description

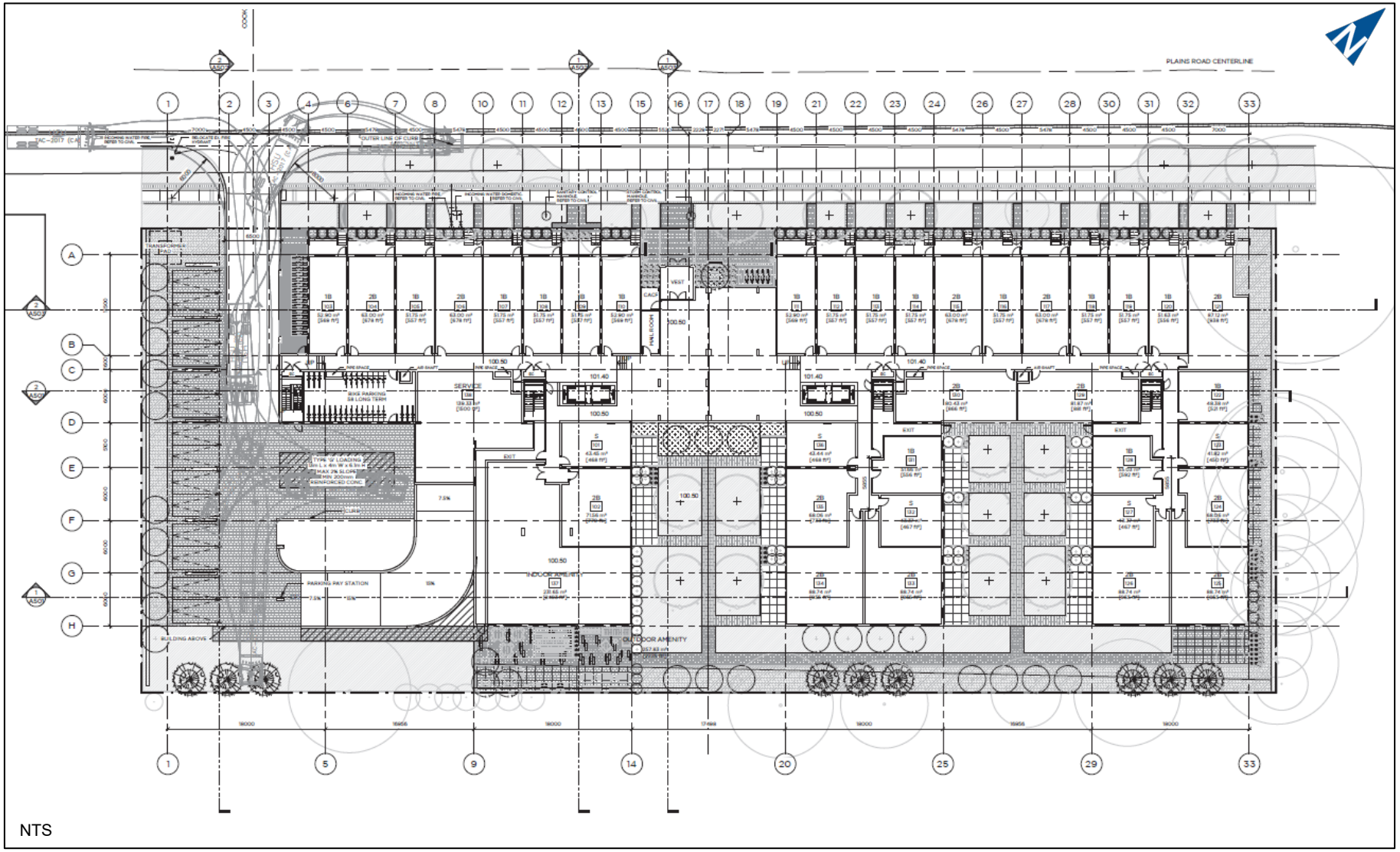
The subject site is located at 40-70 Plains Road East in the City of Burlington. The site is located with in the City of Burlington's Aldershot Mobility Hub area. The City defines this area as an intensification area. Intensification areas are intended to foster a more pedestrian and transit friendly urban environment through a mixture of dense residential, employment, and retail land uses. **Figure 3.1A-B** illustrates the layout of the subject site.

The proposed 9-storey mid-rise development contains 360 residential condominium units. Construction will occur in two phases and result in one building. Phase 1 is estimated to be built-out by Year 2024 and contains 168 residential condominium units. Phase 2 is estimated to be built-out by Year 2025.

The proposed site plan consolidates seven existing private driveways to Plains Road East into one driveway. The site driveway is located directly opposite to Cooke Boulevard and forms the fourth leg to the existing signalized intersection.

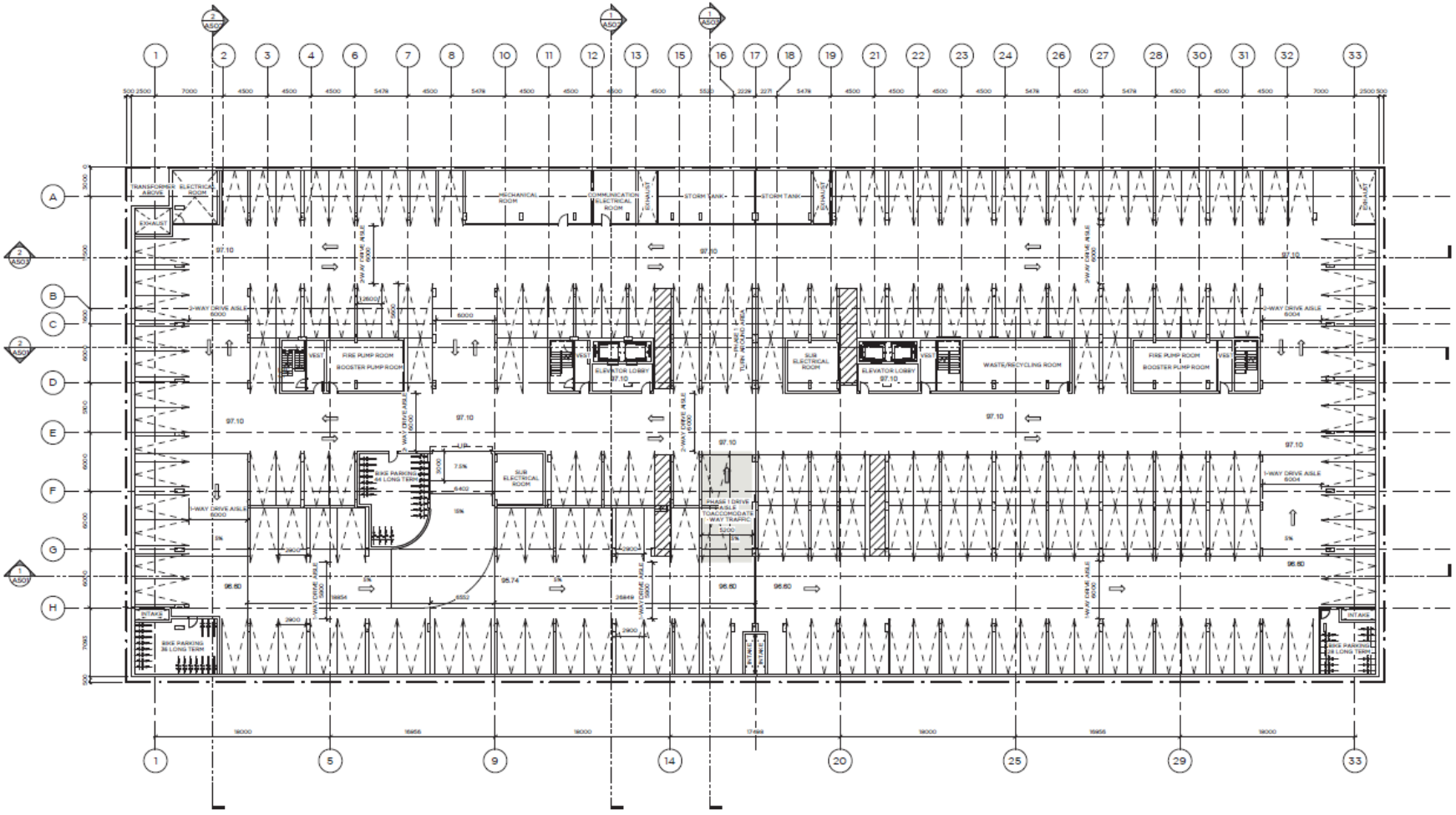
The existing centre two-way-left-turn-lane (TWLTL) on the east leg of Plains Road East at Cooke Boulevard should be repainted as a left-turn lane. A minimum of 15-metres of storage is recommended.

A direct pedestrian connection is proposed between the building's main entrance and the existing sidewalk across the site's Plains Road East frontage. The ground floor units fronting Plains Road East have direct at grade connections to the existing sidewalk across the site's Plains Road East frontage.



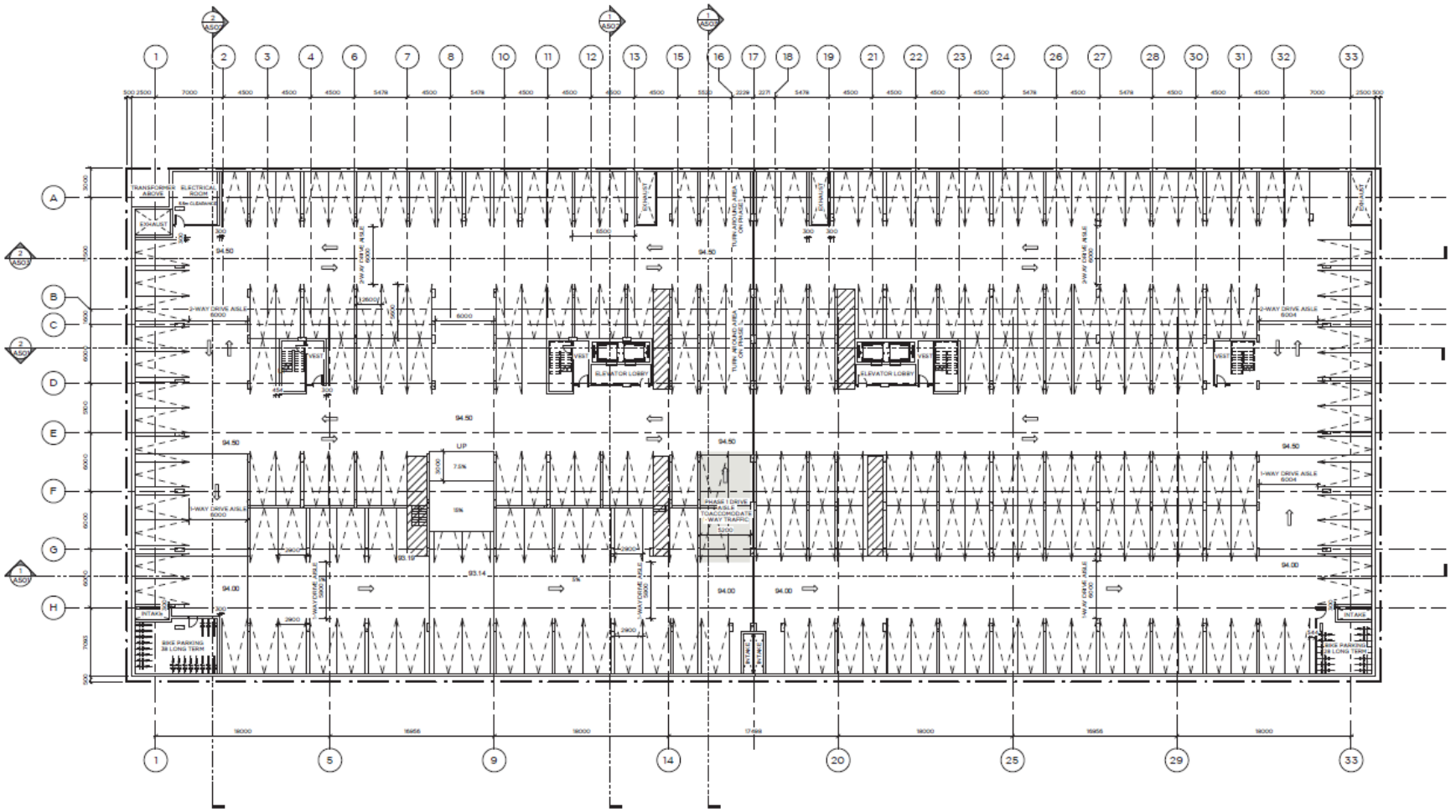
Site Concept Plan

Figure 3.1A



Site Concept Plan – Parking Level 01

Figure 3.1B



NTS

Site Concept Plan – Parking Level 02

Figure 3.1C

3.2 Parking Supply

3.2.1 Vehicle Parking Supply

The site's parking demand is proposed to be accommodated on site. The site statistics indicate a Phase 1 vehicle parking supply of 186 spaces (1.10 spaces per unit). At full build-out the site statistics indicate a total vehicle parking supply of 424 spaces (1.18 spaces per unit). 410 spaces are contained in the proposed two-level underground parking structure. The remaining spaces (14) are located at grade.

The parking supply is reduced when compared to the zoning by-law to complement the future intensification plans for the Mobility Hub. The Aldershot Mobility Hub envisions a dense walkable, bikeable and transit-oriented urban environment with a mix of land uses.

3.2.2 Bicycle Parking Supply

The site statistics indicate a bicycle parking supply of 232 long-term bicycle parking spaces (0.64 spaces per unit) and 20 short-term visitor bicycle parking spaces (0.05 spaces per unit).

The long-term bicycle parking spaces are located at grade in the bike room on the ground floor level and within parking level 01-02. The short-term bicycle parking spaces are located at grade along the site driveway approach to Plains Road East.

3.3 Transportation Demand Management

The site plan includes Transportation Demand Management (TDM) measures to help improve transportation efficiency (reduced congestion), encouraging use of alternative modes, reducing reliance on single occupant vehicles, and encouraging a change in behaviour. The proposed TDM measures include:

- **Walking** – Pedestrian oriented design with walking paths to connect the development with adjacent sidewalks. The pedestrian realm to the rear of the building will include amenities such as benches, seating areas and pedestrian scale lighting;
- **Transit** – Proximity to existing transit service (City and Regional GO Transit) and discounted transit passes for first time purchasers during the first year of occupancy will be included as a marketing item;
- **Cycling** – On-site bicycle parking and repair stations
  - bicycle repair station within the long-term bicycle parking areas will be provided;

- Long-term bicycle parking – 97 spaces (0.23 spaces per unit);
- Short-term bicycle parking – 10 spaces (0.02 spaces per unit); and
- The site is located adjacent to the City's existing cycling network; and
- The City of Burlington's draft Cycling Plan identifies a Protected Bikeway along Plains Road East through the study area.

- **Parking** – Reduced on-site parking supply to complement the future intensification plans for the Mobility Hub. The Aldershot Mobility Hub envisions a dense walkable, bikeable and transit-oriented urban environment with a mix of land uses.

  The applicant intends to unbundle parking costs from residential unit costs. This allows residents to purchase a unit without a parking space.
- **Carshare** – The site operator will explore the feasibility of providing a carshare vehicle and space at grade as an amenity for residents;
- **Wayfinding and Travel Planning** – Travel planning resources for residents (individualized marketing, active transportation transit information, transit and cycling maps, community resources) will be provided. Wayfinding signage to major destinations such as schools, public amenities, GO transit and commercial areas be provide in the landscaping plan or lobby area.
- **Education/ Promotion, Incentives** – Contribute to building a strong TDM brand in marketing material; and

3.4 Site Traffic Forecast

The Institute of Transportation Engineers (ITE) Trip Generation[4] methods predict the site trip generation. Land Use Code Multifamily Housing (Mid-Rise) (221) was used to estimate the site's trip generation. **Table 3.1** summarizes the estimated trip generation for Phase 1. **Table 3.2** summarizes the estimated trip generation for Phase 2.

[4] Trip Generation Manual 10th Edition Institute of Transportation Engineers Washington DC

Phase 1 is forecast to generate approximately 57 vehicle trips during the AM peak hour and approximately 73 vehicle trips during the PM peak hour.

The full build-out of the subject site is forecast to generate approximately 120 vehicle trips during the AM peak hour and approximately 152 vehicle trips during the PM peak hour.

To remain conservative no reductions have been made to account for modal choice.

TABLE 3.1: ESTIMATED TRIP GENERATION – PHASE 1

Land Use	Dwelling Units	AM Peak Hour			PM Peak Hour		
		In	Out	Sum	In	Out	Sum
Multifamily Housing (Mid-Rise) (221)[1]	168	15	42	**57**	45	28	**73**
Total Generation		**15**	**42**	**57**	**45**	**28**	**73**

1 Fitted Curve Equation: AM Peak Hour, Ln(T) = 0.98 Ln(X) - 0.98
Fitted Curve Equation: PM Peak Hour, Ln(T) = 0.96 Ln(X) - 0.63

TABLE 3.2: ESTIMATED TRIP GENERATION – FULL BUILD-OUT

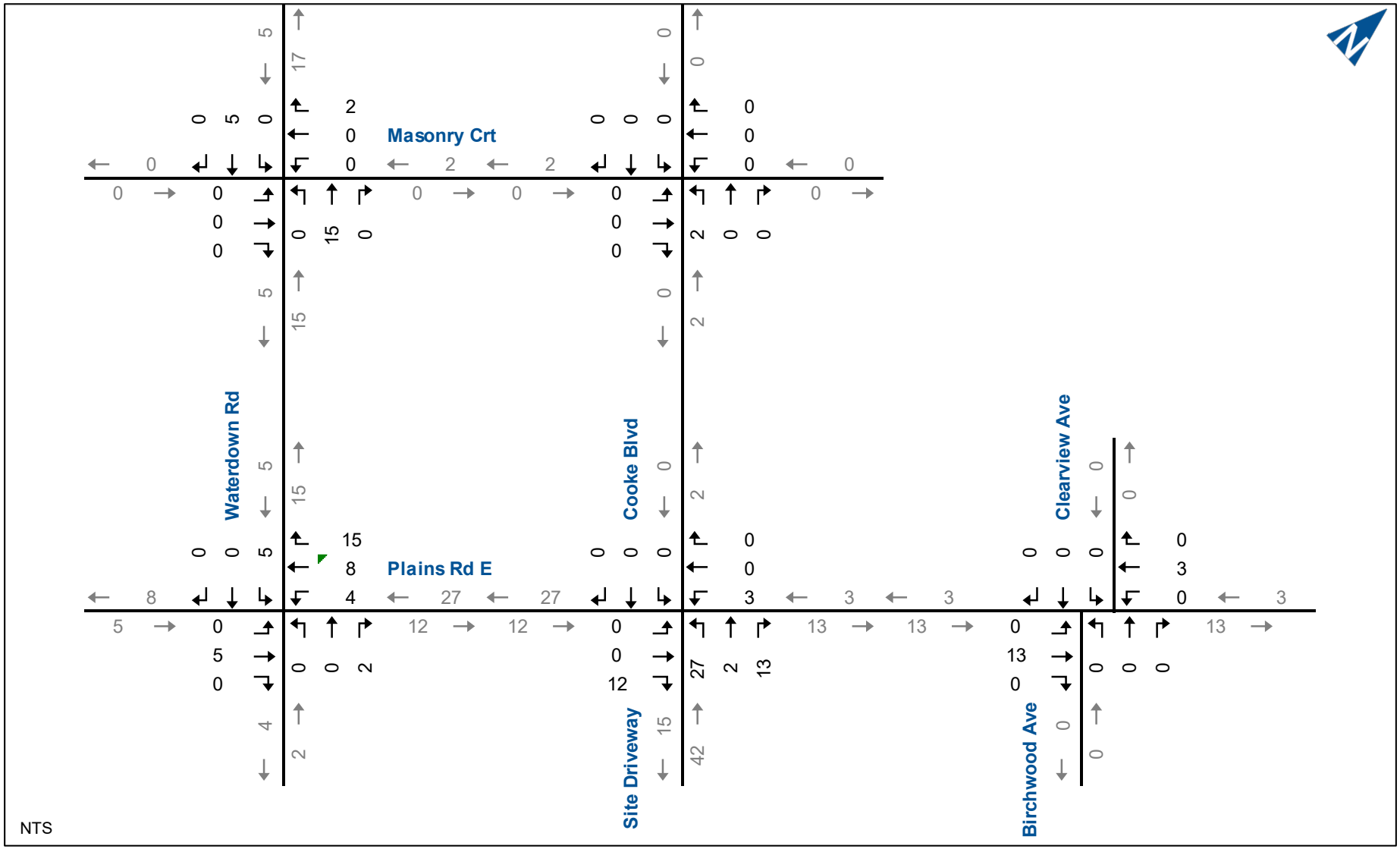
Land Use	Dwelling Units	AM Peak Hour			PM Peak Hour		
		In	Out	Sum	In	Out	Sum
Multifamily Housing (Mid-Rise) (221)[1]	360	31	89	**120**	92	60	**152**
Total Generation		**31**	**89**	**120**	**92**	**60**	**152**

1 Fitted Curve Equation: AM Peak Hour, Ln(T) = 0.98 Ln(X) - 0.98
Fitted Curve Equation: PM Peak Hour, Ln(T) = 0.96 Ln(X) - 0.63

Table 3.3 summarizes the estimated trip distribution. The distribution for site generated traffic is based on existing travel patterns as documented under existing conditions. Travel patterns are expected to follow the existing commuter flows. **Figure 3.2A-B** illustrate the Phase 1 site-generated traffic estimates. **Figure 3.3A-B** illustrate the site-generated traffic estimate under full build-out.

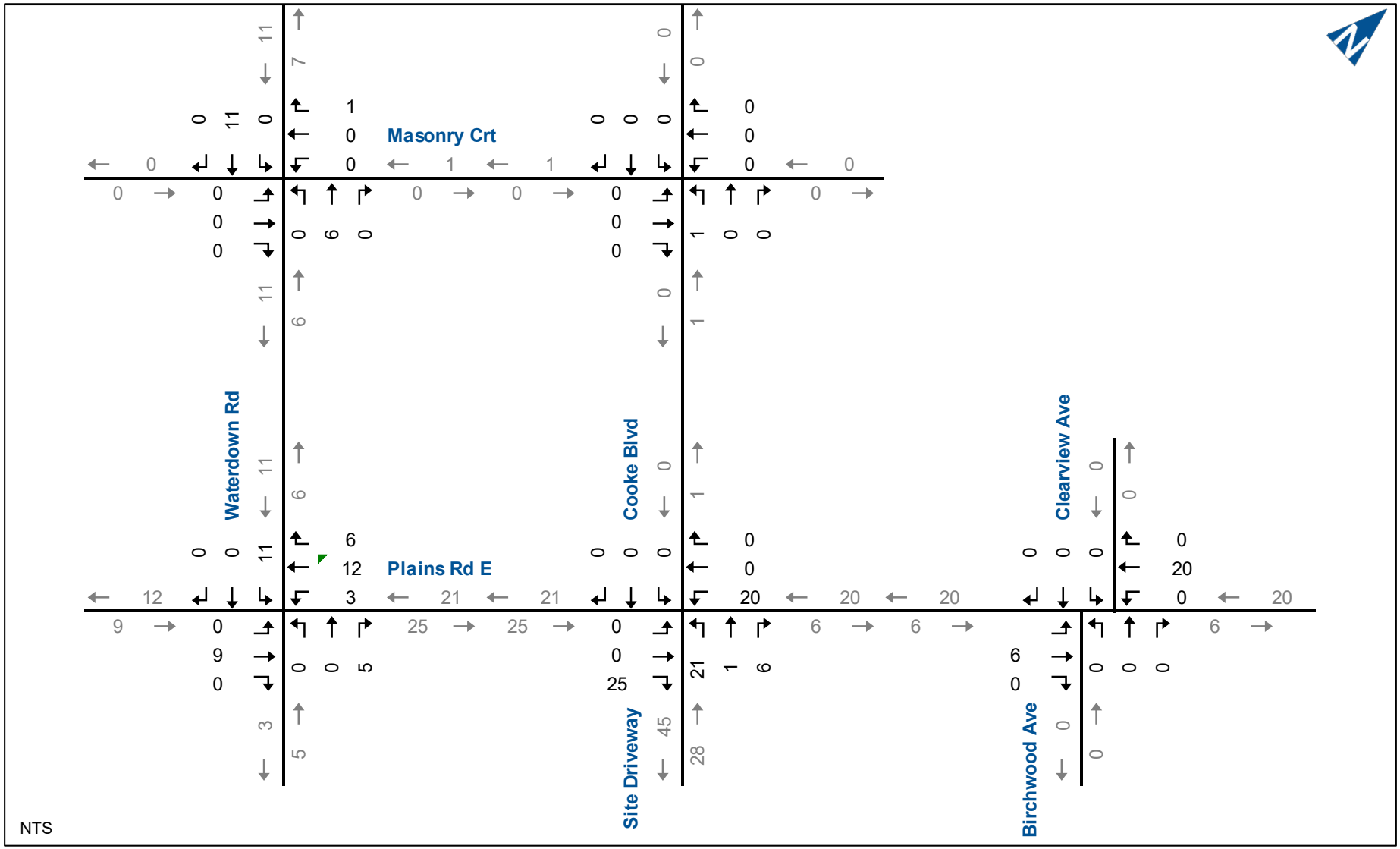
TABLE 3.3: ESTIMATED PEAK HOUR TRIP DISTRIBUTION

Origin/Destination	AM Peak Hour		PM Peak Hour	
	In	Out	In	Out
North via Waterdown Road	30%	35%	25%	20%
North via Cooke Boulevard	0%	5%	0%	5%
South via Waterdown Road	15%	10%	10%	10%
East via Plains Road East	20%	30%	45%	20%
West via Plains Road West	35%	20%	20%	45%
Total	**100%**	**100%**	**100%**	**100%**



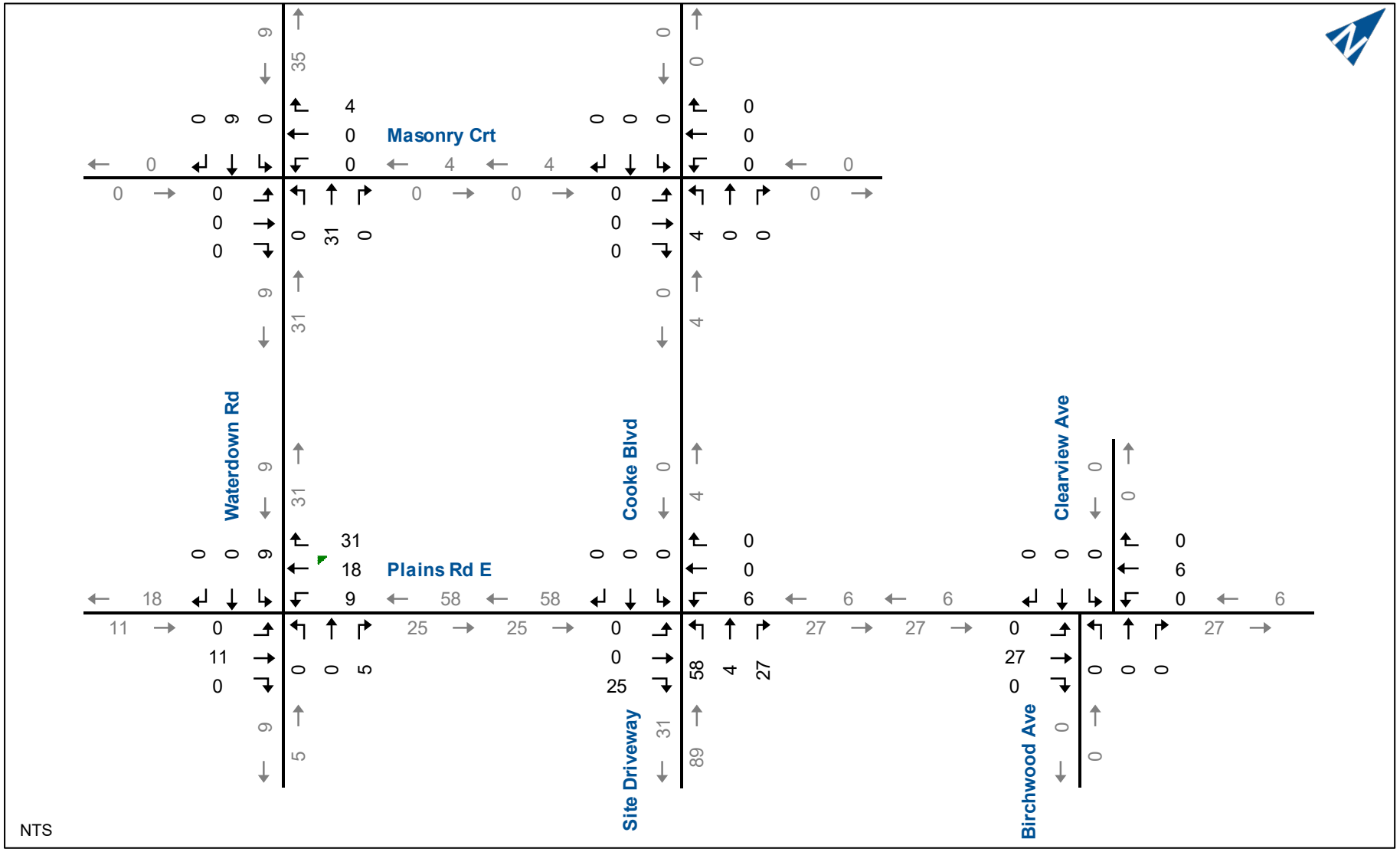
Site Generated Traffic (Phase 1) – AM Peak Hour

Figure 3.2A

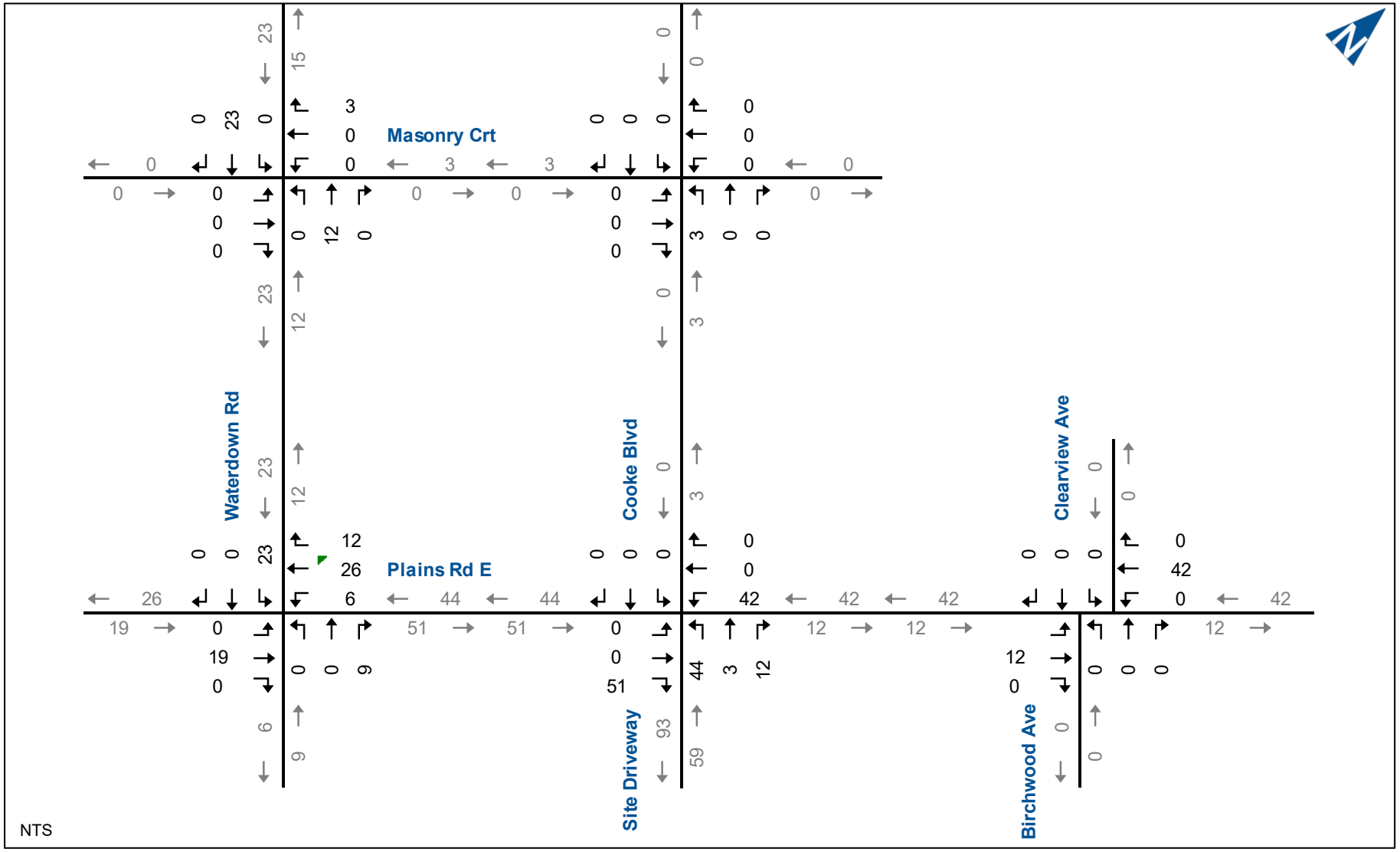


Site Generated Traffic (Phase 1) – PM Peak Hour

Figure 3.2B



Site Generated Traffic (Full Build-Out) – AM Peak Hour



Site Generated Traffic (Full Build-Out) – PM Peak Hour

3.5 Vehicle Circulation

Heavy vehicle circulation for the loading zone and parking structure has been assessed using AutoTURN swept path analysis software. Two design vehicles were used in the analysis:

- Waste collection/loading; and
  - Transportation Association of Canada[5] (TAC) Heavy Single Unit (HSU);
  - TAC Medium Single Unit (MSU)
  - Halton Front loading Garbage Truck
- Passenger Car – TAC Passenger (P)[6].

Appendix D contains the vehicle swept path analysis.

The frequency of delivery waste/vehicles collection vehicles is expected to be low (once a week) with loading and waste collection times managed by the site operator. The level of conflict between the design vehicles and regular on-site traffic is expected to be minimal. Reversing maneuvers into and out of the site's loading zone should ideally be assisted by a traffic control person to reduce conflict between on-site heavy vehicles and passenger cars.

The two-level underground parking structure is accessed by the proposed driveway To Plains Road East. The ramp to the underground parking structure is located south of the site's loading zone. The ramp slopes consist of a 7.5% transition ramp, a 15% ramp and 7.5% transition ramp. There is conflict with the "parking pay station" at the top of the ramp.

Convex mirrors will be provided at all internal corners and at the entry and exit points to the parking structure. Additional 10 km/h signage will be provided internally to the parking structure.

The drive aisle widths are 6.0 m and conforms to the City of Toronto Zoning By-law[7]. All parking space dimensions including accessible parking spaces have been designed and conform to the City of Toronto Zoning By-law. Typical parking spaces measure at least 2.6 m x 5.6 m.

[5] 2.4 – Design Vehicles, Geometric Design Guide for Canadian Roads, Transportation Association of Canada, June 2017.
[6] Ibid.
[7] City of Toronto Zoning By-law 569-2013 Chapter 200 Parking Space Regulations 200.5 Regulations Applying to Parking Spaces 200.5.1 General



4 Future Conditions

The assessment of the future traffic conditions contained in this section includes the traffic forecast as well as the level of service analysis.

4.1 Traffic Forecast

A five-year horizon following the anticipated build-out of each phase of development has been assessed. Year 2029 is representative of Phase 1 build-out conditions and Year 2030 is representative of full build-out.

Future traffic volumes near the subject site are estimated to consist of:

- Increased non-site traffic (generalized background traffic growth). The generalized background traffic growth forecast assumes an annual growth rate of 1% per annum. City staff identified the growth rate during pre-study consultation;
- Traffic generated from adjacent development applications:
  - 35 Plains Road East, a mixed-use development estimated to contain approximately 72 residential units with ground floor commercial space[8];
  - 53-71 Plains Road East, a mixed-use development estimated to contain approximately 450 residential units with ground floor commercial space[9];
  - 92 Plains Road East, a mixed-use development estimated to contain approximately 49 residential units with ground floor office/commercial space[10];
  - 1085 Clearview Avenue, a residential development estimated to contain approximately 160 residential units[11];
  - 101 Masonry Court, a residential development estimated to contain approximately 428 residential units of various types[12]; and
  - Aldershot GO Parking Lot Expansion, a surface parking lot expansion that could result in approximately 1,585 spaces. The parking lot expansion is forecast to generate

[8] 35 Plains Road East Traffic Impact Study, Parking Study & TDM Options Report. Paradigm Transportation Solutions Limited. April 2016.
[9] 53 & 71 Plains Road East Transportation Impact Study, Parking Study & TDM Options Report. Paradigm Transportation Solutions Limited. December 2017.
[10] 92 Plains Road East Traffic Impact Statement and Parking Assessment. WSP. October 2017
[11] 1085 Clearview Avenue & 1082, 1086 & 1090 St. Matthews Avenue Transportation Impact, Parking and TDM Study. Paradigm Transportation Solutions Limited. December 2018.
[12] Preliminary Site Plan Drawing. Trip Generation Estimated using TMC data for Cooke Boulevard & Masonry Court



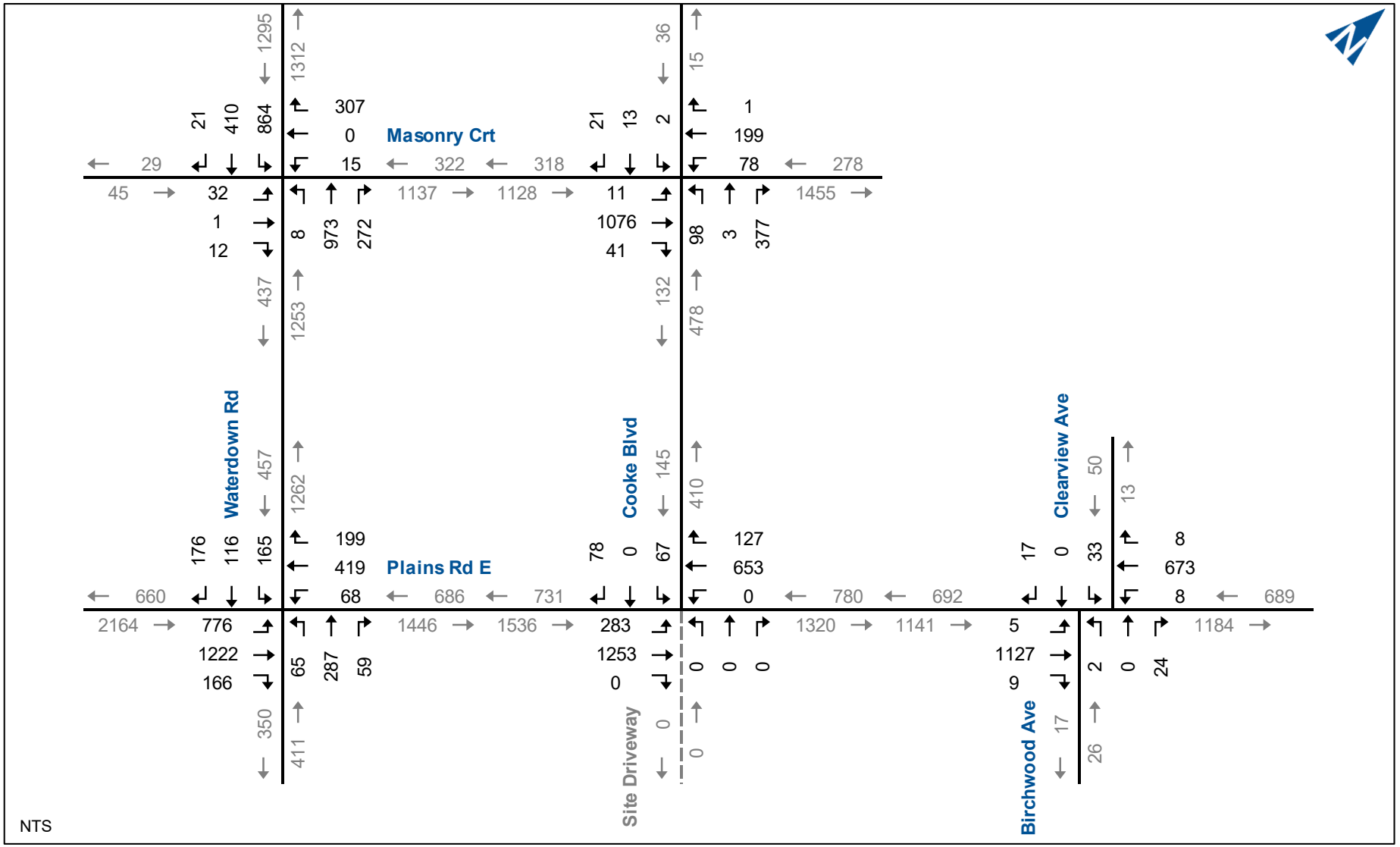
approximately 1,000 new AM peak hour trips and approximately 555 new PM peak hour trips. These trips are anticipated to be distributed through out the study area and will significantly increase design hour volumes along Masonry Court and the entering volumes at the Masonry Court/Cooke Boulevard intersection.

- Traffic generated by the subject site (**Section 3.3**).

Appendix E contains the detailed traffic forecast for the adjacent development applications.

Figure 4.1A-B illustrates the forecast Phase 1 Background Traffic volumes. **Figure 4.2A-B** illustrates the forecast Full Build-Out Background Traffic volumes.

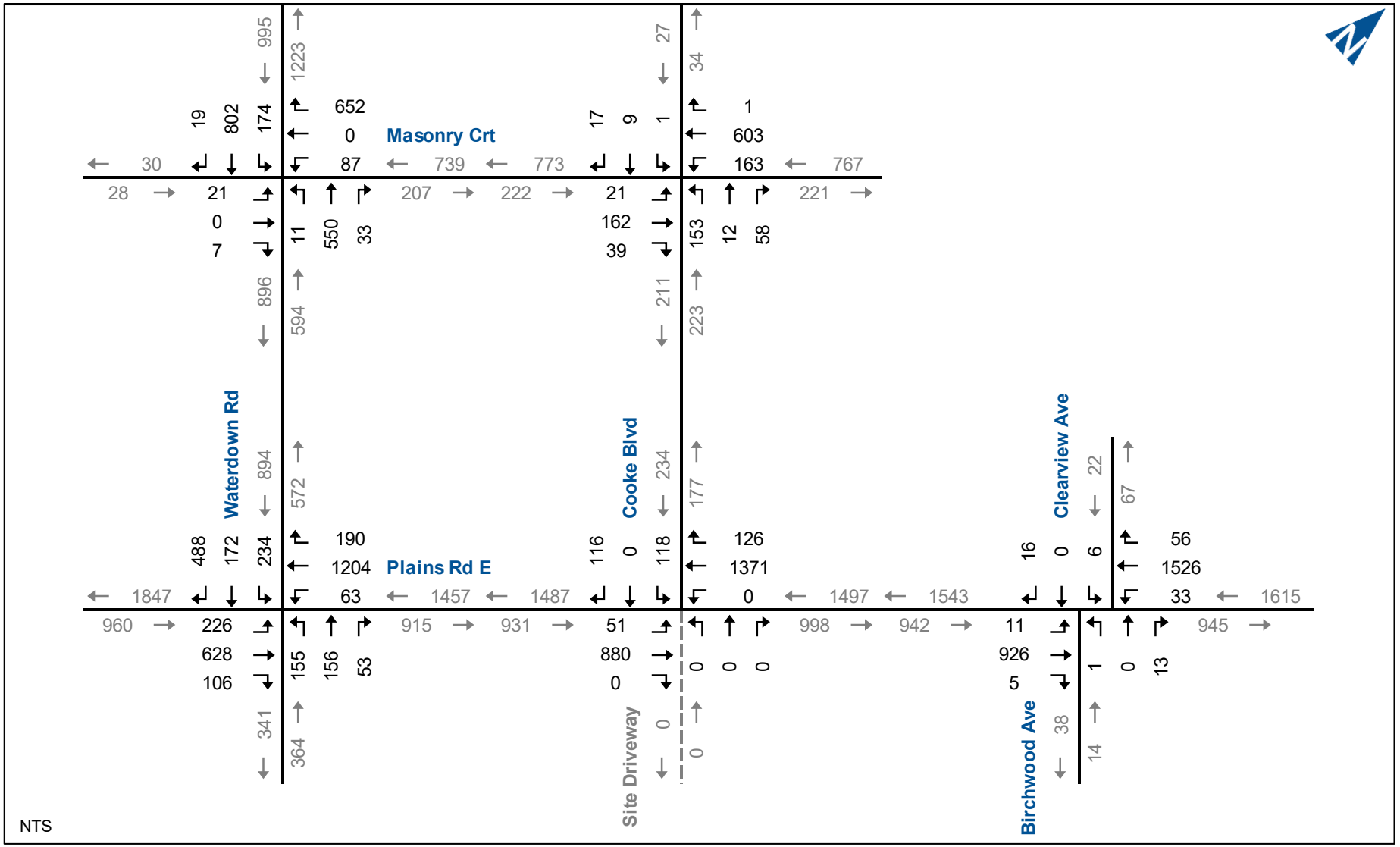
Figure 4.3A-B illustrates the forecast Phase 1 Total Traffic volumes. **Figure 4.4A-B** illustrates the forecast Full Build-Out Total Traffic volumes.



Background Traffic Forecast (Phase 1) – AM Peak Hour

40-70 Plains Road East TIA
190488

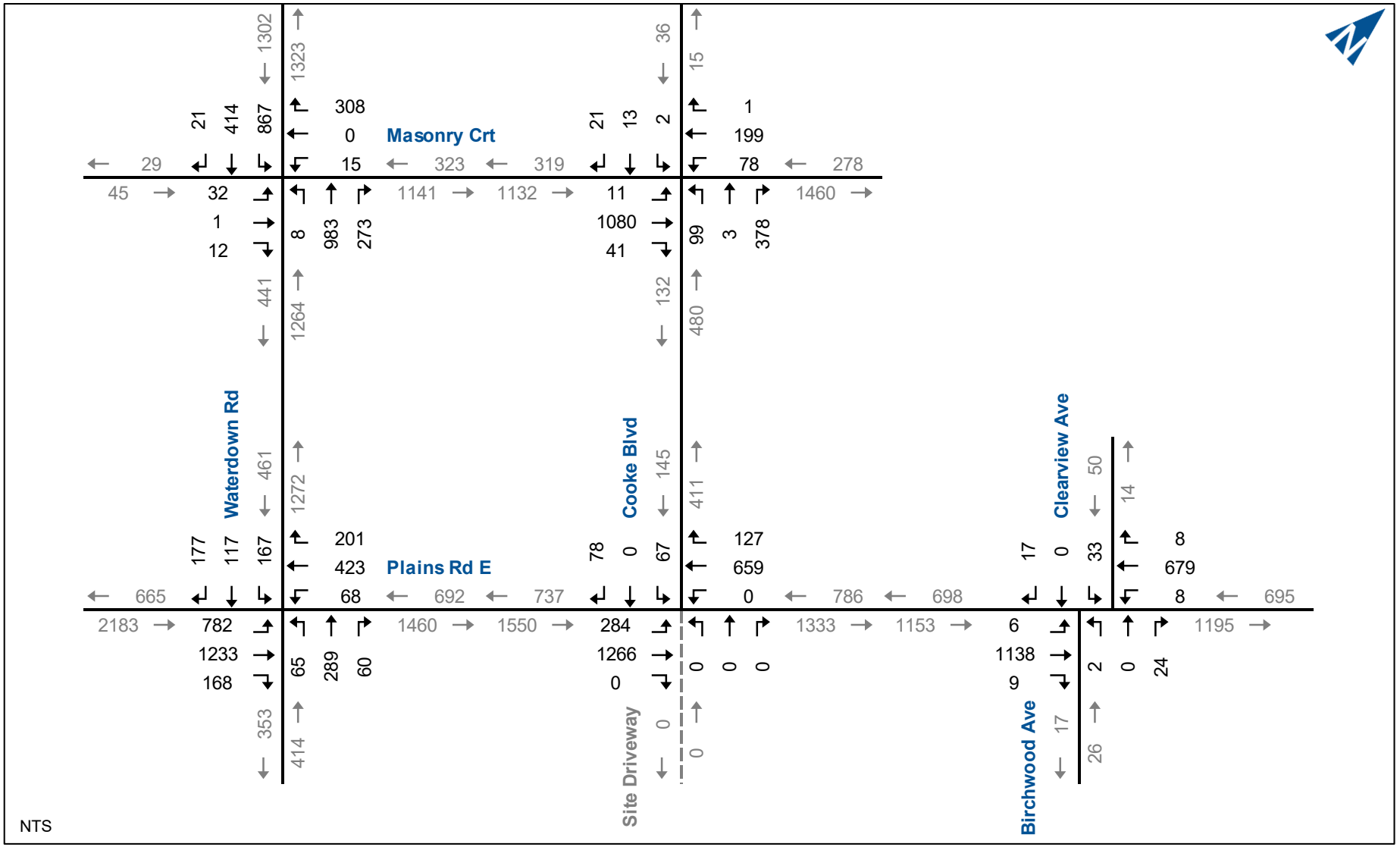
Figure 4.1A



Background Traffic Forecast (Phase 1) – PM Peak Hour

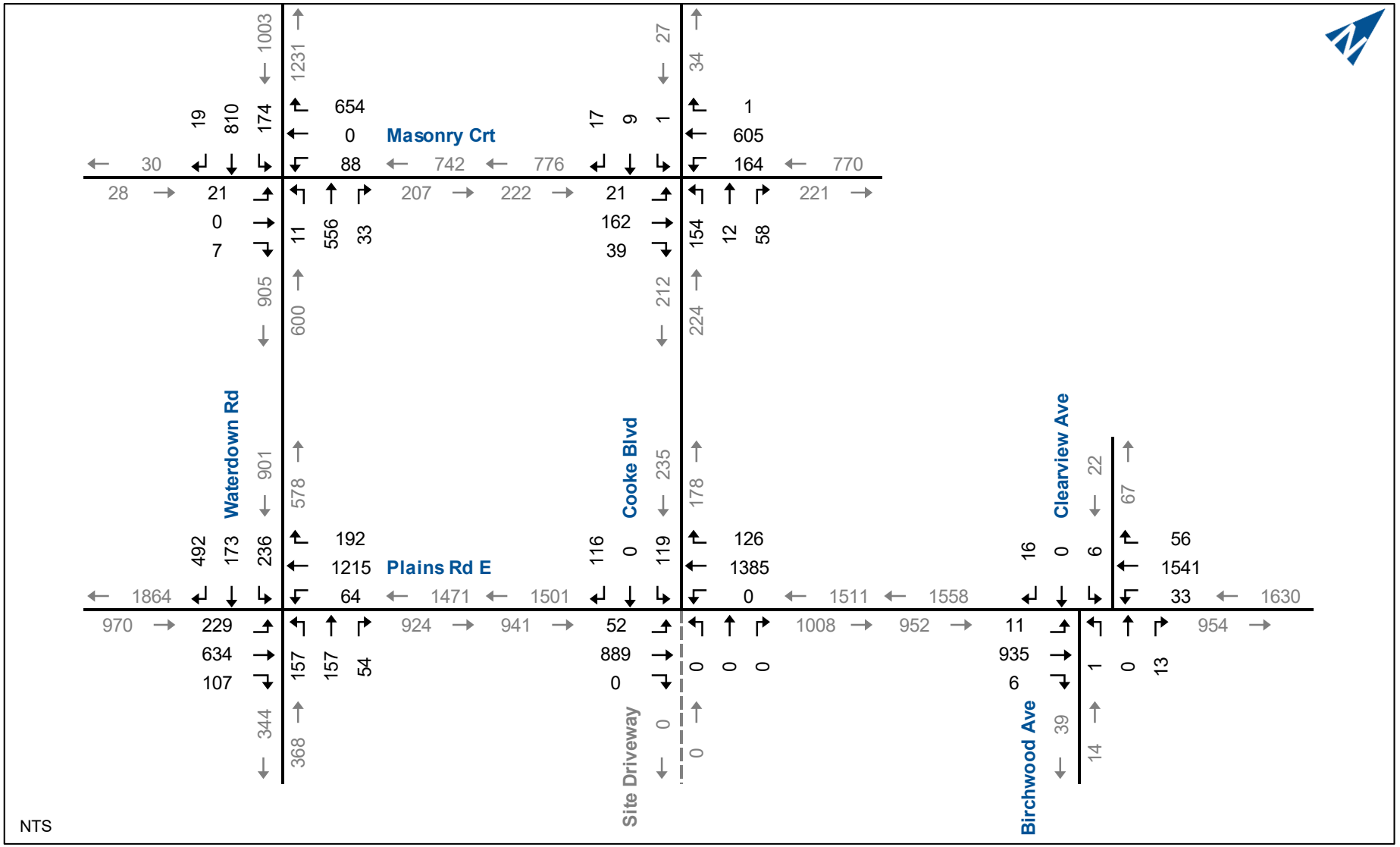
40-70 Plains Road East TIA
190488

Figure 4.1B

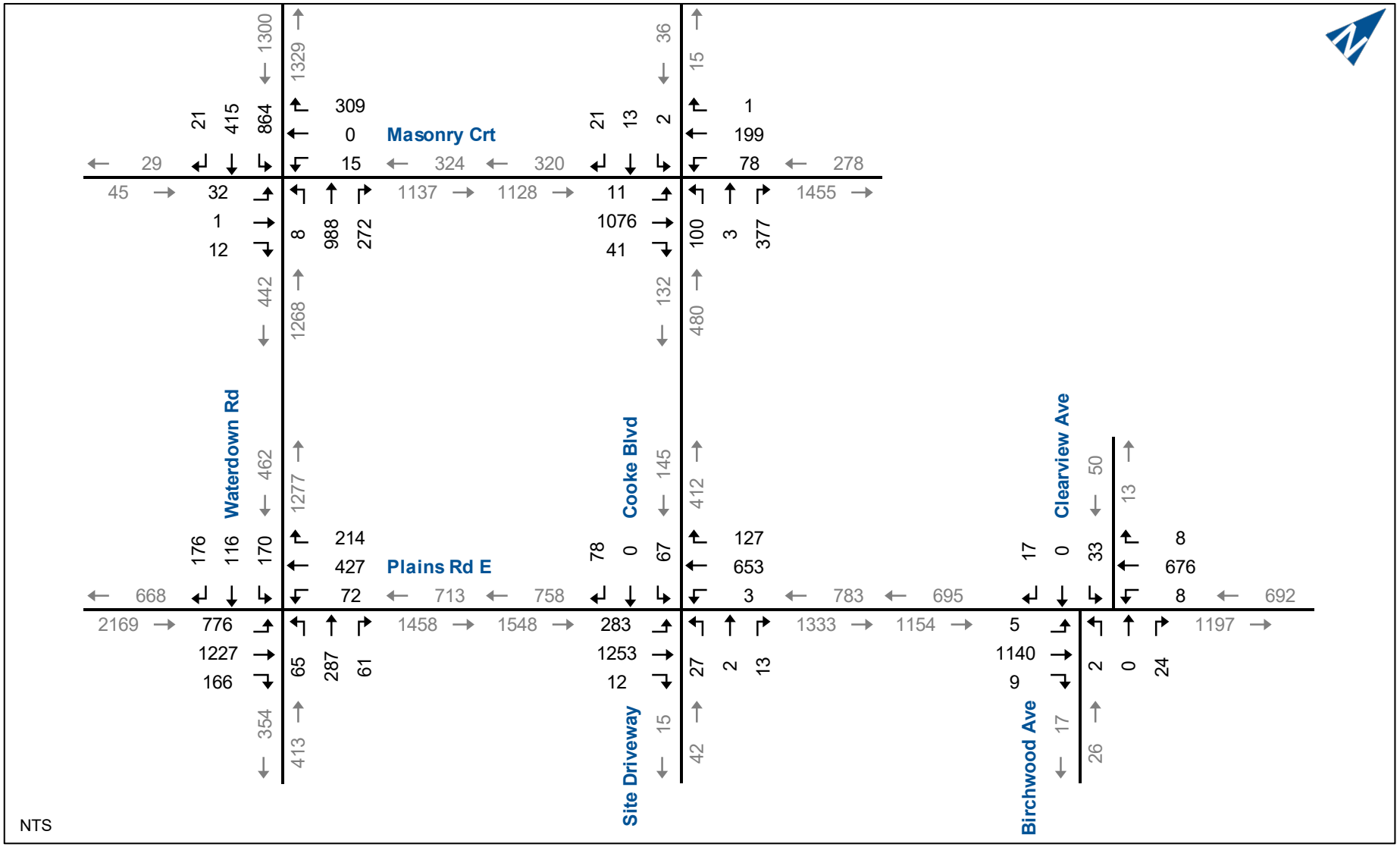


Background Traffic Forecast (Full Build-Out) – AM Peak Hour

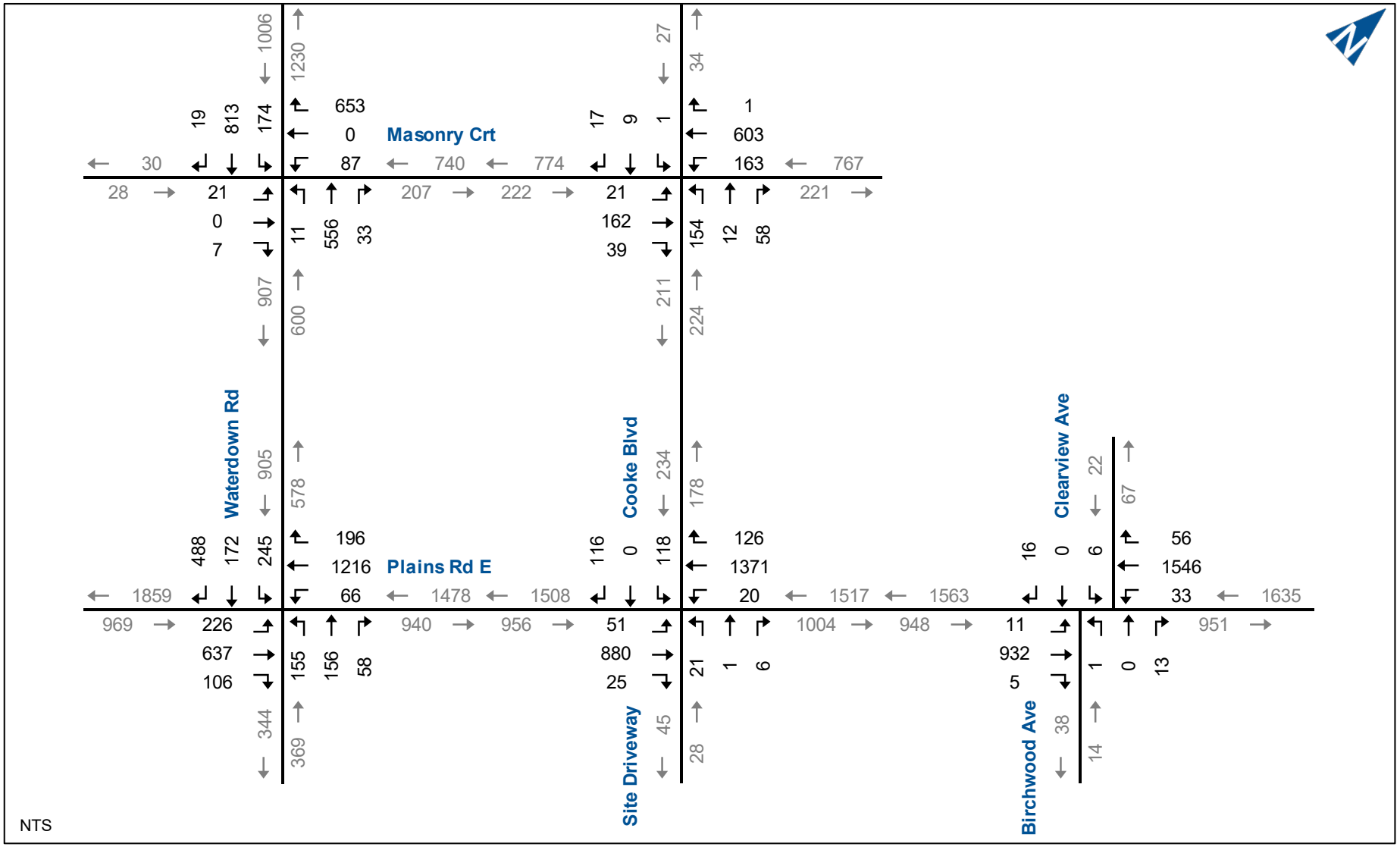
Figure 4.2A



Background Traffic Forecast (Full Build-Out) – PM Peak Hour



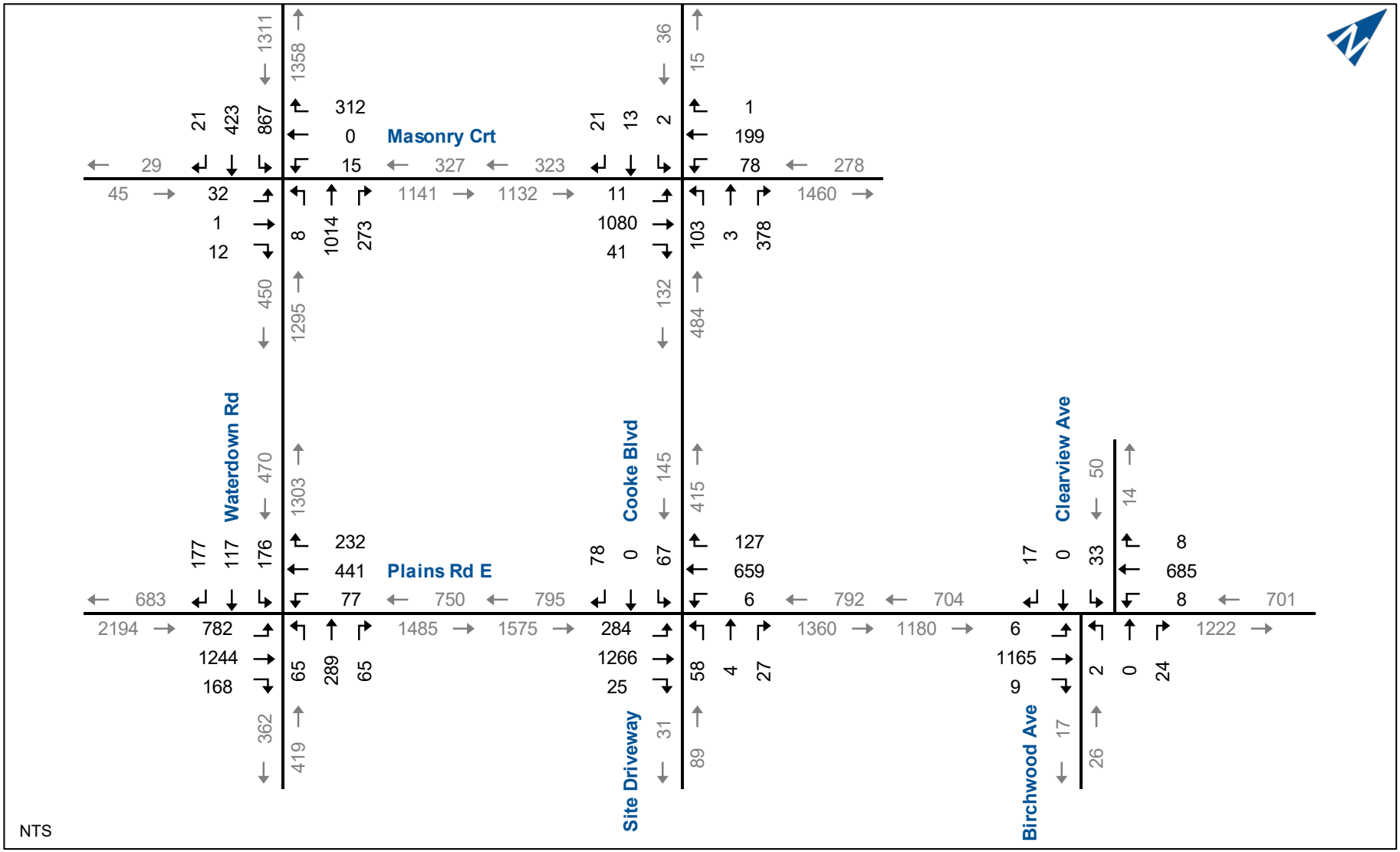
Total Traffic Forecast (Phase 1) – AM Peak Hour



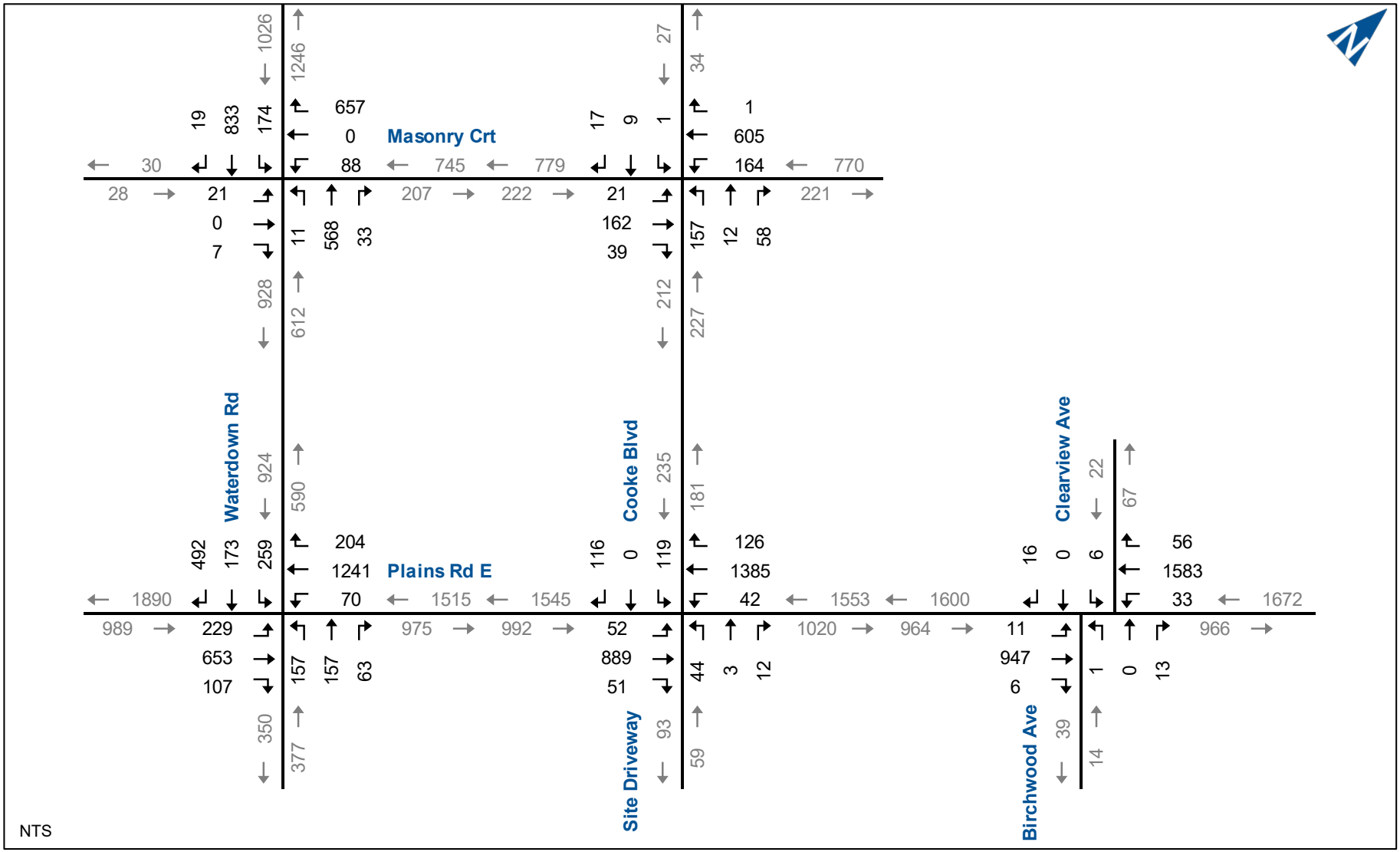
Total Traffic Forecast (Phase 1) – PM Peak Hour

40-70 Plains Road East TIA
190488

Figure 4.3B



Total Traffic Forecast (Full Build-Out) – AM Peak Hour



Total Traffic Forecast (Full Build-Out) – PM Peak Hour

4.2 Background Traffic Operations

4.2.1 Phase 1

The study area intersection operations analyses for the background traffic forecast followed the same methodology used for existing conditions. Signal timings have been optimized. **Table 4.1** summarizes the level of service conditions. The following critical movements are noted:

AM Peak Hour

- Plains Road at Waterdown Road:
  - Eastbound left-turn operating with a v/c ratio greater than 1.00 and a queue length greater than the current available storage. Queue length is forecast to extend into the upstream Emery Avenue intersection.
  - Westbound approach operating with delays in LOS E range with v/c ratio greater than 0.95.
  - Northbound queue length spilling back into the Fairwood Place West intersection.
  - Southbound left-turn movement operating with a v/c ratio greater than 1.00
  - Overall intersection operations in LOS E with a v/c ratio greater than 1.00.
- Plains Road at Cooke Boulevard
  - No capacity issues.
- Plains Road East at Clearview Avenue/Birchwood Avenue
  - No capacity issues.
- Waterdown Road at Masonry Court
  - Eastbound approach operating with v/c ratio greater than 1.00.
  - Northbound approach operating with v/c ratio greater than 1.00.
  - Southbound left-turn operating with a v/c ratio greater than 1.00 and a queue length greater than the current available storage. Queue length is forecast to extend into the upstream Highway 403 eastbound ramp intersection.
  - Overall intersection operations in LOS F with a v/c ratio greater than 1.00.

- Cooke Boulevard at Masonry Court
  - Northbound and southbound approaches are over capacity. Improvements to the existing form of two-way stop control should be considered. **Section 5.1** reviews the intersection's traffic control.

PM Peak Hour

- Plains Road at Waterdown Road:
  - Eastbound left-turn operating with a queue length greater than the current available storage.
  - Westbound queue length spilling back into the Cooke Boulevard intersection.
  - Northbound left-turn operating with a queue length greater than the current available storage.
  - Southbound right-turn operating with a queue length greater than the current available storage.
- Plains Road at Cooke Boulevard
  - Westbound queue length spilling back into the Clearview Avenue/Birchwood Avenue intersection.
- Plains Road East at Clearview Avenue/Birchwood Avenue
  - Southbound approach operating with delays in LOS D range.
- Waterdown Road at Masonry Court
  - Eastbound left-turn operating with a queue length greater than the current available storage.
  - Southbound left-turn operating with a queue length greater than the current available storage.
- Cooke Boulevard at Masonry Court
  - Northbound approach is over capacity. Improvements to the existing form of two-way stop control should be considered. **Section 5.1** reviews the intersection's traffic control.

Appendix F contains the supporting detailed Synchro 9 output

The above noted capacity deficiencies are forecast to occur under the future background condition, these deficiencies are not related, nor are a result of the development of the subject site.

TABLE 4.1: BACKGROUND TRAFFIC OPERATIONS – PHASE 1

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	Plains Rd E & Waterdown Rd	TCS	LOS	F	C	>	E	D	E	>	E	D	E	>	D	F	C	E	F	E
			Delay	126	25	>	61	44	64	>	62	36	55	>	52	256	35	76	131	69
			V/C	1.18	0.79	>		0.64	0.96	>		0.24	0.83	>		1.39	0.27	0.13		1.20
			Q	311	183	>		16	113	>		24	132	>		85	43	28		
			Ex	30	165	>		40	120	>		30	95	>		315	315	40		
			Avail.	-281	-18	>		24	8	>		7	-37	>		230	272	12		
	Plains Rd E & Cooke Boulevard	TCS	LOS	A	A		A		A	>	A					D		>	D	A
			Delay	6	2		3		10	>	10					48		>	48	7
			V/C	0.60	0.48				0.37	>						0.56		>		0.58
			Q	8	17				76	>						38		>		
			Ex	40	120				120	>						315		>		
			Avail.	32	104				44	>						277		>		
	Plains Rd E & Clearview Ave/Birchwood Ave	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	C	>	C	
			Delay	<	0	>	0	<	1	>	1	<	12	>	12	<	16	>	16	
			V/C	<	0.35	>		<	0.21	>		<	0.05	>		<	0.13	>		
			Q	<	0	>		<	0	>		<	1	>		<	4	>		
			Ex	<	120	>		<	90	>		<	120	>		<	180	>		
			Avail.	<	120	>		<	90	>		<	119	>		<	176	>		
	Waterdown Rd & Masonry Crt	TCS	LOS	<	F	>	F	D	D	>	D	B	F	>	F	F	A	>	F	F
			Delay	<	233	>	233	44	45	>	45	20	106	>	105	122	4	>	82	90
			V/C	<	1.09	>		0.07	0.21	>		0.04	1.16	>		1.17	0.18	>		1.15
			Q	<	34	>		10	0	>		1	183	>		356	22	>		
			Ex	<	-	>		15	120	>		20	315	>		15	345	>		
			Avail.	<	-	>		5	120	>		19	132	>		-341	323	>		
	Cooke Blvd & Masonry Crt	TWSC	LOS	<	A	>	A	<	A	>	A	<	F	>	F	<	F	>	F	
			Delay	<	1	>	1	<	9	>	9	<	Err	>	Err	<	Err	>	Err	
			V/C	<	0.01	>		<	0.26	>		<	####	>		<	Err	>		
			Q	<	0	>		<	8	>		<	Err	>		<	Err	>		
			Ex	<	120	>		<	300	>		<	315	>		<	-	>		
			Avail.	<	120	>		<	292	>		<	315	>		<	-	>		
PM Peak Hour	Plains Rd E & Waterdown Rd	TCS	LOS	E	B	>	C	B	C	>	C	D	D	>	D	E	C	D	D	D
			Delay	69	17	>	30	12	31	>	30	38	37	>	37	62	23	49	47	35
			V/C	0.92	0.42	>		0.21	0.95	>		0.56	0.47	>		0.93	0.38	0.86		0.94
			Q	87	73	>		5	219	>		41	60	>		47	39	122		
			Ex	30	165	>		40	120	>		30	95	>		315	315	40		
			Avail.	-57	92	>		35	-99	>		-11	35	>		268	276	-82		
	Plains Rd E & Cooke Boulevard	TCS	LOS	B	A		A		B	>	B					D		>	D	B
			Delay	13	5		5		13	>	13					45		>	45	13
			V/C	0.29	0.34				0.67	>						0.67		>		0.66
			Q	5	37				147	>						67		>		
			Ex	40	120				120	>						315		>		
			Avail.	35	83				-27	>						248		>		
	Plains Rd E & Clearview Ave/Birchwood Ave	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	D	>	D	
			Delay	<	1	>	1	<	1	>	1	<	11	>	11	<	26	>	26	
			V/C	<	0.29	>		<	0.50	>		<	0.03	>		<	0.12	>		
			Q	<	1	>		<	1	>		<	1	>		<	3	>		
			Ex	<	120	>		<	90	>		<	120	>		<	180	>		
			Avail.	<	119	>		<	89	>		<	119	>		<	177	>		
	Waterdown Rd & Masonry Crt	TCS	LOS	<	C	>	C	C	D	>	D	B	B	>	B	B	B	>	B	C
			Delay	<	25	>	25	27	41	>	40	14	16	>	16	13	13	>	13	22
			V/C	<	0.05	>		0.23	0.77	>		0.05	0.38	>		0.42	0.41	>		0.56
			Q	<	1	>		22	90	>		3	73	>		40	91	>		
			Ex	<	-	>		15	120	>		20	315	>		15	345	>		
			Avail.	<	-	>		-7	30	>		17	243	>		-25	254	>		
	Cooke Blvd & Masonry Crt	TWSC	LOS	<	A	>	A	<	A	>	A	<	F	>	F	<	D	>	D	
			Delay	<	1	>	1	<	4	>	4	<	854	>	854	<	30	>	30	
			V/C	<	0.04	>		<	0.15	>		<	2.69	>		<	0.18	>		
			Q	<	1	>		<	4	>		<	206	>		<	5	>		
			Ex	<	120	>		<	300	>		<	315	>		<	-	>		
			Avail.	<	119	>		<	296	>		<	109	>		<	-	>		

Avail. - Available Storage
Delay - Average Delay per Vehicle in Seconds
Ex. - Existing Available Storage (Turn lane or segment length)
LOS - Level of Service
MOE - Measure of Effectiveness
Q - 95th Percentile Queue Length
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
V/C - Volume to Capacity Ratio
< - Shared Left-turn
> - Shared Right-turn

4.2.2 Full Build-Out

The study area intersection operations analyses for the background traffic forecast followed the same methodology used for existing conditions. Signal timings have been optimized. **Table 4.2** summarizes the level of service conditions. The following critical movements are noted:

AM Peak Hour

- Plains Road at Waterdown Road:
  - Eastbound left-turn operating with a v/c ratio greater than 1.00 and a queue length greater than the current available storage. Queue length is forecast to extend into the upstream Emery Avenue intersection.
  - Westbound approach operating with delays in LOS E range with v/c ratio greater than 0.95.
  - Northbound straight through operating with a v/c ratio approaching 0.85 and a queue length greater than the current available storage. Queue length is forecast to extend into the upstream Fairwood Place West intersection.
  - Southbound left-turn movement operating with a v/c ratio greater than 1.00
  - Overall intersection operations in LOS E with a v/c ratio greater than 1.00.
- Plains Road at Cooke Boulevard
  - No capacity issues.
- Plains Road East at Clearview Avenue/Birchwood Avenue
  - No capacity issues.
- Waterdown Road at Masonry Court
  - Eastbound approach operating with v/c ratio greater than 1.00.
  - Northbound approach operating with v/c ratio greater than 1.00.
  - Southbound left-turn operating with a v/c ratio greater than 1.00 and a queue length greater than the current available storage. Queue length is forecast to extend into the upstream Highway 403 eastbound ramp intersection.
  - Overall intersection operations in LOS F with a v/c ratio greater than 1.00.

- Cooke Boulevard at Masonry Court
  - Northbound and southbound approaches are over capacity. Improvements to the existing form of two-way stop control should be considered. **Section 5.1** reviews the intersection's traffic control.

PM Peak Hour

- Plains Road at Waterdown Road:
  - Eastbound left-turn operating with a queue length greater than the current available storage.
  - Westbound queue length spilling back into the Cooke Boulevard intersection.
  - Northbound left-turn operating with a queue length greater than the current available storage.
  - Southbound right-turn operating with a queue length greater than the current available storage.
- Plains Road at Cooke Boulevard
  - Westbound queue length spilling back into the Clearview Avenue/Birchwood Avenue intersection.
- Plains Road East at Clearview Avenue/Birchwood Avenue
  - Southbound approach operating with delays in LOS D range.
- Waterdown Road at Masonry Court
  - Eastbound left-turn operating with a queue length greater than the current available storage.
  - Southbound left-turn operating with a queue length greater than the current available storage.
- Cooke Boulevard at Masonry Court
  - Northbound approach is over capacity. Improvements to the existing form of two-way stop control should be considered. **Section 5.1** reviews the intersection's traffic control.

Appendix G contains the supporting detailed Synchro 9 output

The above noted capacity deficiencies are forecast to occur under the future background condition, these deficiencies are not related, nor are a result of the development of the subject site.

TABLE 4.2: BACKGROUND TRAFFIC OPERATIONS – FULL BUILD-OUT

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	Plains Rd E & Waterdown Rd	TCS	LOS	F	C	>	**E**	D	E	>	**E**	D	E	>	**D**	F	C	E	**F**	**E**
			Delay	130	25	>	**63**	45	66	>	**64**	36	56	>	**53**	262	35	76	**133**	**71**
			V/C	1.19	0.79	>		0.64	0.96	>		0.24	0.83	>		1.40	0.27	0.13		**1.22**
			Q	314	186	>		16	114	>		24	134	>		87	43	29		
			Ex	30	165	>		40	120	>		30	95	>		315	315	40		
			Avail.	-284	-21	>		24	7	>		7	-39	>		228	272	12		
	Plains Rd E & Cooke Boulevard	TCS	LOS	A	A		**A**		A	>	**A**					D		>	**D**	**A**
			Delay	7	2		**3**		10	>	**10**					48		>	**48**	**7**
			V/C	0.60	0.49				0.37	>						0.56		>		**0.59**
			Q	8	17				77	>						38		>		
			Ex	40	120				120	>						315		>		
			Avail.	32	103				43	>						277		>		
	Plains Rd E & Clearview Ave/Birchwood Ave	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	B	>	**B**	<	C	>	**C**	
			Delay	<	0	>	**0**	<	1	>	**1**	<	12	>	**12**	<	16	>	**16**	
			V/C	<	0.36	>		<	0.21	>		<	0.05	>		<	0.14	>		
			Q	<	0	>		<	0	>		<	1	>		<	4	>		
			Ex	<	120	>		<	90	>		<	120	>		<	180	>		
			Avail.	<	120	>		<	90	>		<	119	>		<	176	>		
	Waterdown Rd & Masonry Crt	TCS	LOS	<	F	>	**F**	D	D	>	**D**	C	F	>	**F**	F	A	>	**F**	**F**
			Delay	<	233	>	**233**	44	45	>	**45**	20	110	>	**110**	124	4	>	**84**	**93**
			V/C	<	1.09	>		0.07	0.21	>		0.04	1.17	>		1.18	0.18	>		**1.16**
			Q	<	34	>		10	0	>		1	183	>		358	22	>		
			Ex	<	-	>		15	120	>		20	315	>		15	345	>		
			Avail.	<	-	>		5	120	>		19	132	>		-343	323	>		
	Cooke Blvd & Masonry Crt	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	F	>	**F**	<	F	>	**F**	
			Delay	<	1	>	**1**	<	9	>	**9**	<	Err	>	**Err**	<	Err	>	**Err**	
			V/C	<	0.01	>		<	0.27	>		<	####	>		<	Err	>		
			Q	<	0	>		<	8	>		<	Err	>		<	Err	>		
			Ex	<	120	>		<	300	>		<	315	>		<	-	>		
			Avail.	<	120	>		<	292	>		<	315	>		<	-	>		
PM Peak Hour	Plains Rd E & Waterdown Rd	TCS	LOS	E	B	>	**C**	B	C	>	**C**	D	D	>	**D**	E	C	D	**D**	**D**
			Delay	69	17	>	**30**	12	34	>	**33**	38	37	>	**37**	62	23	50	**48**	**36**
			V/C	0.92	0.43	>		0.22	0.97	>		0.56	0.47	>		0.94	0.38	0.87		**0.95**
			Q	88	74	>		5	221	>		41	61	>		48	39	125		
			Ex	30	165	>		40	120	>		30	95	>		315	315	40		
			Avail.	-58	91	>		35	-101	>		-11	35	>		267	276	-85		
	Plains Rd E & Cooke Boulevard	TCS	LOS	B	A		**A**		B	>	**B**					D		>	**D**	**B**
			Delay	14	5		**6**		13	>	**13**					45		>	**45**	**13**
			V/C	0.30	0.35				0.68	>						0.67		>		**0.67**
			Q	5	37				149	>						68		>		
			Ex	40	120				120	>						315		>		
			Avail.	35	83				-29	>						247		>		
	Plains Rd E & Clearview Ave/Birchwood Ave	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	B	>	**B**	<	D	>	**D**	
			Delay	<	1	>	**1**	<	1	>	**1**	<	11	>	**11**	<	27	>	**27**	
			V/C	<	0.29	>		<	0.51	>		<	0.03	>		<	0.12	>		
			Q	<	1	>		<	1	>		<	1	>		<	3	>		
			Ex	<	120	>		<	90	>		<	120	>		<	180	>		
			Avail.	<	119	>		<	89	>		<	119	>		<	177	>		
	Waterdown Rd & Masonry Crt	TCS	LOS	<	C	>	**C**	C	D	>	**D**	B	B	>	**B**	B	B	>	**B**	**C**
			Delay	<	25	>	**25**	27	41	>	**40**	14	16	>	**16**	13	13	>	**13**	**22**
			V/C	<	0.05	>		0.23	0.77	>		0.05	0.38	>		0.42	0.42	>		**0.57**
			Q	<	1	>		22	91	>		3	73	>		40	92	>		
			Ex	<	-	>		15	120	>		20	315	>		15	345	>		
			Avail.	<	-	>		-7	29	>		17	243	>		-25	253	>		
	Cooke Blvd & Masonry Crt	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	F	>	**F**	<	D	>	**D**	
			Delay	<	1	>	**1**	<	4	>	**4**	<	872	>	**872**	<	30	>	**30**	
			V/C	<	0.04	>		<	0.15	>		<	2.73	>		<	0.19	>		
			Q	<	1	>		<	4	>		<	208	>		<	5	>		
			Ex	<	120	>		<	300	>		<	315	>		<	-	>		
			Avail.	<	119	>		<	296	>		<	107	>		<	-	>		

Avail. - Available Storage
Delay - Average Delay per Vehicle in Seconds
Ex. - Existing Available Storage (Turn lane or segment length)
LOS - Level of Service
MOE - Measure of Effectiveness
Q - 95th Percentile Queue Length
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
V/C - Volume to Capacity Ratio
< - Shared Left-turn
> - Shared Right-turn

4.3 Total Traffic Operations

4.3.1 Phase 1

The study area intersection operations analyses for the total traffic forecast followed the same methodology used for background conditions. Signal timings have been optimized. **Table 4.3** summarizes the level of service conditions.

The capacity deficiencies forecast to occur under the future background condition are expected to continue to occur with the addition of site generated traffic. Minor increase in delay and queueing is expected as a result of the addition of the site-generated traffic. No additional critical movements are noted as a result of the addition of the site-generated traffic.

Driveway approach to Plains Road East is operating with delays in LOS C-D range with a v/c ratio of less than 0.20. Queue lengths are in the order of 20 metres.

The westbound left-turn movement into the subject site is forecast to operate with delays in the LOS A range with a v/c ratio of less than 0.10. The eastbound left-turn queue length is less than 15 metres.

Appendix H contains the supporting detailed Synchro 9 output



TABLE 4.3: TOTAL TRAFFIC OPERATIONS – PHASE 1

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	Plains Rd E & Waterdown Rd	TCS	LOS	F	C	>	**E**	D	E	>	**E**	C	D	>	**D**	F	C	C	**F**	**E**
			Delay	170	28	>	**78**	46	66	>	**64**	32	46	>	**44**	217	32	31	**100**	**74**
			V/C	1.29	0.84	>		0.63	0.94	>		0.22	0.78	>		1.30	0.26	0.13		**1.25**
			Q	305	187	>		15	108	>		21	110	>		78	38	17		
			Ex	30	165	>		40	120	>		30	95	>		315	315	40		
			Avail.	-275	-22	>		25	12	>		9	-15	>		237	277	23		
	Plains Rd E & Cooke Boulevard	TCS	LOS	A	A	>	**A**	A	B	>	**B**	<	D	>	**D**	<	D	>	**D**	**A**
			Delay	8	5	>	**6**	9	10	>	**10**	<	37	>	**37**	<	37	>	**37**	**9**
			V/C	0.60	0.50	>		0.01	0.39	>		<	0.17	>		<	0.46	>		**0.57**
			Q	31	78	>		2	76	>		<	15	>		<	26	>		
			Ex	40	120	>		15	120	>		<	-	>		<	315	>		
			Avail.	9	42	>		13	44	>		<	-	>		<	289	>		
	Plains Rd E & Clearview Ave/Birchwood Ave	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	B	>	**B**	<	C	>	**C**	
			Delay	<	0	>	**0**	<	1	>	**1**	<	12	>	**12**	<	16	>	**16**	
			V/C	<	0.36	>		<	0.21	>		<	0.05	>		<	0.13	>		
			Q	<	0	>		<	0	>		<	1	>		<	4	>		
			Ex	<	120	>		<	90	>		<	120	>		<	180	>		
			Avail.	<	120	>		<	90	>		<	119	>		<	176	>		
	Waterdown Rd & Masonry Crt	TCS	LOS	<	F	>	**F**	D	D	>	**D**	B	E	>	**E**	F	A	>	**F**	**F**
			Delay	<	148	>	**148**	37	38	>	**38**	20	63	>	**63**	189	3	>	**127**	**90**
			V/C	<	0.90	>		0.07	0.21	>		0.03	1.03	>		1.34	0.18	>		**1.26**
			Q	<	28	>		8	20	>		4	194	>		328	20	>		
			Ex	<	-	>		15	120	>		20	315	>		15	345	>		
			Avail.	<	-	>		7	100	>		16	121	>		-313	325	>		
	Cooke Blvd & Masonry Crt	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	F	>	**F**	<	F	>	**F**	
			Delay	<	1	>	**1**	<	10	>	**10**	<	Err	>	**Err**	<	Err	>	**Err**	
			V/C	<	0.01	>		<	0.27	>		<	####	>		<	Err	>		
			Q	<	0	>		<	9	>		<	Err	>		<	Err	>		
			Ex	<	120	>		<	300	>		<	315	>		<	-	>		
			Avail.	<	120	>		<	291	>		<	Err	>		<	-	>		
PM Peak Hour	Plains Rd E & Waterdown Rd	TCS	LOS	E	B	>	**C**	B	D	>	**D**	D	D	>	**D**	F	D	D	**E**	**D**
			Delay	69	17	>	**29**	16	44	>	**43**	46	44	>	**45**	158	38	37	**70**	**46**
			V/C	0.92	0.44	>		0.22	0.96	>		0.67	0.62	>		1.19	0.46	0.36		**1.01**
			Q	66	84	>		14	281	>		42	65	>		82	54	30		
			Ex	30	165	>		40	120	>		30	95	>		315	315	40		
			Avail.	-36	81	>		26	-161	>		-12	30	>		234	261	10		
	Plains Rd E & Cooke Boulevard	TCS	LOS	B	A	>	**A**	A	B	>	**B**	<	C	>	**C**	<	D	>	**D**	**B**
			Delay	14	7	>	**7**	9	16	>	**16**	<	31	>	**31**	<	42	>	**42**	**15**
			V/C	0.33	0.39	>		0.07	0.75	>		<	0.09	>		<	0.70	>		**0.73**
			Q	8	58	>		7	177	>		<	11	>		<	59	>		
			Ex	40	120	>		15	120	>		<	-	>		<	315	>		
			Avail.	32	62	>		8	-57	>		<	-	>		<	256	>		
	Plains Rd E & Clearview Ave/Birchwood Ave	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	B	>	**B**	<	D	>	**D**	
			Delay	<	1	>	**1**	<	1	>	**1**	<	11	>	**11**	<	28	>	**28**	
			V/C	<	0.29	>		<	0.51	>		<	0.03	>		<	0.13	>		
			Q	<	1	>		<	1	>		<	1	>		<	3	>		
			Ex	<	120	>		<	90	>		<	120	>		<	180	>		
			Avail.	<	119	>		<	89	>		<	119	>		<	177	>		
	Waterdown Rd & Masonry Crt	TCS	LOS	<	C	>	**C**	C	D	>	**D**	B	B	>	**B**	B	B	>	**B**	**C**
			Delay	<	25	>	**25**	26	45	>	**43**	15	18	>	**18**	12	11	>	**11**	**23**
			V/C	<	0.07	>		0.22	0.84	>		0.06	0.38	>		0.41	0.43	>		**0.60**
			Q	<	1	>		25	130	>		6	64	>		29	68	>		
			Ex	<	-	>		15	120	>		20	315	>		15	345	>		
			Avail.	<	-	>		-10	-10	>		14	251	>		-14	277	>		
	Cooke Blvd & Masonry Crt	TWSC	LOS	<	A	>	**A**	<	A	>	**A**	<	F	>	**F**	<	D	>	**D**	
			Delay	<	1	>	**1**	<	4	>	**4**	<	841	>	**841**	<	27	>	**27**	
			V/C	<	0.03	>		<	0.15	>		<	2.67	>		<	0.17	>		
			Q	<	1	>		<	4	>		<	205	>		<	5	>		
			Ex	<	120	>		<	300	>		<	315	>		<	-	>		
			Avail.	<	119	>		<	296	>		<	110	>		<	-	>		

Avail. - Available Storage
Delay - Average Delay per Vehicle in Seconds
Ex. - Existing Available Storage (Turn lane or segment length)
LOS - Level of Service
MOE - Measure of Effectiveness
Q - 95th Percentile Queue Length
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
V/C - Volume to Capacity Ratio
< - Shared Left-turn
> - Shared Right-turn

4.3.2 Full Build-Out

The study area intersection operations analyses for the total traffic forecast followed the same methodology used for background conditions. Signal timings have been optimized. **Table 4.4** summarizes the level of service conditions.

The capacity deficiencies forecast to occur under the future background condition are expected to continue to occur with the addition of site generated traffic. Minor increase in delay and queueing is expected as a result of the addition of the site-generated traffic. No additional critical movements are noted as a result of the addition of the site-generated traffic.

Driveway approach to Plains Road East is operating with delays in LOS D range with a v/c ratio of less than 0.45. The 95th percentile queue length is less than 30 metres.

The westbound left-turn movement into the subject site is forecast to operate with delays in the LOS A-B range with a v/c ratio of less than 0.25. The eastbound left-turn queue length is less than 15 metres.

Appendix I contains the supporting detailed Synchro 9 output



TABLE 4.4: TOTAL TRAFFIC OPERATIONS – FULL BUILD-OUT

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	Plains Rd E & Waterdown Rd	TCS	LOS	F	C	>	F	D	E	>	E	C	D	>	D	F	C	C	F	E
			Delay	176	29	>	81	49	74	>	72	32	47	>	45	234	32	31	107	79
			V/C	1.30	0.85	>		0.67	0.98	>		0.22	0.79	>		1.35	0.26	0.13		1.27
			Q	308	191	>		16	116	>		21	114	>		82	38	17		
			Ex	30	165	>		40	120	>		30	95	>		315	315	40		
			Avail.	-278	-26	>		24	4	>		9	-19	>		233	277	23		
	Plains Rd E & Cooke Boulevard	TCS	LOS	A	A	>	A	A	B	>	B	<	D	>	D	<	D	>	D	A
			Delay	8	5	>	6	9	10	>	10	<	40	>	40	<	37	>	37	10
			V/C	0.61	0.51	>		0.03	0.40	>		<	0.44	>		<	0.48	>		0.58
			Q	31	81	>		4	77	>		<	28	>		<	25	>		
			Ex	40	120	>		15	120	>		<	-	>		<	315	>		
			Avail.	9	39	>		11	43	>		<	-	>		<	290	>		
	Plains Rd E & Clearview Ave/Birchwood Ave	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	C	>	C	
			Delay	<	0	>	0	<	1	>	1	<	12	>	12	<	16	>	16	
			V/C	<	0.37	>		<	0.22	>		<	0.05	>		<	0.14	>		
			Q	<	0	>		<	0	>		<	1	>		<	4	>		
			Ex	<	120	>		<	90	>		<	120	>		<	180	>		
			Avail.	<	120	>		<	90	>		<	119	>		<	176	>		
	Waterdown Rd & Masonry Crt	TCS	LOS	<	F	>	F	D	D	>	D	B	E	>	E	F	A	>	F	F
			Delay	<	148	>	148	37	38	>	38	20	70	>	70	192	3	>	128	93
			V/C	<	0.90	>		0.07	0.22	>		0.03	1.05	>		1.34	0.18	>		1.26
			Q	<	28	>		8	21	>		4	200	>		331	21	>		
			Ex	<	-	>		15	120	>		20	315	>		15	345	>		
			Avail.	<	-	>		7	99	>		16	115	>		-316	324	>		
	Cooke Blvd & Masonry Crt	TWSC	LOS	<	A	>	A	<	A	>	A	<	F	>	F	<	F	>	F	
			Delay	<	1	>	1	<	10	>	10	<	Err	>	Err	<	Err	>	Err	
			V/C	<	0.01	>		<	0.27	>		<	####	>		<	Err	>		
			Q	<	0	>		<	9	>		<	Err	>		<	Err	>		
			Ex	<	120	>		<	300	>		<	315	>		<	-	>		
			Avail.	<	120	>		<	291	>		<	Err	>		<	-	>		
PM Peak Hour	Plains Rd E & Waterdown Rd	TCS	LOS	E	B	>	C	B	D	>	D	D	D	>	D	F	D	D	E	D
			Delay	69	17	>	29	16	52	>	50	46	44	>	45	186	38	37	79	51
			V/C	0.92	0.45	>		0.23	0.99	>		0.67	0.63	>		1.26	0.46	0.37		1.05
			Q	67	87	>		15	292	>		43	67	>		90	54	29		
			Ex	30	165	>		40	120	>		30	95	>		315	315	40		
			Avail.	-37	78	>		25	-172	>		-13	28	>		225	261	11		
	Plains Rd E & Cooke Boulevard	TCS	LOS	B	A	>	A	B	B	>	B	<	C	>	C	<	D	>	D	B
			Delay	14	7	>	7	10	17	>	16	<	32	>	32	<	42	>	42	16
			V/C	0.35	0.41	>		0.15	0.76	>		<	0.21	>		<	0.70	>		0.73
			Q	8	61	>		12	180	>		<	19	>		<	59	>		
			Ex	40	120	>		15	120	>		<	-	>		<	315	>		
			Avail.	32	59	>		3	-60	>		<	-	>		<	256	>		
	Plains Rd E & Clearview Ave/Birchwood Ave	TWSC	LOS	<	A	>	A	<	A	>	A	<	B	>	B	<	D	>	D	
			Delay	<	1	>	1	<	2	>	2	<	11	>	11	<	29	>	29	
			V/C	<	0.30	>		<	0.52	>		<	0.03	>		<	0.13	>		
			Q	<	1	>		<	1	>		<	1	>		<	4	>		
			Ex	<	120	>		<	90	>		<	120	>		<	180	>		
			Avail.	<	119	>		<	89	>		<	119	>		<	176	>		
	Waterdown Rd & Masonry Crt	TCS	LOS	<	C	>	C	C	D	>	D	B	B	>	B	B	B	>	B	C
			Delay	<	24	>	24	26	46	>	44	15	18	>	18	12	12	>	12	23
			V/C	<	0.07	>		0.22	0.85	>		0.06	0.39	>		0.42	0.45	>		0.61
			Q	<	1	>		25	134	>		6	66	>		29	70	>		
			Ex	<	-	>		15	120	>		20	315	>		15	345	>		
			Avail.	<	-	>		-10	-14	>		14	249	>		-14	275	>		
	Cooke Blvd & Masonry Crt	TWSC	LOS	<	A	>	A	<	A	>	A	<	F	>	F	<	D	>	D	
			Delay	<	1	>	1	<	4	>	4	<	877	>	877	<	28	>	28	
			V/C	<	0.03	>		<	0.15	>		<	2.74	>		<	0.17	>		
			Q	<	1	>		<	4	>		<	211	>		<	5	>		
			Ex	<	120	>		<	300	>		<	315	>		<	-	>		
			Avail.	<	119	>		<	296	>		<	104	>		<	-	>		

Avail. - Available Storage
Delay - Average Delay per Vehicle in Seconds
Ex. - Existing Available Storage (Turn lane or segment length)
LOS - Level of Service
MOE - Measure of Effectiveness
Q - 95th Percentile Queue Length
TCS - Traffic Control Signal
TWSC - Two-Way Stop Control
V/C - Volume to Capacity Ratio
< - Shared Left-turn
> - Shared Right-turn

5 Remedial Measures

5.1 Traffic Control Improvements

The operational analysis contained in **Section 4** (background traffic and total traffic conditions) suggests that the Masonry Court intersection with Cooke Boulevard will begin to experience higher levels of delay under the forecast background traffic volumes. This congestion is estimated to occur without the development of the subject site.

The GO Station parking lot expansion is forecast to generate a considerable number of new vehicle trips to this intersection. The City of Burlington should review the planned parking lot expansion and its impact on the overall road network.

To address the capacity related concerns the intersection has been assessed using the OTM Book 12[13] signal warrant guidelines to determine if the need for improvements to the existing form of two-way stop control is warranted.

Appendix J contains the signal warrant analysis and **Table 5.1** summarizes the warrant analysis. The criteria necessary to warrant the installation of a traffic control signal is not satisfied. OTM warrants must be 120% fulfilled for future conditions. No changes to the existing form of stop control is recommended.

It is recommended that the City of Burlington monitor the operations of the intersection to ensure an appropriate form of traffic control is in place.

TABLE 5.1: OTM WARRANT SUMMARY

Horizon Year	Warrant				Warranted
	1A	1B	2A	2B	
Base Year (Year 2020)	34%	43%	24%	52%	No
Background Phase 1 (Year 2024)	110%	112%	83%	92%	No
Background Phase 2 (Year 2025)	110%	113%	83%	93%	No
Total Phase 1 (Year 2024)	110%	113%	83%	93%	No
Total Phase 2 (Year 2025)	110%	114%	83%	95%	No

[13] Ontario Traffic Manual Book 12 – Traffic Signal

In the longer term as the Aldershot Intensification area develops, daily traffic volumes through this intersection may further increase and ultimately warrant the installation of traffic control signal.

6 Parking Justification

6.1 Proposed Parking Supply

The site statistics indicate a Phase 1 vehicle parking supply of 168 spaces (1.10 spaces per unit). At full build-out the site statistics indicate a total vehicle parking supply of 424 spaces (1.18 spaces per unit). 410 spaces are contained in the proposed two-level underground parking structure. The remaining spaces (14) are located at grade.

Table 6.1 summarizes the location and assignment of parking for each phase of development.

TABLE 6.1: PROPOSED PARKING SUPPLY

Location	Phase 1			Full Build-Out		
	Occupant	Visitor	Total	Occupant	Visitor	Total
Surface	0	14	**14**	0	14	**14**
Parking Level 1	77	0	**77**	190	0	**190**
Parking Level 2	95	0	**95**	220	0	**220**
Total	**172**	**14**	**186**	**410**	**14**	**424**
Rate	**1.02**	**0.08**	**1.11**	**1.14**	**0.04**	**1.18**

The parking supply is reduced when compared to the zoning by-law to complement the future intensification plans for the Mobility Hub. The Aldershot Mobility Hub envisions a dense walkable, bikeable and transit-oriented urban environment with a mix of land uses.

6.2 Zoning By-Law Requirements

The Zoning By-law 2020 parking requirements apply to the entire City of Burlington, including the low-density suburban areas and the denser urbanized environments such as the downtown and the other identified Intensification Areas in the City. The City recognizes the need to update the Zoning By-law to reflect modern trends in transportation and the different environments present throughout the city.

The City of Burlington's Zoning By-law 2020[14] prescribes parking ratios for apartment buildings for Occupants (O) and Visitors (V). The following parking ratios are noted:

[14] Zoning By-Law 2020/Part 1 - General Conditions and Provisions/2.0 General Provisions

- Minimum Parking Ratio
  - 1.25 occupant spaces per one-bedroom unit;
  - 1.50 occupant spaces per two-bedroom unit;
  - 1.75 occupant spaces per three or more-bedroom unit; and
  - 0.35 visitor spaces per unit.

Table 6.2 summarizes the site's Zoning By-law 2020 parking requirements for the current site concept plan.

The Phase 1 build out parking supply is considered deficient by 104 spaces (59 occupant and 45 visitor parking spaces) when compared to Zoning By-law 2020.

Overall, the site's parking supply is considered deficient by 199 spaces (112 occupant and 87 visitor parking spaces) when compared to Zoning By-law 2020.

TABLE 6.2: ZONING BY-LAW PARKING REQUIREMENT

Phase	Bedrooms	Units	Ratio	Calculation	Supply
Phase 1	1 Bedroom	51	1.25	64	205
	2 Bedroom	142	1.50	213	
	Visitor	193	0.35	68	48
	Subtotal			**345**	**253**
Full Build-Out	1 Bedroom	175	1.25	219	410
	2 Bedroom	185	1.50	278	
	Visitor	360	0.35	126	14
	Subtotal			**754**	**539**

6.3 City-Wide Parking Standards Review

The City of Burlington is updating the 30-year old Zoning By-law that regulates off-street parking requirements. The City of Burlington's City-Wide Parking Standards Review[15] report includes recommended parking ratios for various land uses throughout the city and provides unique ratios for sites located within Intensification Areas such as the subject site.

The City-Wide Parking Standards Review offers a parking ratio domain for Intensification Areas with maximum and minimum ratios defined.

[15] Burlington City-Wide Parking Standards Review Consolidated Report Prepared for City of Burlington by IBI Group, July 2017

The Burlington City-Wide Parking Standards Review survey data observed a maximum parking demand of 1.10 space per unit, with a maximum visitor demand of 0.10 space per unit. The recommended parking ratios for apartment units in an Intensification Area are noted as follows:

- Maximum Parking Ratios;
  - Occupant parking – 1.50 spaces per unit; and
  - Visitor parking – 0.25 spaces per unit.
- Minimum Parking Ratios; and
  - Occupant parking – 1.00 spaces per unit; and
  - Visitor parking – 0.25 spaces per unit.
- 1.00 space per 75 units is recommended to be reserved as "maintenance vehicle parking."

Table 6.3 summarizes the site's parking requirements

TABLE 6.3: CITY-WIDE PARKING STANDARDS - RATE

Land Use: Apartment Units (Intensification Area)	Number of Units	Ratio		Calculation		
		O	V	O	V	Total
Phase 1	168	1.00	0.25	168	42	**210**
Full Build-Out	360	1.00	0.25	360	90	**450**
Maintenance Vehicle Parking						**5**

The Phase 1 build out parking supply is considered deficient by 26 spaces (+4 occupant and 28 visitor parking spaces) when compared to the rates outlined in the City-Wide Parking Standards Review.

Overall, the site's parking supply is considered deficient by 26 spaces (50 occupant and 76 visitor parking spaces) when compared to the rates outlined in the City-Wide Parking Standards Review.

6.4 Vehicle Ownership

Vehicle ownership data from the Transportation Tomorrow Survey[16] (TTS) for zones surrounding GO Transit stations along the Lakeshore West line between Hamilton GO Centre and Port Credit (Mississauga) suggests that approximately 25% of residents living in apartments style units do not own a vehicle.

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Table 6.4 summarizes the vehicle ownership characteristics for apartment units. The survey data suggests that vehicle ownership for apartment units is approximately 0.94 vehicles per unit.

TABLE 6.4: VEHICLES PER HOUSEHOLD (2016 TTS)

Dwelling Unit Type	Number of Vehicles in Household					Total Vehicles
	0	1	2	3	4	
Apartment	0	19,434	11,194	1,188	272	32,088
Percentage	0%	61%	35%	4%	1%	100%
Vehicles per Unit	0.00	0.57	0.33	0.03	0.01	**0.94**

The parking demand for occupants is estimated to be 339 spaces. With 410 occupant spaces proposed, the site's occupant parking demand is estimated to be less than the proposed supply. The unassigned occupant spaces (71 spaces) could be reassigned to visitors. This would result in 85 visitor spaces or 0.24 spaces per unit. This ratio is very close to the visitor parking rate outlined in the City-Wide Parking Standards Review

The applicant intends to unbundle parking costs from unit costs. This allows residents to purchase a unit without a parking space. Unbundling of parking encourages active transportation and transit use choices and reduces the reliance on car ownership and decrease parking demand. This factor will impact parking demand far more than many other TDM measures.

6.5 Industry Parking Guidelines

There are numerous industry associations that are dedicated to the survey and review of parking requirements related to various land uses. These associations, such as the Institute of Transportation Engineers (ITE), collect, review, and publish information related to parking demand, supply, and appropriate design standards.

An accepted industry standard for the determination of potential parking demand is ITE's Parking Generation Manual[17]. ITE provides data on surveys across the USA and Canada of peak parking demand for different land uses.

ITE Parking Generation is generally regarded as the best source for measured parking demands other than local data collected at similar land uses.

[17] Institute of Transportation Engineers. Parking Generation Manual, 5th Edition

Land use code 221 (Multifamily Housing (Mid-Rise)) for sites located within half a mile (± 800 m) of rail transit is used to estimate the site's peak parking generation. **Table 6.5** summarizes the estimated peak parking generation for the subject site.

The site's parking demand is estimated to be between 302-323 spaces. With a supply of 424 spaces proposed, the site's parking demand is estimated to be less than the proposed supply. The site's parking demand is forecast to be contained on-site.

TABLE 6.5: ITE PARKING GENERATION

Land Use	Multifamily Housing (Mid-Rise) (221)
Variable	Bedrooms
Period	Weekday (Monday - Friday)
Setting	10:00 p.m. - 5:00 a.m.
Number of Studies:	13
Avg. Num. of Dwelling Units:	198
Average Rate:	0.61
Range of Rates:	0.42 - 1.25
33rd / 85th Percentile:	0.55 / 0.86
95% Confidence Interval:	***
Standard Deviation:	0.12
Coefficient of Variation:	20%
Fitted Curve Equation:	Ln(P) = 0.90 Ln(X) + 0.04
R2:	0.96
Calculated Parking Demand:	**Phase 1 | Phase 2**
Average Rate	**154 | 323**
Fitted Curve	**151 | 302**
Supply	**186 | 424**

6.6 Local Parking Survey Data

Another proven method of estimating parking demands is to survey existing sites with similar situational characteristics. Local surveys are perceived to be the best predictor of demands.

Paradigm collected parking data for apartment buildings within the City of Burlington. The parking utilization surveys were undertaken at three different residential sites:

- Site 1 – 551 Maple Avenue, Strata Condominiums. A 19-storey building with 186 units;

- Site 2 – 360 Pearl Street, 360 on Pearl Condominiums. A 17-storey building with 75 units; and
- Site 3 – 1284 Guelph Line, The Mod'rn Condominiums. A 4-storey building with 78 units.

Two of these sites; Sites 1 and 2, are in the City's Downtown Intensification Area while Site 3 is located outside of an Intensification Area just north of the Queen Elizabeth Way/403. Site 3 was also surveyed by the City as part of the City-Wide Parking Standard Review. Overall, 12 days of temporal data has been collected for occupant and visitor parking demands.

Parking demand data at these sites was collected in 15-minute intervals from 16:00 to 22:00 on weekdays (Tuesday-Thursday) between April and November 2016.

Published data by the Urban Land Institute[18] (ULI) recommends no monthly adjustment factor for residential land uses to account for seasonal variations and that the parking demand for residential occupants and visitors is consistent between weekday and weekend time periods. The data further notes that a peak visitor demand occurs between 19:00 and 22:00.

Overall, the collected parking utilization data is in line with industry standard data collection methods and is representative of parking demand at local multi-family buildings.

Table 6.6 details the observed parking demand ratios. Occupant parking demands range from 0.68 to 0.83 spaces per unit. Visitor parking demands range from 0.08 to 0.24 spaces per unit.

TABLE 6.6: OBSERVED PARKING DEMAND RATIOS

User Group	Site	Observation				Range	
		Day A	Day B	Day C	Day D	Min	Max
Occupant	Site 1	0.78	0.83	0.83	0.80	0.78	0.83
	Site 2	0.77	0.77	0.76	0.75	0.75	0.77
	Site 3	0.69	0.68	0.77	0.82	0.68	0.82
Occupant - Range						**0.68**	**0.83**
Visitor	Site 1	0.10	0.13	0.12	0.10	0.10	0.13
	Site 2	0.11	0.11	0.13	0.08	0.08	0.13
	Site 3	0.17	0.24	0.09	0.13	0.09	0.24
Visitor - Range						**0.08**	**0.24**

[18] Shared Parking Second Edition, Urban Land Institute

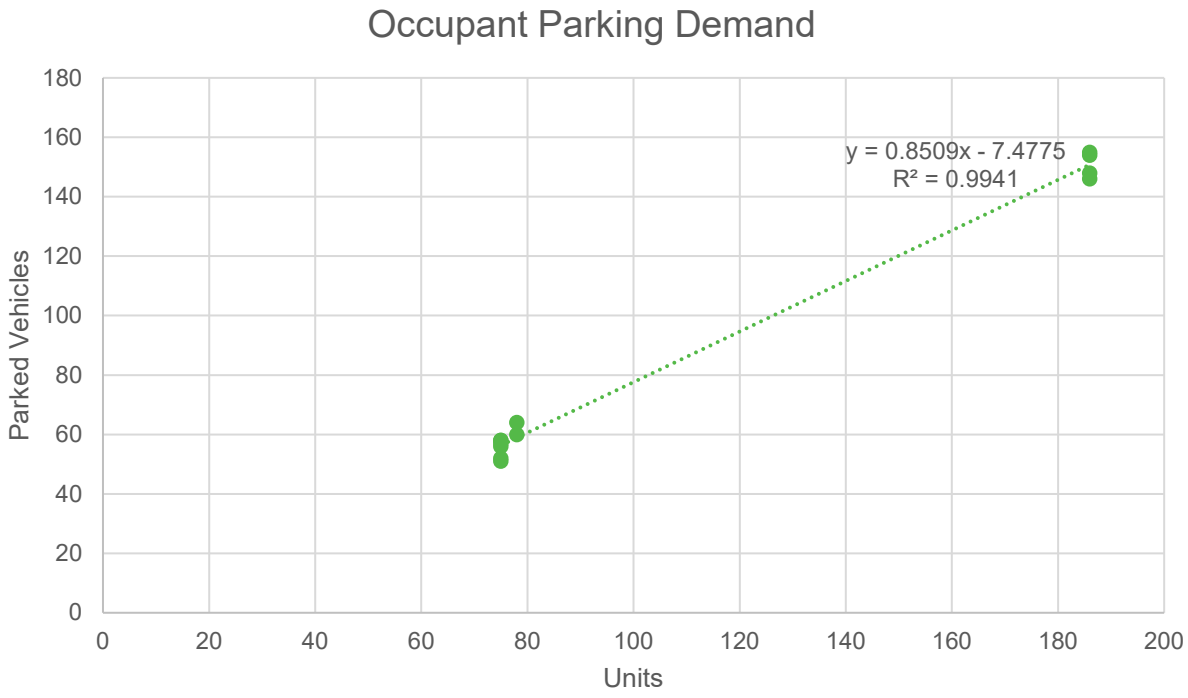
Figure 6.1 illustrates the data plots and the forecast parking demand for the occupant and visitor parking.

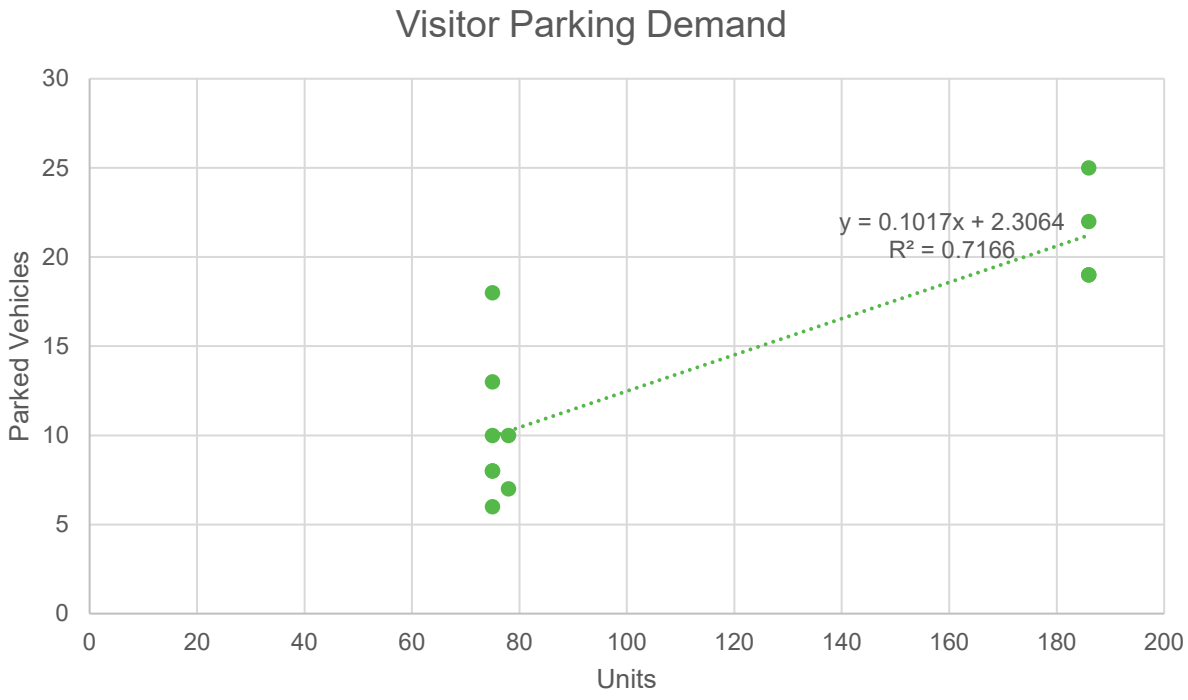
The coefficient of determination (R^2) for occupant parking is 0.99. The coefficient of determination for visitor parking is 0.71. As the R^2 value approaches 1.0 the better the fit; as the R^2 value approaches zero, the worse the fit.

With an R^2 value for occupant parking demand approaching 0.99 there is a good correlation between the variables. With an R^2 value of 0.71 for visitor parking, 71% of the variance in the number of parked cars is accounted for by the variance in the size of the independent variable.

Based on the Burlington market parking utilization studies the forecast parking demand for the subject site is estimated to be approximately 299 occupant parking spaces and 39 visitor parking spaces. This equates to an overall parking ratio of 0.94 spaces per unit or 338 parking spaces.

With at total of 424 parking spaces proposed on site, the site's parking demand is estimated to be less than the proposed supply based on this methodology. The site's parking demand would be fully contained on site. The allocation of parking between occupants and visitors needs to be adjusted. A minimum of 39 visitor parking spaces is recommended.





paradigm TRANSPORTATION SOLUTIONS LIMITED

Occupant & Visitor Parking Data Plots

6.7 Parking Reduction

The City of Burlington currently does not have a checklist or other sources to determine potential reductions in parking due to the provision of TDM measures. The Region of Waterloo TDM Checklist quantifies estimated parking reductions.

The Region of Waterloo TDM Checklist[19] was reviewed to determine potential parking reductions based on the TDM plan outlined in **Section 3.3**.

With the TDM measures proposed, the site's potential parking reduction is calculated to be 9% of the parking requirement. The reduction in parking is related to:

- **Pedestrian & Cyclist Orientation – 1% reduction**
  - Development incorporates functional building entrances that are oriented to public space or to locations where pedestrians and transit users arrive from such as a street, square, park, or plaza – 1% reduction
- **Parking – 3% reduction**
  - 75% of parking or more is located underground or in a structure – 3% reduction
- **Trip Reduction Incentives – 5% reduction**
  - The building owner/occupant agrees to charge for parking as a separate cost to occupants – 5% reduction.

A 9% reduction to the City Wide Parking Standards rates results in a parking requirement of 409 spaces. With 424 spaces proposed the site's parking demand is estimated to be less than the proposed supply. The site's parking demand is forecast to be contained on-site.

Appendix K contains the Region of Waterloo TDM Checklist.

[19] Region of Waterloo Report P-13-088, Proposed Revisions to the Regional Transportation Impact Study Guidelines, September 10, 2013

6.8 Summary of Parking Demand Estimates

The development program requires 623 parking spaces to comply with the minimum parking requirement of the Zoning By-law. With 424 spaces provided, the site is deficient by approximately 199 parking spaces or 31% of the Zoning By-law.

The City of Burlington is updating the 30-year old Zoning By-law that regulates off-street parking requirements. The City of Burlington's City-Wide Parking Standards Review recommended a parking supply of 360 spaces for occupant and 90 spaces for visitors (450 total spaces). The site's occupant parking requirement is greater than the proposed supply.

Vehicle ownership data from the TTS for zones surrounding GO Transit stations along the Lakeshore West line suggests a vehicle ownership rate 0.94 spaces per apartment unit. The parking demand for occupants is estimated to be 339 spaces. With 410 occupant spaces proposed, the site's occupant parking demand is estimated to less than the proposed supply. The unassigned occupant spaces (71 spaces) could be reassigned to visitors. This would result in 85 visitor spaces or 0.24 spaces per unit. This ratio is very close to the visitor parking rate outlined in the City-Wide Parking Standards Review

Published data by ITE estimates the site's overall parking demand (occupants + visitors) to be 302-323 spaces. The site's parking supply is greater than the forecast demand.

Based on the Burlington market parking utilization studies the forecast parking demand for the subject site is estimated to be 299 occupant parking spaces and 39 visitor parking spaces. The site's parking demand would be fully contained on site. The allocation of parking between occupants and visitors needs to be adjusted to provide for at least 39 spaces.

The transition from an automobile-dependent environment to one that is transit-supportive will require strategies to assist in shifting modal split and enabling the emergence of a pedestrian-friendly and transit-supportive environment through TDM measures.

The City of Burlington currently does not have a checklist or other sources to determine potential reductions in parking due to the provision of TDM measures. The Region of Waterloo TDM Checklist quantifies estimated parking reductions.

To support the proposed parking supply, a shift in travel modes and vehicle ownership for residents plus the integration of TDM measures



will be critical to the development's success. The applicant intends to unbundle parking costs from residential unit costs. This allows residents to purchase a unit without a parking space thus lowering parking demand and the site's associated transportation impacts.

7 Conclusions and Recommendations

7.1 Conclusions

The main findings and conclusions of this study are as follows:

- **Study Area**: The intersections that form the study area include the Plains Road intersections with Waterdown Road, Cooke Boulevard, and Clearview Avenue/Birchwood Avenue and the Masonry Court intersections with Waterdown Road and Cooke Boulevard.
- **Existing Traffic Conditions**: The intersections within the study area are generally operating with acceptable levels of service during the AM and PM peak hours. Localized congestion is occurring for select turning movements at the Waterdown Road intersections with Masonry Court and Plains Road.
- **Forecast Traffic**: The forecast traffic volumes near the subject site have been assessed for a five-year horizon (Year 2029) beyond the anticipated opening date of the subject site (Year 2024). The likely future traffic volumes near the subject site are estimated to consist of:
  - Generalized background traffic growth;
  - Build-out of six adjacent development applications including the Aldershot GO parking lot expansion; and
  - Traffic generated by the subject site.
- **Background Traffic Conditions**: The localized congestion previously identified under existing conditions at Waterdown Road with Masonry Court and Plains Road is anticipated to continue to occur. In addition, high levels of delay are forecast to occur on the northbound and southbound approaches of Cooke Boulevard to Masonry Court. To address the forecast capacity issues, the City of Burlington should review the intersections form of traffic control.
- **Site Concept**: The proposed 9-storey mid-rise development contains 360 residential condominium units. Construction will occur in two phases. Phase 1 is estimated to be built-out by Year 2024 and contains 168 residential condominium units. Phase 2 is estimated to be built-out by Year 2025.
- **Site Generated Traffic**: Phase 1 is forecast to generate approximately 57 vehicle trips during the AM peak hour and approximately 73 vehicle trips during the PM peak hour.

The full build-out of the subject site is forecast to generate approximately 120 vehicle trips during the AM peak hour and approximately 152 vehicle trips during the PM peak hour.

- **Parking Supply**: 424 parking spaces are proposed to accommodate the site's parking demand. Occupant parking is proposed at 410 spaces (1.14 spaces per unit). Visitor parking is proposed at 14 spaces (0.04 spaces per unit).

  Relying on empirical survey data collected for the Burlington market, the forecast parking demand for the subject site is estimated to be less than the parking rates identified in the City-Wide Parking Standard review report.

  The parking demand for the subject site is estimated to be approximately 299 occupant parking spaces and 39 visitor parking spaces. This equates to an overall parking ratio of 0.94 spaces per unit or 338 parking spaces. The site's parking demand would be fully contained on site. The allocation of parking between occupants and visitors needs to be adjusted to provide for at least 39 spaces. To support the proposed parking supply the integration of TDM measures will be critical to the development's success.

- **Transportation Demand Management**: The site concept plan includes TDM measures intended to assist in mitigating the site's transportation and parking impacts.

- **Total Traffic Conditions**: The intersections within the study area are forecast to operate with levels of service like the background traffic condition. No new intersection capacity are noted to occur as a result of site generated traffic.

- **Remedial Measures**: Improvements to the existing form of two-way stop control should be considered at the intersection of Cooke Boulevard to Masonry Court. The need for traffic control improvements is driven by the forecast background traffic.

  The GO Station parking lot expansion is forecast to add considerable number of new vehicle trips to this intersection. The City of Burlington should review the planned parking lot expansion and its impact on the overall road network.

7.2 Recommendations

Based on the findings of this study, it is recommended that:

- Minor pavement marking changes should occur at the Plains Road East intersection with Cooke Boulevard. The existing centre two-way left-turn lane should be redesigned as a left-turn



lane. A minimum storage lane length of 15 metres should be provided to accommodate site generated traffic.

- The site's visitor parking supply be increased to provide for at least 39 spaces (0.10 spaces per unit).
- The TDM measures outline in **Section 3.3** be included in the final site plan. Some elements of the TDM plan can be designed directly into the site plan while other elements are amenities that can only be achieved after occupancy.
- The City of Burlington monitor the operation of the Masonry Court intersection with Cooke Boulevard to ensure an appropriate form of traffic control is provided to accommodate the future travel demands in the longer term. In the longer term as the Aldershot Intensification area develops, daily traffic volumes through this intersection may further increase and ultimately warrant the installation of traffic control signal.

Appendix A

Pre-Study Consultation

Scott Catton

From: Lucas, Steve <Steve.Lucas@burlington.ca>
Sent: Tuesday, 10 September, 2019 11:10 AM
To: Scott Catton; Ozimkovic , Danijel
Cc: Andrew Brown; Davren, Kerry
Subject: RE: 190488 (40-50 Plains Rd E TIA) Scope of Work

Hello Scott,

I hope your summer has gone well! With regards to your scope of work, our comments are as follows:

- Study Intersections:
  - Please include Birchwood Avenue @ Plains, Cooke Boulevard @ Masonry Court and Waterdown Road @ Masonry Court
- Growth Rate of 1% is acceptable
- Please ensure that any additional traffic counts are conducted on weekdays (Tuesday to Thursday), and if using older counts that they are less than 2 years old.
- Available TMC's to purchase (Please contact Florin Patrau for more details – florin.patrau@burlington.ca) :
  - Waterdown Road @ Masonry Court – June 21st, 2018
  - Plains Road @ Waterdown Road – September 18th , 2018
- On-going Development Applications:
  - https://www.burlington.ca/en/services-for-you/35-Plains-Road.asp
  - https://www.burlington.ca/en/services-for-you/vrancor-group---53-71-plains-road-east--1025-cooke-boulevard.asp
  - https://www.burlington.ca/en/services-for-you/92-Plains-Road-East.asp
  - https://www.burlington.ca/en/services-for-you/1085-clearview-ave.asp
  - https://www.burlington.ca/en/services-for-you/adi-development-group---101-masonry-crt.asp
  - Aldershot GO Parking Lot Expansion Project

If you have any comments or concerns, please get in touch with us.

Thank you,

Steve Lucas
City of Burlington | Transportation Planning Technologist
t: 905.335.7671 ext.7691 | e: steve.lucas@burlington.ca

From: Scott Catton <scatton@ptsl.com>
Sent: Wednesday, September 04, 2019 9:28 AM
To: Lucas, Steve <Steve.Lucas@burlington.ca>; Ozimkovic , Danijel <Danijel.Ozimkovic@burlington.ca>
Cc: Andrew Brown <abrown@ptsl.com>
Subject: 190488 (40-50 Plains Rd E TIA) Scope of Work

Hi Steve/Dan,
We've been retained to complete the Transportation Impact Assessment (TIA) for the proposed development of 40-50 Plains Road East.

The proposed land use is a 10-storey, 162-unit mid-rise apartment. A single driveway to Plains Road East is proposed. The driveway is aligned with the Cooke Boulevard CL per the City's pre-study comments. The site's

parking supply is currently noted as approximately 188 parking spaces (14 at grade spaces and 174 structured parking spaces). A copy of the current site plan is attached.

Can you please review the attached proposed scope of work for this study and provide comment at your earliest convenience?

Also, please provide input on the following items:

1. Is there any recent TMC data available at the study area intersections that would be appropriate for use in this study?
2. We've used a generalized 1.00% per annum growth rate for other studies in the area. Is this rate still appropriate?
3. There are several adjacent development applications in the immediate area. Please identify the specific development applications that should be considered in the traffic forecast.

We look forward to hearing back from you.

Thanks again.

Scott Catton, Dipl. T., C.E.T., MITE
Senior Project Manager

Paradigm Transportation Solutions Limited
5A-150 Pinebush Road, Cambridge, ON N1R 8J8
p: 905.381.2229 x302
e: scatton@ptsl.com
w: www.ptsl.com

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5A-150 Pinebush Road
Cambridge ON N1R 8J8
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519.896.3163

www.ptsl.com

04 September 2019
Project: 190438

Steve Lucas
City of Burlington
Transportation Services
steve.lucas@burlington.ca

Dear Mr. Lucas:

RE: SCOPE OF WORK – TRANSPORTATION IMPACT ASSESSMENT. PROPOSED MID-RISE MULTIFAMILY HOUSING, 40-50 PLAINS ROAD EAST, CITY OF BURLINGTON.

Paradigm Transportation Solutions Limited is pleased to submit the following scope of work to undertake a **Transportation Impact Assessment (TIA)** for the above-noted development proposal.

Project Understanding

The subject site is located at 40-50 Plains Road East in the City of Burlington. The property owner is proposing to develop the site to include a mid-rise multifamily housing building with approximately 162 units.

Vehicle access is proposed by a single private driveway to Plains Road East aligned with Cooke Boulevard. The site's parking supply is proposed to consist of approximately 188 parking spaces (14 at grade spaces and 174 structured parking spaces).

Based on our understanding of the proposal, we have assumed preparation of a TIA to evaluate the effects of the proposed development on the transportation system and recommend improvements, if necessary, to address potential impacts. The study will generally follow the Region of Halton's Traffic Impact Study Guidelines and any further direction provided by staff during pre-study consultation. The study area will comprise the following intersections:

- Plains Road East at Waterdown Road (signalized); and
- Plains Road East at Cooke Boulevard/site driveway (signalized).

Traffic forecasts and analysis will be completed for a five-year planning horizon following the anticipated opening date of the development (to be determined) and for two (2) analysis periods (weekday AM and PM peak hours).

Work Plan

The following outlines our proposed work plan to carry out this assignment:

Task 1 – Pre-Study Consultation and Data Assembly

We will contact the City of Burlington (the review agency) to request their feedback on the scope of work, study area and other assumptions.

We will gather available data, relevant background reports and any other information about the study area pertinent to the assessment (e.g. other approved developments in the vicinity, zoning by-law provisions).

We will visit the site to observe current traffic and parking conditions on roads in the study area. Roadway configuration and traffic control will be documented, with a figure illustrating the study area prepared. Other related features such as pedestrian and cycling facilities and transit stops will be noted.

We will conduct weekday 8-hour Turning Movement Counts (TMC) at the study area intersections.

Task 2 – Forecasting and Analysis

We will prepare vehicle traffic forecasts for each planning horizon and analysis period. The components of the forecasts are as follows:

- **Existing** 2019 volumes will be derived from the traffic counts collected in Task 1;
- **Future Background** volumes for the five-year horizon will be estimated by applying a growth rate to the Existing volumes and adding anticipated trips from nearby approved and in-stream developments. Growth rates and the specific developments to include in the background traffic forecasts will be confirmed with the review agency during Task 1; and
- Vehicle trips generated by the proposed development will be forecast based on the rates contained in the Institute of Transportation Engineers (ITE) Trip Generation Manual (10th Edition). These trips will be distributed and assigned to the study area intersections based on existing traffic patterns and/or Transportation Tomorrow Survey data. The resulting net site-generated traffic will be added to the Future Background estimates to produce **Future Total** volumes for each future horizon year and analysis period.

We will analyze the operation of the study area intersections for the Existing, Future Background (without the development) and Future Total (with the development) traffic conditions for each horizon year and analysis period using Synchro software. Volume-to-capacity (v/c) ratios, Level of Service (LOS) and queuing will be assessed.

Based on the analysis results, we will identify any operational deficiencies as well as the net impact of the proposed development on the study area road network. The need for road improvements (e.g., auxiliary turn lanes) and/or other mitigating measures (e.g., traffic control device modifications) to address deficiencies will be determined. We will assess whether these measures are required due to non-site traffic (i.e. Existing or Future Background) or the increase in volumes resulting from the proposed development (i.e. Future Total).

We will explore opportunities to reduce vehicular traffic volumes generated by the proposed development through non-auto mode use, including public transit, walking and cycling, and other potential TDM measures.

Task 3 – Report Preparation

We will document the study methodologies, findings and conclusions in a report for submission to the review agency. The final report will include appendices containing the detailed analysis results and any data collected.

Yours truly,

PARADIGM TRANSPORTATION SOLUTIONS LIMITED



Scott Catton, Dipl.T., C.E.T. MITE
Senior Project Manager



Stew Elkins, B.E.S., MITE
Vice President

Appendix B

Existing Count Data



Plains Rd @ Waterdown Rd

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 10:00:00

One Hour Peak
From: 7:15:00
To: 8:15:00

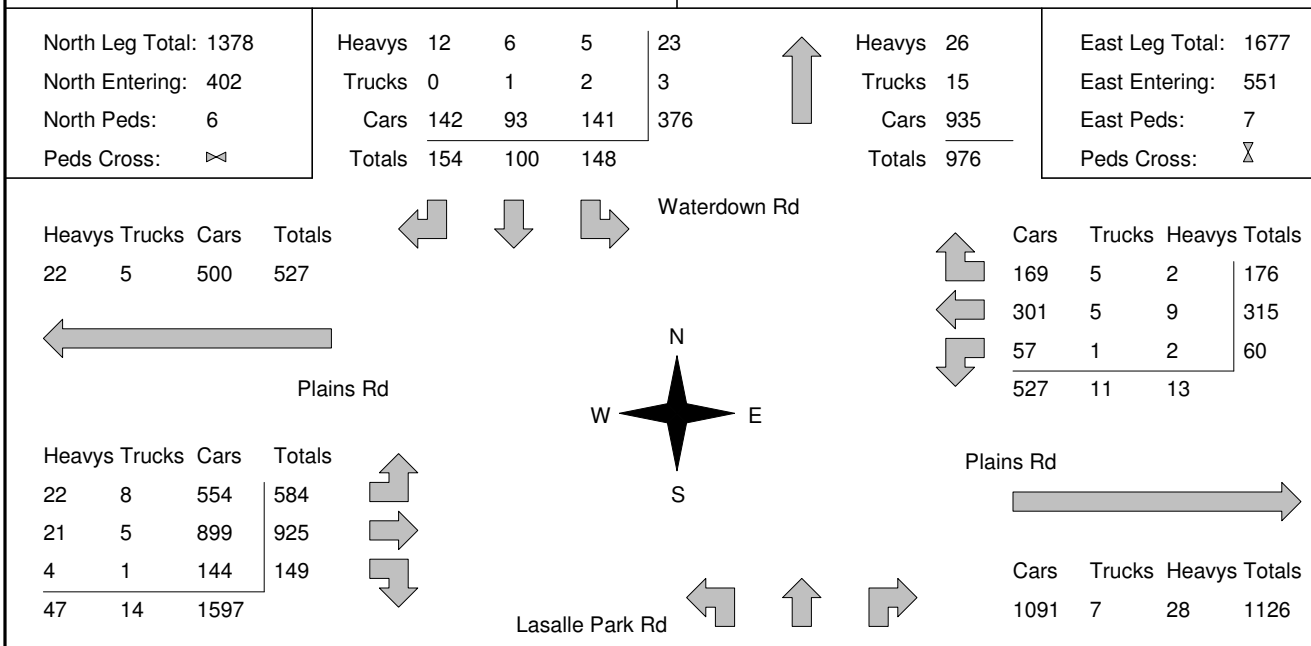
Municipality: Burlington
Site #: 0000000003
Intersection: Plains Rd & Waterdown Rd
TFR File #: 3
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Plains Rd runs W/E



Comments

Plains Rd @ Waterdown Rd

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 13:00:00

One Hour Peak
From: 12:00:00
To: 13:00:00

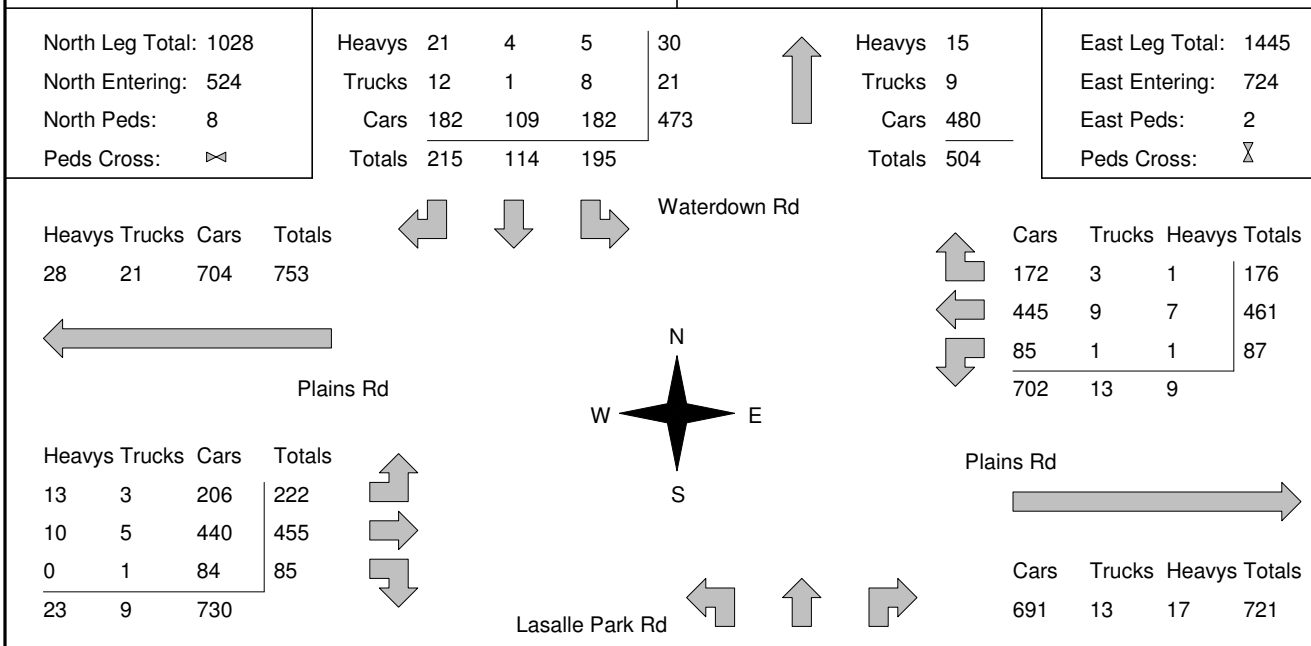
Municipality: Burlington
Site #: 0000000003
Intersection: Plains Rd & Waterdown Rd
TFR File #: 3
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Plains Rd runs W/E



Comments

Plains Rd @ Waterdown Rd

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:45:00
To: 17:45:00

Municipality: Burlington
Site #: 0000000003
Intersection: Plains Rd & Waterdown Rd
TFR File #: 3
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Plains Rd runs W/E

North Leg Total:	1263			
North Entering:	768			
North Peds:	3			
Peds Cross:	⋈			
Heavys	16	0	1	17
Trucks	1	0	0	1
Cars	390	154	206	750
Totals	407	154	207	
Heavys	13			
Trucks	5			
Cars	477			
Totals	495			
East Leg Total:	1992			
East Entering:	1223			
East Peds:	2			
Peds Cross:	⧖			

Waterdown Rd

Heavys	Trucks	Cars	Totals
22	13	1507	1542

Cars	Trucks	Heavys	Totals
164	1	5	170
981	9	6	996
56	0	1	57
1201	10	12	

Plains Rd

N
W E
S

Heavys	Trucks	Cars	Totals
8	1	183	192
4	1	510	515
0	2	93	95
12	4	786	

Plains Rd

Cars	Trucks	Heavys	Totals
763	1	5	769

Lasalle Park Rd

Peds Cross:	⧖			
West Peds:	12			
West Entering:	802			
West Leg Total:	2344			
Cars	303			
Trucks	2			
Heavys	1			
Totals	306			
Cars	136	130	47	313
Trucks	3	3	0	6
Heavys	0	0	0	0
Totals	139	133	47	
Peds Cross:	⋈			
South Peds:	19			
South Entering:	319			
South Leg Total:	625			

Comments

Plains Rd @ Waterdown Rd

Total Count Diagram

Municipality: Burlington
Site #: 0000000003
Intersection: Plains Rd & Waterdown Rd
TFR File #: 3
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Plains Rd runs W/E

North Leg Total:	9663			
North Entering:	4756			
North Peds:	60			
Peds Cross:	⋈			
Heavys	131	17	43	191
Trucks	30	13	27	70
Cars	1885	983	1627	4495
Totals	2046	1013	1697	
Heavys	174			
Trucks	80			
Cars	4653			
Totals	4907			
East Leg Total:	12933			
East Entering:	6278			
East Peds:	37			
Peds Cross:	⧖			

Waterdown Rd

Heavys	Trucks	Cars	Totals
226	89	6887	7202

Cars	Trucks	Heavys	Totals
1301	27	26	1354
4284	53	84	4421
490	7	6	503
6075	87	116	

Plains Rd

N
W E
S

Heavys	Trucks	Cars	Totals
131	39	2160	2330
88	33	4391	4512
17	8	682	707
236	80	7233	

Plains Rd

Cars	Trucks	Heavys	Totals
6455	61	139	6655

Lasalle Park Rd

Peds Cross:	⧖			
West Peds:	113			
West Entering:	7549			
West Leg Total:	14751			
Cars	2155			
Trucks	28			
Heavys	40			
Totals	2223			
Cars	718	1192	437	2347
Trucks	6	14	1	21
Heavys	11	17	8	36
Totals	735	1223	446	
Peds Cross:	⋈			
South Peds:	117			
South Entering:	2404			
South Leg Total:	4627			

Comments

Plains Rd @ Cooke Blvd

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 10:00:00

One Hour Peak
From: 7:30:00
To: 8:30:00

Municipality: Burlington
Site #: 0000000004
Intersection: Plains Rd & Cooke Blvd
TFR File #: 4
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

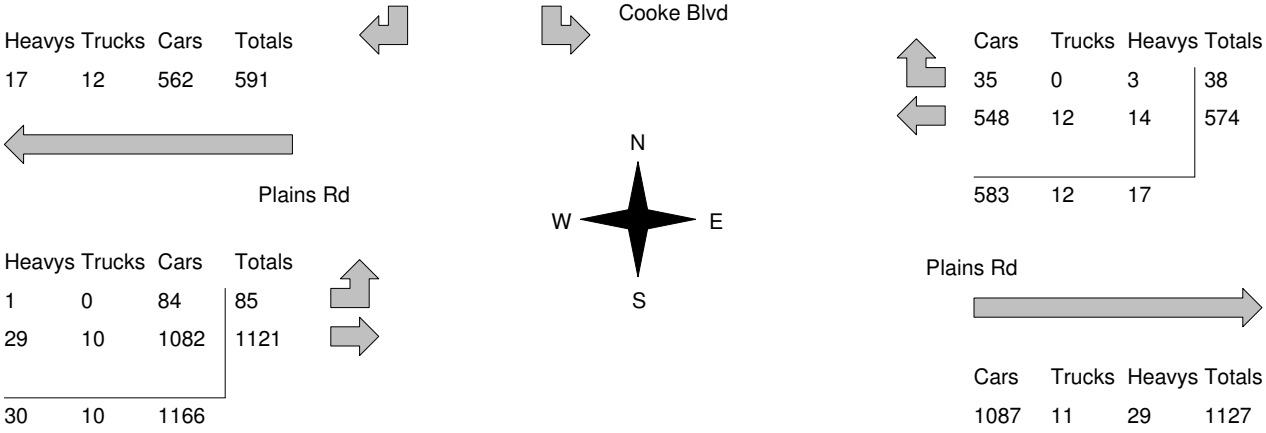
Major Road: Plains Rd runs W/E

North Leg Total: 146
North Entering: 23
North Peds: 4
Peds Cross: ⋈

Heavys	3	0	3
Trucks	0	1	1
Cars	14	5	19
Totals	17	6	

Heavys	4
Trucks	0
Cars	119
Totals	123

East Leg Total: 1739
East Entering: 612
East Peds: 2
Peds Cross: ⧖



Peds Cross: ⧖
West Peds: 3
West Entering: 1206
West Leg Total: 1797

Comments

Plains Rd @ Cooke Blvd

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 13:00:00

One Hour Peak
From: 12:00:00
To: 13:00:00

Municipality: Burlington
Site #: 0000000004
Intersection: Plains Rd & Cooke Blvd
TFR File #: 4
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

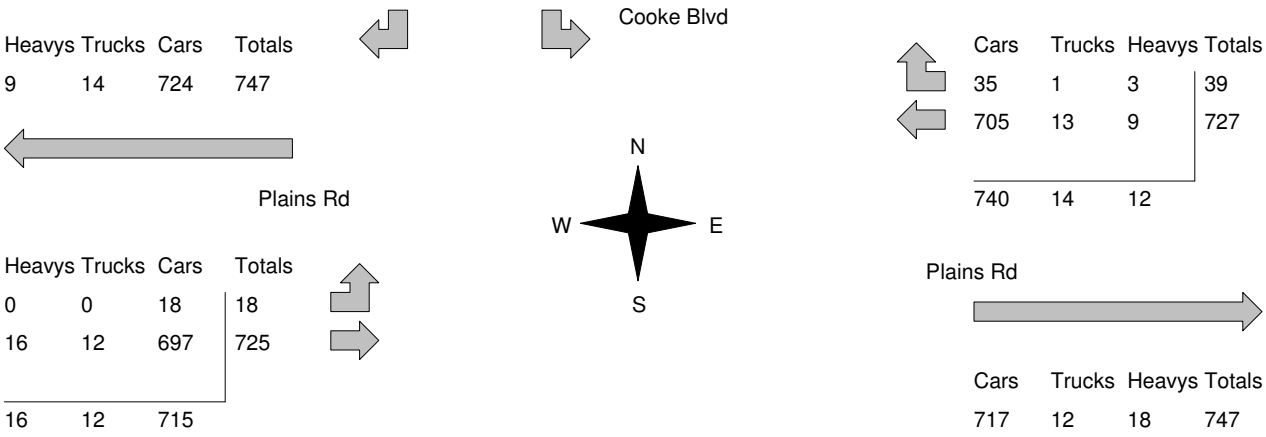
Major Road: Plains Rd runs W/E

North Leg Total: 99
North Entering: 42
North Peds: 15
Peds Cross: ⋈

Heavys	0	2	2
Trucks	1	0	1
Cars	19	20	39
Totals	20	22	

Heavys	3
Trucks	1
Cars	53
Totals	57

East Leg Total: 1513
East Entering: 766
East Peds: 8
Peds Cross: ⧖



Peds Cross: ⧖
West Peds: 17
West Entering: 743
West Leg Total: 1490

Comments

Plains Rd @ Cooke Blvd

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:45:00
To: 17:45:00

Municipality: Burlington
Site #: 0000000004
Intersection: Plains Rd & Cooke Blvd
TFR File #: 4
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

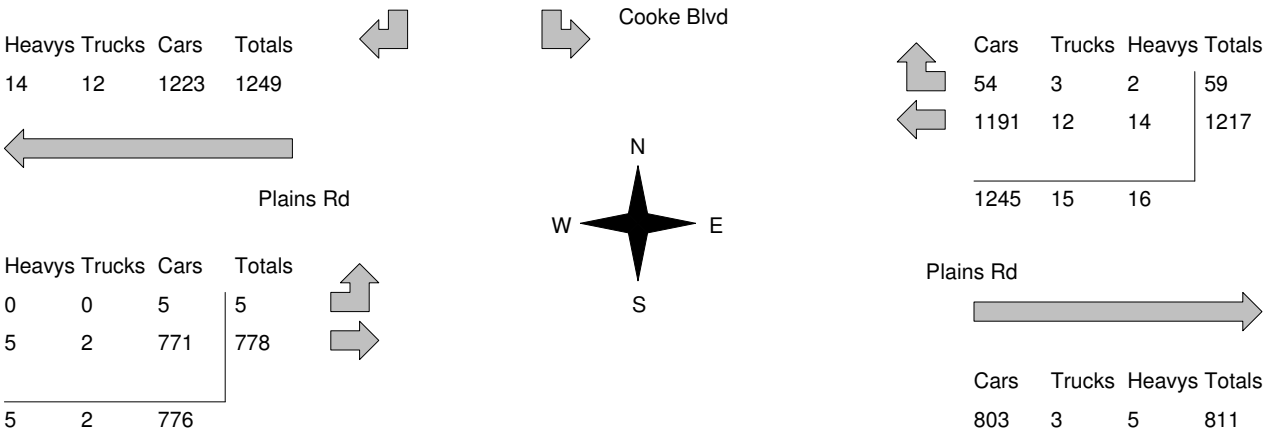
Major Road: Plains Rd runs W/E

North Leg Total: 129
North Entering: 65
North Peds: 5
Peds Cross: ⋈

Heavys	0	0	0
Trucks	0	1	1
Cars	32	32	64
Totals	32	33	

Heavys	2
Trucks	3
Cars	59
Totals	64

East Leg Total: 2087
East Entering: 1276
East Peds: 0
Peds Cross: ⧖



Peds Cross: ⧖
West Peds: 4
West Entering: 783
West Leg Total: 2032

Comments

Plains Rd @ Cooke Blvd

Total Count Diagram

Municipality: Burlington
Site #: 0000000004
Intersection: Plains Rd & Cooke Blvd
TFR File #: 4
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Plains Rd runs W/E

North Leg Total:	817		
North Entering:	317		
North Peds:	74		
Peds Cross:	⋈		

Heavys	5	3	8
Trucks	1	7	8
Cars	162	139	301
Totals	168	149	

Heavys	25
Trucks	9
Cars	466
Totals	500

East Leg Total:	13478
East Entering:	6585
East Peds:	21
Peds Cross:	⧖

Cooke Blvd

Heavys	Trucks	Cars	Totals
110	86	6272	6468

Cars	Trucks	Heavys	Totals
254	9	22	285
6110	85	105	6300
6364	94	127	

Plains Rd

N
W E
S

Heavys	Trucks	Cars	Totals
3	0	212	215
135	64	6545	6744
138	64	6757	

Plains Rd

Cars	Trucks	Heavys	Totals
6684	71	138	6893

Peds Cross:	⧖
West Peds:	44
West Entering:	6959
West Leg Total:	13427

Comments

Plains Rd E @ Birchwood Ave / Clearview Ave

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 10:00:00

One Hour Peak
From: 7:45:00
To: 8:45:00

Municipality: Burlington
Site #: 0000000001
Intersection: Plains Rd E & Birchwood Ave
TFR File #: 1
Count date: 10-Dec-2019

Weather conditions:
Clear/Dry, Flurries

Person(s) who counted:
Diane

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

Major Road: Plains Rd E runs W/E

North Leg Total: 18
North Entering: 13
North Peds: 0
Peds Cross: ⋈

Heavys	0	0	0	0
Trucks	1	0	0	1
Cars	10	0	2	12
Totals	11	0	2	

Heavys	0
Trucks	0
Cars	5
Totals	5

East Leg Total: 1537
East Entering: 539
East Peds: 0
Peds Cross: ⧖

Clearview Ave

Heavys	Trucks	Cars	Totals
11	26	508	545

Cars	Trucks	Heavys	Totals
0	0	0	0
496	25	11	532
6	1	0	7
502	26	11	

Plains Rd E

N
W E
S

Heavys	Trucks	Cars	Totals
0	0	5	5
5	32	937	974
0	0	8	8
5	32	950	

Plains Rd E

Cars	Trucks	Heavys	Totals
960	33	5	998

Birchwood Ave

Peds Cross: ⧖
West Peds: 0
West Entering: 987
West Leg Total: 1532

Cars	2	0	21	23
Trucks	0	0	1	1
Heavys	0	0	0	0
Totals	2	0	22	

Cars	14
Trucks	1
Heavys	0
Totals	15

Peds Cross: ⋈
South Peds: 9
South Entering: 24
South Leg Total: 39

Comments

Plains Rd E @ Birchwood Ave / Clearview Ave

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 13:00:00

One Hour Peak
From: 11:45:00
To: 12:45:00

Municipality: Burlington
Site #: 0000000001
Intersection: Plains Rd E & Birchwood Ave
TFR File #: 1
Count date: 10-Dec-2019

Weather conditions:
Clear/Dry, Flurries

Person(s) who counted:
Diane

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

Major Road: Plains Rd E runs W/E

	North Leg Total: 24			
	North Entering: 15			
	North Peds: 5			
	Peds Cross: ⋈			

Heavys	0	0	0	0
Trucks	1	0	0	1
Cars	10	1	3	14
Totals	11	1	3	

Heavys	0	
Trucks	0	
Cars	9	
Totals	9	

	East Leg Total: 1596			
	East Entering: 776			
	East Peds: 0			
	Peds Cross: ⧖			

Heavys	Trucks	Cars	Totals
5	25	739	769

Clearview Ave

Cars	Trucks	Heavys	Totals
6	0	0	6
728	24	5	757
13	0	0	13
747	24	5	

Plains Rd E

N
W E
S

Heavys	Trucks	Cars	Totals
0	0	3	3
1	20	789	810
0	0	6	6
1	20	798	

Plains Rd E

Cars	Trucks	Heavys	Totals
799	20	1	820

Birchwood Ave

	Peds Cross: ⧖			
	West Peds: 1			
	West Entering: 819			
	West Leg Total: 1588			

Cars	20			
Trucks	0			
Heavys	0			
Totals	20			

Cars	1	0	7	8
Trucks	0	0	0	0
Heavys	0	0	0	0
Totals	1	0	7	

	Peds Cross: ⋈			
	South Peds: 10			
	South Entering: 8			
	South Leg Total: 28			

Comments

Plains Rd E @ Birchwood Ave / Clearview Ave

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:45:00
To: 17:45:00

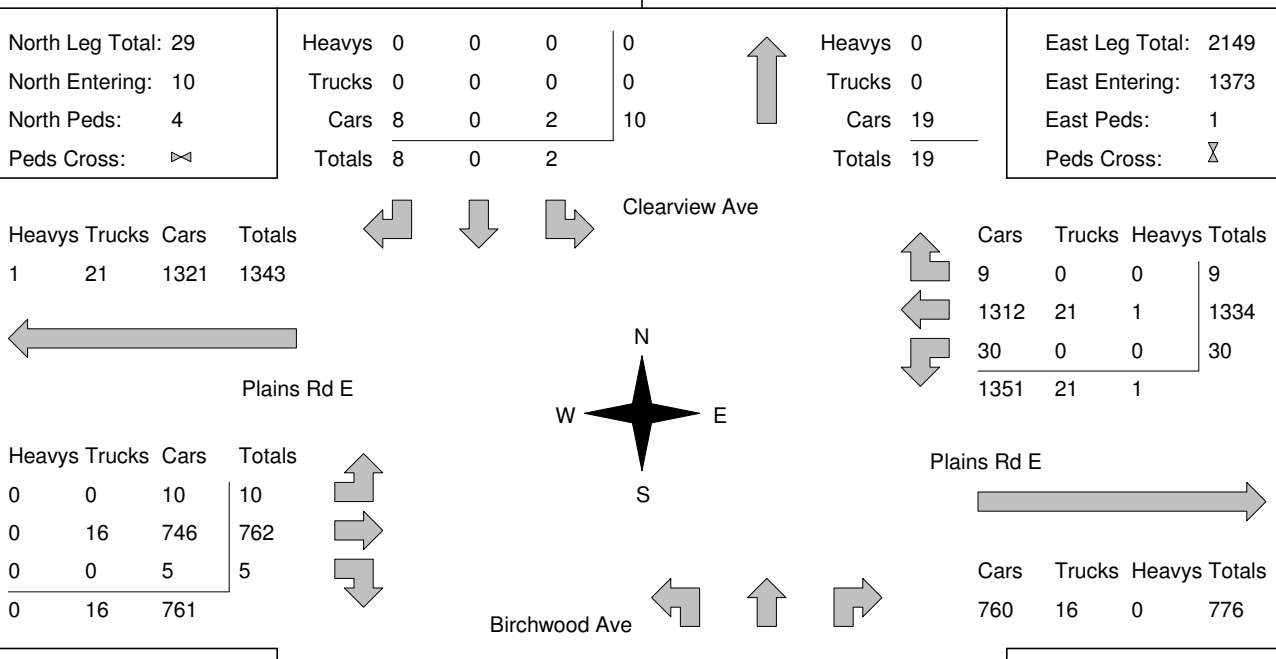
Municipality: Burlington
Site #: 0000000001
Intersection: Plains Rd E & Birchwood Ave
TFR File #: 1
Count date: 10-Dec-2019

Weather conditions:
Clear/Dry, Flurries

Person(s) who counted:
Diane

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

Major Road: Plains Rd E runs W/E



Comments

Plains Rd E @ Birchwood Ave / Clearview Ave

Total Count Diagram

Municipality: Burlington
Site #: 0000000001
Intersection: Plains Rd E & Birchwood Ave
TFR File #: 1
Count date: 10-Dec-2019

Weather conditions:
Clear/Dry, Flurries

Person(s) who counted:
Diane

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

Major Road: Plains Rd E runs W/E

North Leg Total:	195
North Entering:	110
North Peds:	42
Peds Cross:	⋈

Heavys	1	0	0	1
Trucks	5	0	0	5
Cars	72	1	31	104
Totals	78	1	31	

Heavys	0
Trucks	4
Cars	81
Totals	85

East Leg Total:	12946
East Entering:	6537
East Peds:	1
Peds Cross:	⧖

Clearview Ave

Heavys	Trucks	Cars	Totals
39	180	6273	6492

Cars	Trucks	Heavys	Totals
33	2	0	35
6187	175	38	6400
101	1	0	102
6321	178	38	

Plains Rd E

N
W E
S

Heavys	Trucks	Cars	Totals
0	2	48	50
39	200	6047	6286
0	2	49	51
39	204	6144	

Plains Rd E

Cars	Trucks	Heavys	Totals
6169	201	39	6409

Birchwood Ave

Peds Cross:	⧖
West Peds:	2
West Entering:	6387
West Leg Total:	12879

Cars	151			
Trucks	3			
Heavys	0			
Totals	154			

Cars	14	0	91	105
Trucks	0	0	1	1
Heavys	0	0	0	0
Totals	14	0	92	

Peds Cross:	⋈
South Peds:	55
South Entering:	106
South Leg Total:	260

Comments

Masonry Crt @ Waterdown Rd

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 10:00:00

One Hour Peak
From: 7:00:00
To: 8:00:00

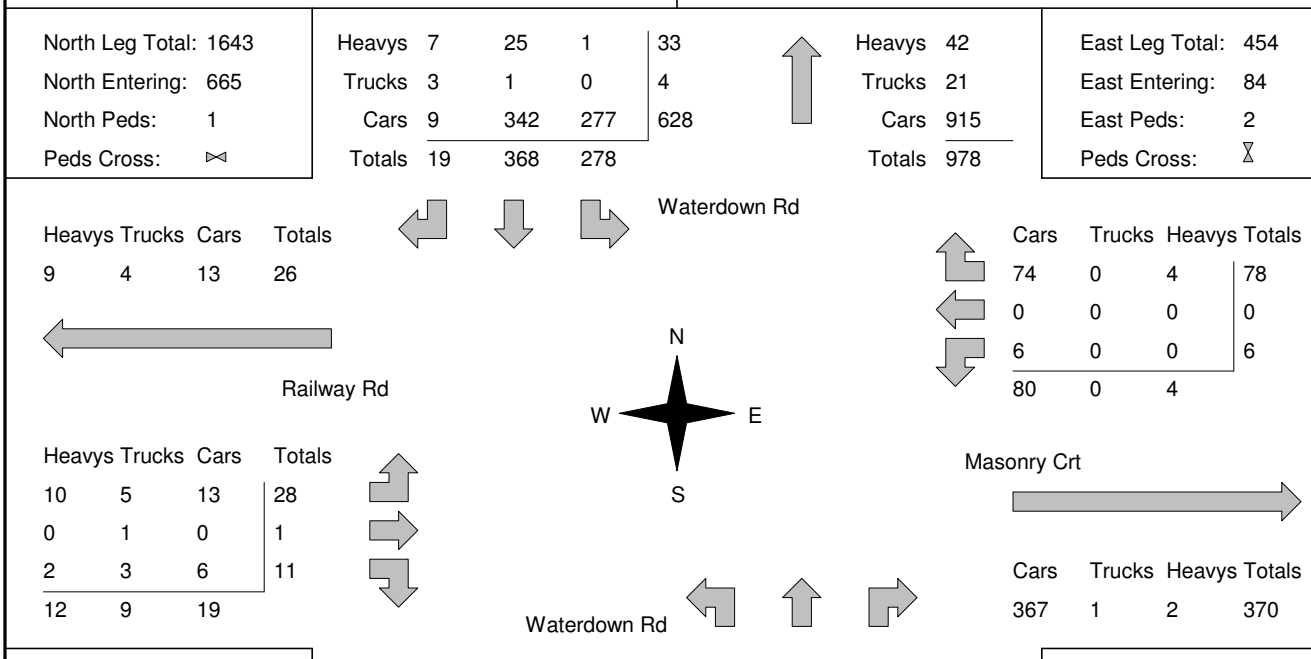
Municipality: Burlington
Site #: 0000000001
Intersection: Waterdown Rd & Masonry Crt
TFR File #: 1
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Waterdown Rd runs N/S



Comments

Masonry Crt @ Waterdown Rd

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 13:00:00

One Hour Peak
From: 11:45:00
To: 12:45:00

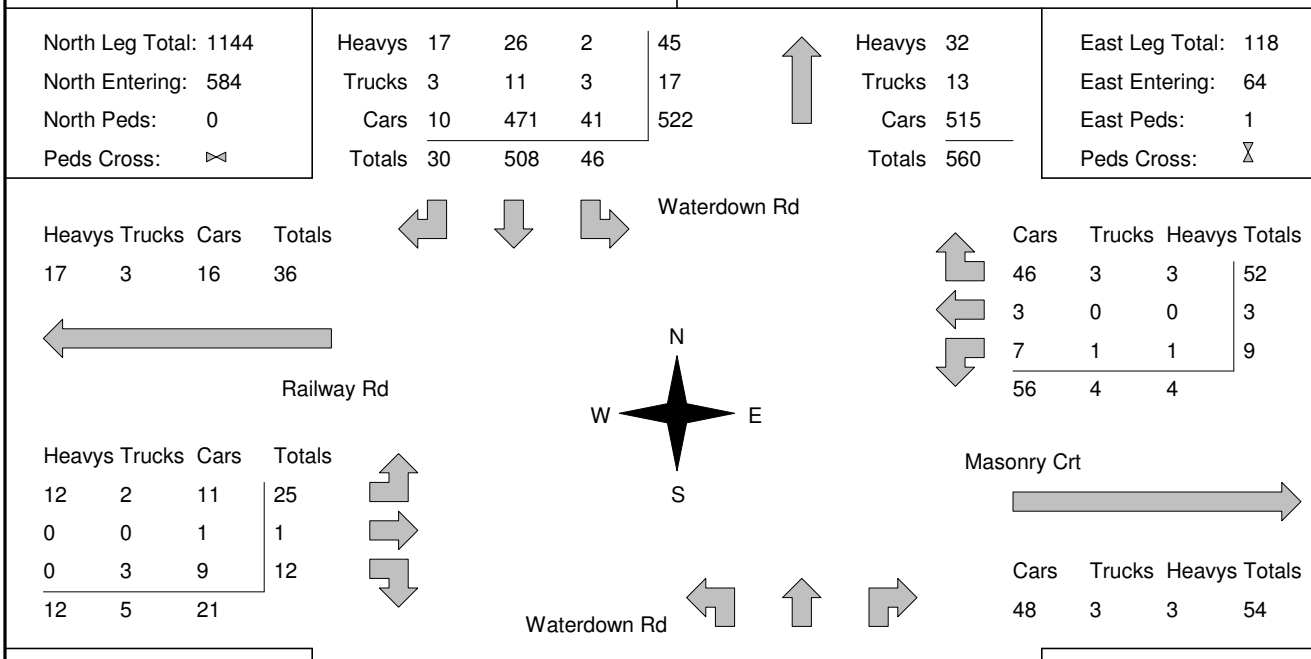
Municipality: Burlington
Site #: 0000000001
Intersection: Waterdown Rd & Masonry Crt
TFR File #: 1
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Waterdown Rd runs N/S



Comments

Masonry Crt @ Waterdown Rd

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:30:00
To: 17:30:00

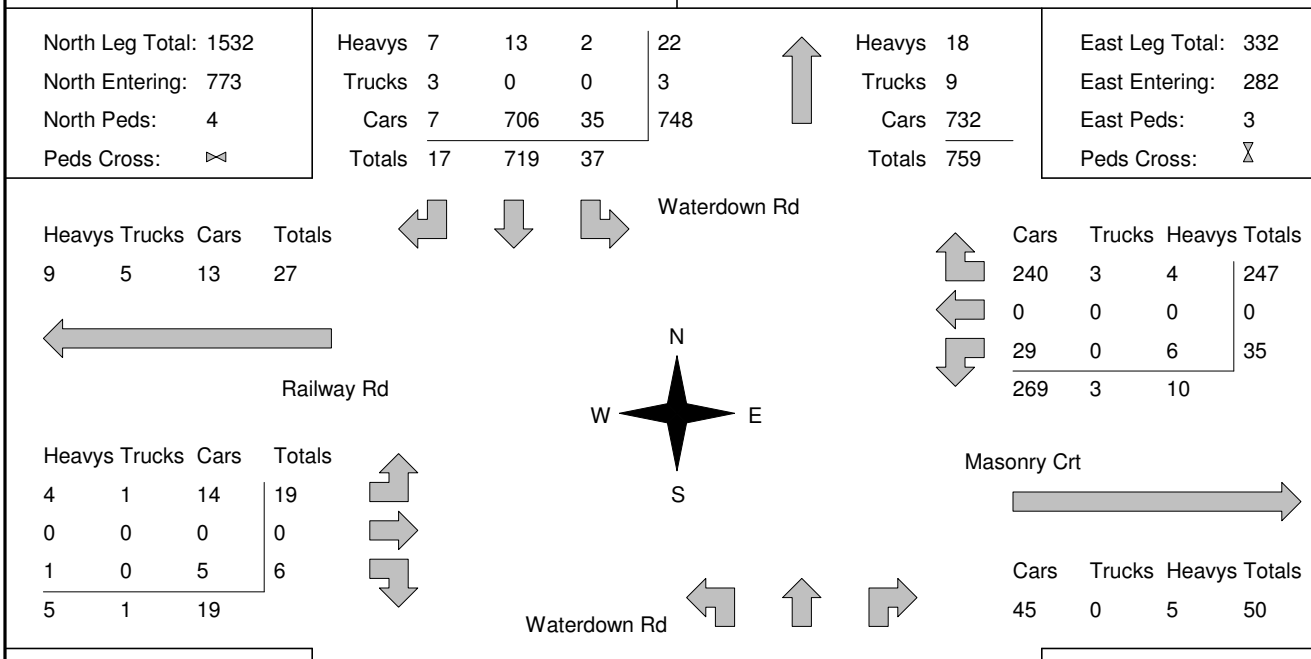
Municipality: Burlington
Site #: 0000000001
Intersection: Waterdown Rd & Masonry Crt
TFR File #: 1
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Waterdown Rd runs N/S



Comments

Masonry Crt @ Waterdown Rd

Total Count Diagram

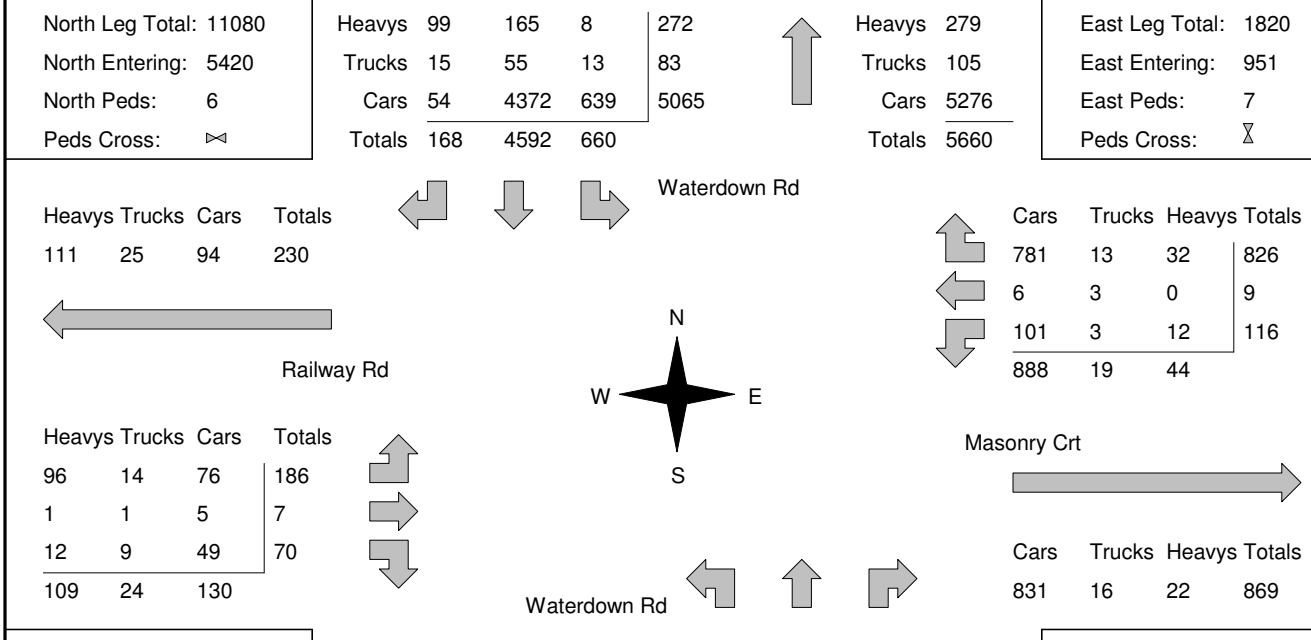
Municipality: Burlington
Site #: 0000000001
Intersection: Waterdown Rd & Masonry Crt
TFR File #: 1
Count date: 20-Sep-2018

Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Waterdown Rd runs N/S



Comments

Masonry Crt @ Cooke Blvd

Morning Peak Diagram

Specified Period
From: 7:00:00
To: 10:00:00

One Hour Peak
From: 7:00:00
To: 8:00:00

Municipality: Burlington
Site #: 0000000002
Intersection: Masonry Crt & Cooke Blvd
TFR File #: 2
Count date: 20-Sep-2018

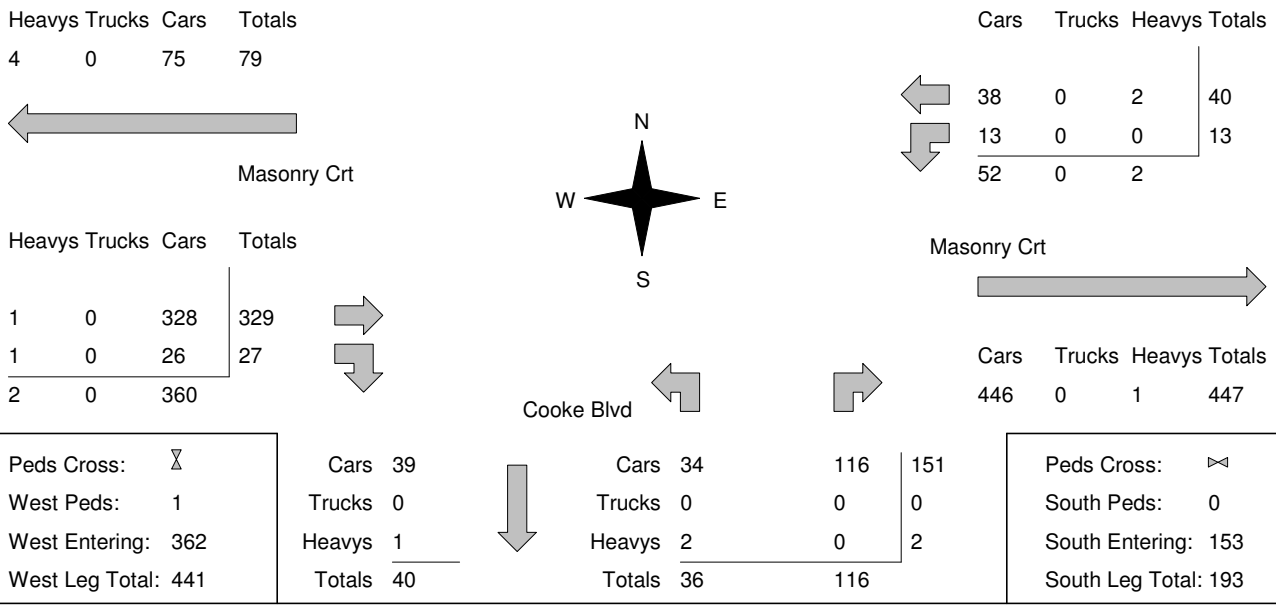
Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

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

Major Road: Masonry Crt runs W/E

East Leg Total: 501
East Entering: 54
East Peds: 7
Peds Cross: ⧖



Peds Cross: ⧖
West Peds: 1
West Entering: 362
West Leg Total: 441

Cars 39
Trucks 0
Heavys 1
Totals 40

Cars 34 116 151
Trucks 0 0 0
Heavys 2 0 2
Totals 36 116

Peds Cross: ⋈
South Peds: 0
South Entering: 153
South Leg Total: 193

Comments

Masonry Crt @ Cooke Blvd

Mid-day Peak Diagram

Specified Period
From: 11:00:00
To: 13:00:00

One Hour Peak
From: 12:00:00
To: 13:00:00

Municipality: Burlington
Site #: 0000000002
Intersection: Masonry Crt & Cooke Blvd
TFR File #: 2
Count date: 20-Sep-2018

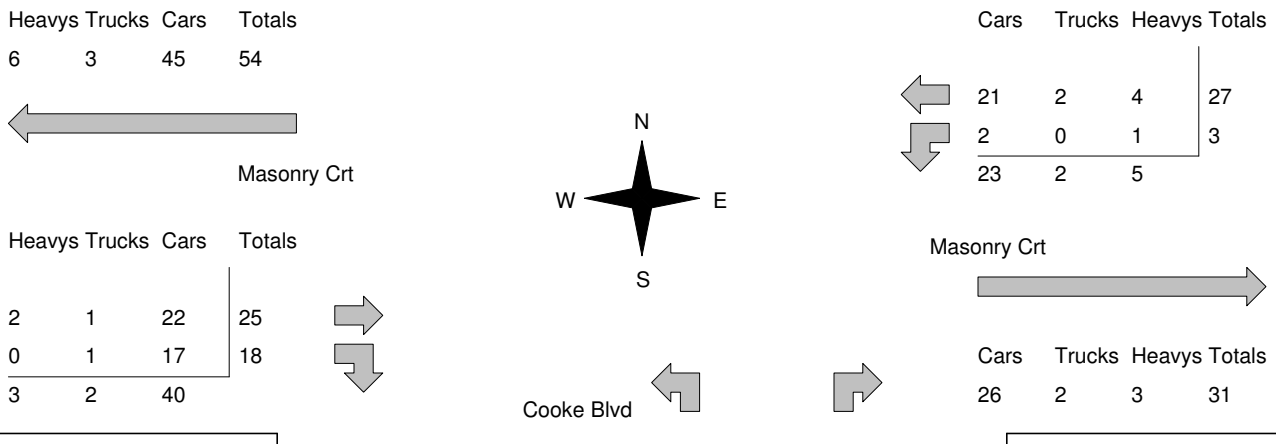
Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

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

Major Road: Masonry Crt runs W/E

East Leg Total: 61
East Entering: 30
East Peds: 8
Peds Cross:



Peds Cross:
West Peds: 0
West Entering: 45
West Leg Total: 99

Cars 24
Trucks 1
Heavys 1
Totals 26

Cars 22 4 30
Trucks 1 0 2
Heavys 2 0 2
Totals 25 4

Peds Cross:
South Peds: 1
South Entering: 34
South Leg Total: 60

Comments

Masonry Crt @ Cooke Blvd

Afternoon Peak Diagram

Specified Period
From: 15:00:00
To: 18:00:00

One Hour Peak
From: 16:45:00
To: 17:45:00

Municipality: Burlington
Site #: 0000000002
Intersection: Masonry Crt & Cooke Blvd
TFR File #: 2
Count date: 20-Sep-2018

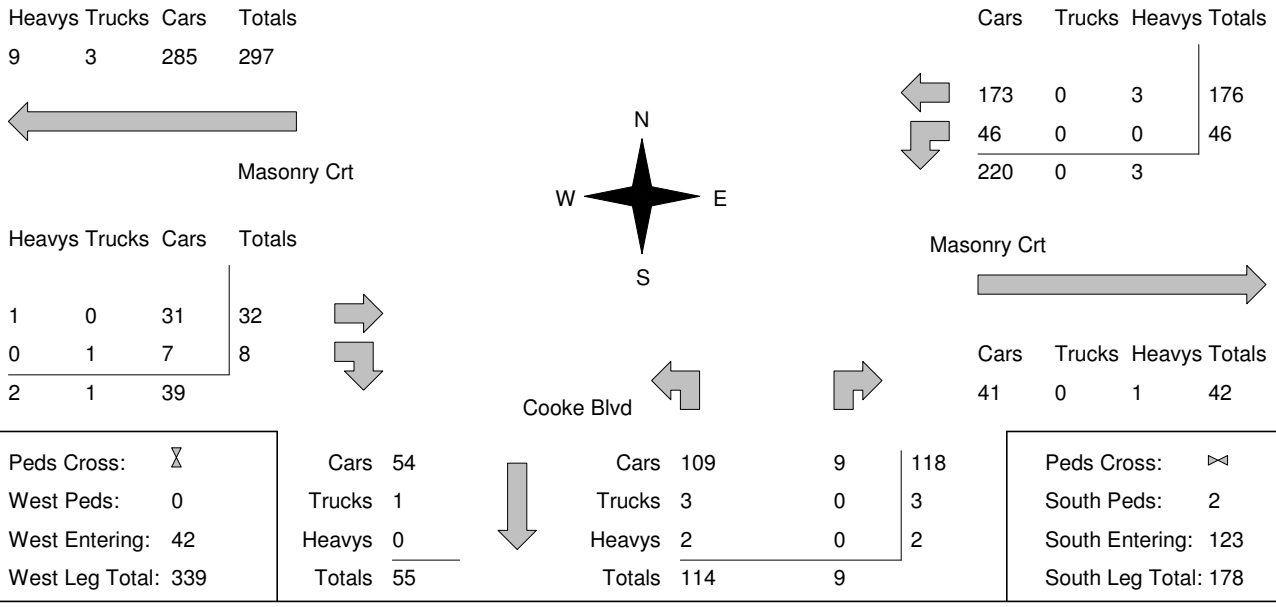
Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

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

Major Road: Masonry Crt runs W/E

East Leg Total: 265
East Entering: 223
East Peds: 3
Peds Cross:



Peds Cross:
West Peds: 0
West Entering: 42
West Leg Total: 339

Cars 54
Trucks 1
Heavys 0
Totals 55

Cars 109 9 118
Trucks 3 0 3
Heavys 2 0 2
Totals 114 9

Peds Cross:
South Peds: 2
South Entering: 123
South Leg Total: 178

Comments

Masonry Crt @ Cooke Blvd

Total Count Diagram

Municipality: Burlington
Site #: 0000000002
Intersection: Masonry Crt & Cooke Blvd
TFR File #: 2
Count date: 20-Sep-2018

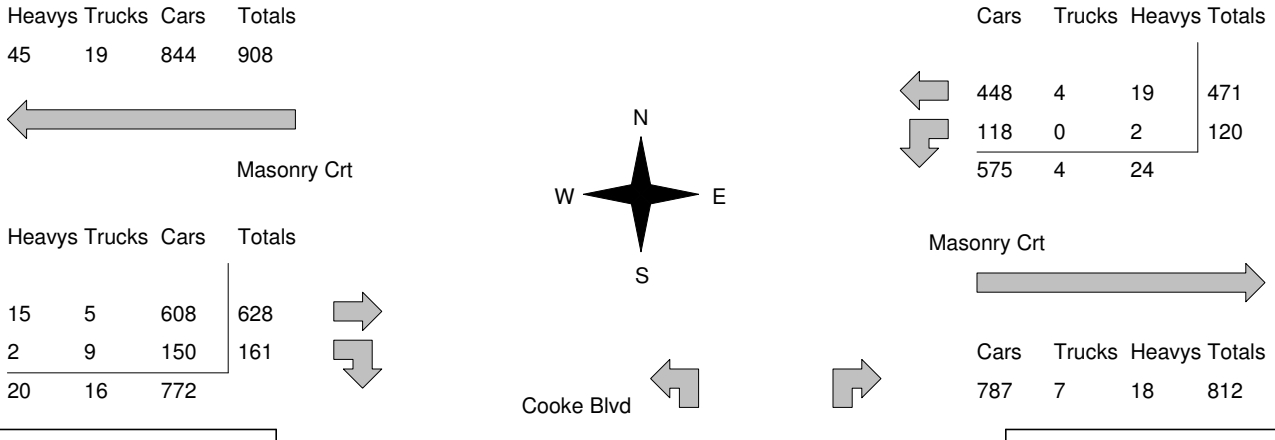
Weather conditions:
Cloudy/Dry

Person(s) who counted:
Cam

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

Major Road: Masonry Crt runs W/E

East Leg Total: 1415
East Entering: 603
East Peds: 28
Peds Cross: ⧖



Peds Cross: ⧖
West Peds: 3
West Entering: 808
West Leg Total: 1716

Cars 279
Trucks 9
Heavys 4
Totals 292

Cars 373 173 555
Trucks 15 1 17
Heavys 19 2 21
Totals 407 176

Peds Cross: ⋈
South Peds: 9
South Entering: 593
South Leg Total: 885

Comments

Intersection Name:	TS ID:	Line No:	Model:	IP address:	Controller Make:
Plains Road @ Waterdown Rd	100	4	ACS/3	172.22.7.2	Econolite

Type of Operation: 8 Phase Semi-Actuated

*-Start from Main Menu

No	Date			Description	Prepared by
	Y	M	D		MA
8	2019	5	15	Plains Road Optimization	

PHASE DESCRIPTION

Ph1	WBLT - Plains Road	Ph5	EBLT - Plains Road
Ph2	EB - Plains Road	Ph6	WB - Plains Road
Ph3	SBLT - Waterdown Road	Ph7	NBLT - Waterdown Road
Ph4	NB - Waterdown Road	Ph8	SB - Waterdown Road

PHASE IN USE/EXCLUSIVE PED (MM) *- 1 - 2

Phase:	1	2	3	4	5	6	7	8
Phase in Use	X	X	X	X	X	X	X	X
Exclusive PED								

CONTROLLER TIMING DATA - VEHICLE TIMING * - 2 - 1

Timing Plan: 1	Phase: 1	2	3	4	5	6	7	8
Minimum Green	6	8	6	8	6	8	6	8
Walk		8		10		8		10
Ped. Clearance		13		17		13		17
Pedestrian Carry Over								
Vehicle Extension	3	3	3	3	3	3	3	3
MAX 1	12	35	12	25	12	35	12	25
MAX 2	12	35	12	25	12	35	12	25
Yellow Change	3	4	3	4	3	4	3	4
Red Clearance		2		3		2		3
Phase Minimum:	10	28	10	35	10	28	10	35

PHASE DATA - VEHICLE AND PEDESTRIAN RECALLS * - 2 - 8

Phase:	1	2	3	4	5	6	7	8
Lock Detector								
Vehicle Recall								
Pedestrian Recall		X				X		
MAX Recall		X				X		
Min Recall								

COORDINATION: COORDINATOR PATTERN, SPLIT PATTERN *** - 3 - 2, - 3 - 3**

Coordinator Pattern (CP)	Cycle Length	Offset (sec)	Timing Plan	Split Pattern	Phases (sec)							
					1	2	3	4	5	6	7	8
1	110	0	1	1	12	51	13	34	32	31	10	37
2	90	84	1	2	12	34	10	34	14	32	10	34
3	110	37	1	3	18	46	20	26	18	46	10	36
4	85	52	1	4	12	30	10	33	14	28	10	33
10	0	0	1	10	0	0	0	0	0	0		

TIME BASE: ACTION PLAN, DAY PLAN *** - 5 - 2, - 5 - 3, -5 - 4**

Day Plan	Sched. #	Action Plan	Time Period	Pattern	Timing Plan
1	1	4	06:00	4	1
1	1	1	07:00	1	1
1	1	2	09:00	2	1
1	1	3	15:30	3	1
1	1	4	19:00	4	1
1	1	10	22:00	254	1
2	2	4	08:00	4	1
2	2	3	10:30	3	1
2	2	4	17:00	4	1
2	2	10	21:00	254	1
3	3	4	09:30	4	1
3	3	2	12:00	2	1
3	3	4	17:00	4	1
3	3	10	21:00	254	1

Schedule 1 = Day Plan 1
Schedule 2 = Day Plan 2
Schedule 3 = Day Plan 3

Day Plan 1 (Weekday)
Day Plan 2 (Saturday)
Day Plan 3 (Sunday, Holidays)

Action Plan 10 = free (254)

Special Programming:

Intersection Name:	TS ID:	Line No:	Model:	IP address:	Controller Make:
Plains Road @ Cooke Blvd	117	4	ACS/3	172.22.15.2	Econolite

Type of Operation: 8 Phase Semi-Actuated

*-Start from Main Menu

No	Date			Description	Prepared by
	Y	M	D		MA
5	2019	5	8	Plains Road Optimization	

PHASE DESCRIPTION

Ph1		Ph5	EBLT - Plains Road
Ph2	EB - Plains Road	Ph6	WB - Plains Road
Ph3		Ph7	
Ph4	NB - Driveway	Ph8	SB - Cooke Blvd

PHASE IN USE/EXCLUSIVE PED (MM) *- 1 - 2

Phase:	1	2	3	4	5	6	7	8
Phase in Use		X		X	X	X		X
Exclusive PED								

CONTROLLER TIMING DATA - VEHICLE TIMING * - 2 - 1

Timing Plan: 1	Phase: 1	2	3	4	5	6	7	8
Minimum Green		8		8	6	8		8
Walk		8		8		8		8
Ped. Clearance		11		14		11		14
Pedestrian Carry Over								
Vehicle Extension		3		3	3	3		3
MAX 1		40		30	10	40		30
MAX 2		40		30	10	40		30
Yellow Change		4		4	3	4		4
Red Clearance		3		3		3		3
Phase Minimum:	1	27	1	30	10	27	1	30

PHASE DATA - VEHICLE AND PEDESTRIAN RECALLS * - 2 - 8

Phase:	1	2	3	4	5	6	7	8
Lock Detector								
Vehicle Recall								
Pedestrian Recall		X				X		
MAX Recall		X				X		
Min Recall								

COORDINATION: COORDINATOR PATTERN, SPLIT PATTERN *** - 3 - 2, - 3 - 3**

Coordinator Pattern (CP)	Cycle Length	Offset (sec)	Timing Plan	Split Pattern	Phases (sec)							
					1	2	3	4	5	6	7	8
1	100	20	1	1		68		32	15	53		32
2	90	84	1	2		52		38	12	40		38
3	110	23	1	3		78		32	16	62		32
4	85	52	1	4		55		30	12	43		30
10	0	0	1	10		0		0	0	0		0

TIME BASE: ACTION PLAN, DAY PLAN *** - 5 - 2, - 5 - 3, -5 - 4**

Day Plan	Sched. #	Action Plan	Time Period	Pattern	Timing Plan	
1	1	4	06:00	4	1	
1	1	1	07:00	1	1	Schedule 1 = Day Plan 1
1	1	2	09:00	2	1	Schedule 2 = Day Plan 2
1	1	3	15:30	3	1	Schedule 3 = Day Plan 3
1	1	4	19:00	4	1	
1	1	10	22:00	254	1	Day Plan 1 (Weekday)
2	2	4	08:00	4	1	Day Plan 2 (Saturday)
2	2	3	10:30	3	1	Day Plan 3 (Sunday, Holidays)
2	2	4	17:00	4	1	
2	2	10	21:00	254	1	Action Plan 10 = free (254)
3	3	4	09:30	4	1	
3	3	2	12:00	2	1	
3	3	4	17:00	4	1	
3	3	10	21:00	254	1	

Special Programming:

Intersection Name:	TS ID:	Line No:	Model:	IP address:	Controller Make:
Waterdown Rd @ Masonry Crt	104	4	ACS/3	172.22.8.2	Econolite

Type of Operation: 8 Phase Semi-Actuated

*-Start from Main Menu

No	Date			Description	Prepared by
	Y	M	D		BP
8	2017	12	19	Timings reverted back to original	

PHASE DESCRIPTION

Ph1	SBL - Waterdown Road	Ph5	
Ph2	NB - Waterdown Road	Ph6	SB - Waterdown Road
Ph3		Ph7	
Ph4	EB - Railway Road	Ph8	WB - Masonry Court

PHASE IN USE/EXCLUSIVE PED (MM) *- 1 - 2

Phase:	1	2	3	4	5	6	7	8
Phase in Use	X	X		X		X		X
Exclusive PED								

CONTROLLER TIMING DATA - VEHICLE TIMING * - 2 - 1

Timing Plan: 1	Phase: 1	2	3	4	5	6	7	8
Minimum Green	8	8		8		8		8
Walk		15		8		15		8
Ped. Clearance		14		14		14		14
Pedestrian Carry Over								
Vehicle Extension	3	3		5		3		5
MAX 1	15	40		30		40		30
MAX 2	15	40		30		40		30
Yellow Change	3	4		4		4		4
Red Clearance	0	2		3		2		3
Phase Minimum:	**12**	**36**	**1**	**30**	**1**	**36**	**1**	**30**

PHASE DATA - VEHICLE AND PEDESTRIAN RECALLS * - 2 - 8

Phase:	1	2	3	4	5	6	7	8
Lock Detector								
Vehicle Recall								
Pedestrian Recall		X				X		

MAX Recall		X				X		
Min Recall								

COORDINATION: COORDINATOR PATTERN, SPLIT PATTERN *** - 3 - 2, - 3 - 3**

Coordinator Pattern (CP)	Cycle Length	Offset (sec)	Timing Plan	Split Pattern	Phases (sec)							
					1	2	3	4	5	6	7	8
1	100	22	1	1	18	42		40		60		40
2	0	0	0	0	0	0		0		0		0
3	110	72	1	3	18	60		32		78		32
10	0	0	1	10	0	0		0		0		0

TIME BASE: ACTION PLAN, DAY PLAN *** - 5 - 2, - 5 - 3, -5 - 4**

Day Plan	Sched. #	Action Plan	Time Period	Pattern	Timing Plan	
1	1	1	06:00	1	1	
1	1	10	09:00	254	1	
1	1	3	15:30	3	1	Schedule 1 = Day Plan 1
1	1	10	19:00	254	1	Schedule 2 = Day Plan 2
2	2	1	09:00	1	1	Schedule 3 = Day Plan 3
2	2	10	18:00	254	1	
3	3	1	9:00	1	1	Day Plan 1 (Weekday)
3	3	10	18:00	254	1	Day Plan 2 (Saturday)
						Day Plan 3 (Sunday, Holidays)
						Action Plan 10 = free (254)

Special Programming:

Appendix C

Existing Traffic Operations

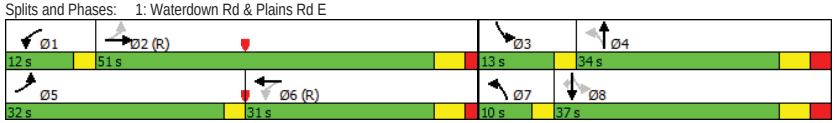


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations									
Traffic Volume (vph)	590	934	61	318	59	218	149	101	156
Future Volume (vph)	590	934	61	318	59	218	149	101	156
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm
Protected Phases	5	2	1	6	7	4	3	8	
Permitted Phases	2		6		4		8		8
Detector Phase	5	2	1	6	7	4	3	8	8
Switch Phase									
Minimum Initial (s)	6.0	8.0	6.0	8.0	6.0	8.0	6.0	8.0	8.0
Minimum Split (s)	9.0	27.0	9.0	27.0	9.0	34.0	9.0	34.0	34.0
Total Split (s)	32.0	51.0	12.0	31.0	10.0	34.0	13.0	37.0	37.0
Total Split (%)	29.1%	46.4%	10.9%	28.2%	9.1%	30.9%	11.8%	33.6%	33.6%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	0.0	2.0	0.0	3.0	0.0	3.0	3.0
Lost Time Adjust (s)	1.0	-2.0	1.0	-2.0	1.0	-3.0	1.0	-3.0	-3.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?									
Recall Mode	None	C-Max	None	C-Max	None	None	None	None	None
Act Effct Green (s)	64.5	55.9	33.4	27.0	30.5	24.7	36.7	29.5	29.5
Actuated g/C Ratio	0.59	0.51	0.30	0.25	0.28	0.22	0.33	0.27	0.27
v/c Ratio	1.04	0.66	0.32	0.61	0.17	0.70	0.71	0.22	0.33
Control Delay	73.8	23.9	19.9	33.4	24.5	46.8	43.5	32.3	6.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	73.8	23.9	19.9	33.4	24.5	46.8	43.5	32.3	6.4
LOS	E	C	B	C	C	D	D	C	A
Approach Delay		41.5		31.9		42.8		26.5	
Approach LOS		D		C		D		C	

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.04
Intersection Signal Delay: 37.8 — Intersection LOS: D
Intersection Capacity Utilization 88.3% — ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 1: Waterdown Rd & Plains Rd E



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	628	1154	65	527	63	289	159	107	166
v/c Ratio	1.04	0.66	0.32	0.61	0.17	0.70	0.71	0.22	0.33
Control Delay	73.8	23.9	19.9	33.4	24.5	46.8	43.5	32.3	6.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	73.8	23.9	19.9	33.4	24.5	46.8	43.5	32.3	6.4
Queue Length 50th (m)	~132.0	101.3	6.1	45.8	9.6	57.8	25.7	19.2	0.0
Queue Length 95th (m)	#221.3	142.7	13.8	64.4	18.1	83.3	#41.0	32.4	15.5
Internal Link Dist (m)		169.9		129.1		138.9		321.6	
Turn Bay Length (m)	30.0		40.0		30.0				40.0
Base Capacity (vph)	605	1737	225	870	367	497	228	532	545
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.04	0.66	0.29	0.61	0.17	0.58	0.70	0.20	0.30

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	590	934	150	61	318	178	59	218	54	149	101	156
Future Volume (vph)	590	934	150	61	318	178	59	218	54	149	101	156
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.95		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1661	3399		1658	3259		1690	1793		1661	1776	1431
Flt Permitted	0.20	1.00		0.25	1.00		0.69	1.00		0.21	1.00	1.00
Satd. Flow (perm)	355	3399		429	3259		1224	1793		366	1776	1431
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	628	994	160	65	338	189	63	232	57	159	107	166
RTOR Reduction (vph)	0	10	0	0	71	0	0	8	0	0	0	121
Lane Group Flow (vph)	628	1144	0	65	456	0	63	281	0	159	107	45
Confl. Peds. (#/hr)	6		19	19		6	17		7	7		17
Heavy Vehicles (%)	5%	3%	3%	5%	4%	4%	2%	2%	4%	5%	7%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		8
Actuated Green, G (s)	61.9	52.7		30.6	24.4		27.9	22.3		35.1	26.5	26.5
Effective Green, g (s)	60.9	54.7		28.6	26.4		25.9	25.3		34.1	29.5	29.5
Actuated g/C Ratio	0.55	0.50		0.26	0.24		0.24	0.23		0.31	0.27	0.27
Clearance Time (s)	3.0	6.0		3.0	6.0		3.0	7.0		3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	594	1690		169	782		307	412		217	476	383
v/s Ratio Prot	c0.32	0.34		0.02	0.14		0.01	0.16		c0.06	0.06	
v/s Ratio Perm	c0.26			0.08			0.04			c0.17		0.03
v/c Ratio	1.06	0.68		0.38	0.58		0.21	0.68		0.73	0.22	0.12
Uniform Delay, d1	27.6	21.0		31.3	36.9		33.4	38.7		30.4	31.3	30.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	53.0	2.2		1.5	3.2		0.3	4.6		12.0	0.2	0.1
Delay (s)	80.5	23.2		32.8	40.1		33.7	43.3		42.4	31.6	30.5
Level of Service	F	C		C	D		C	D		D	C	C
Approach Delay (s)		43.4			39.3			41.5			35.2	
Approach LOS		D			D			D			D	

Intersection Summary				
HCM 2000 Control Delay	41.3	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.93			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	88.3%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

Lane Group	EBL	EBT	WBT	SBL
Lane Configurations				
Traffic Volume (vph)	86	1132	580	6
Future Volume (vph)	86	1132	580	6
Turn Type	pm+pt	NA	NA	Prot
Protected Phases	5	2	6	8
Permitted Phases	2			
Detector Phase	5	2	6	8
Switch Phase				
Minimum Initial (s)	6.0	8.0	8.0	6.0
Minimum Split (s)	9.0	26.0	26.0	19.0
Total Split (s)	15.0	68.0	53.0	32.0
Total Split (%)	15.0%	68.0%	53.0%	32.0%
Yellow Time (s)	3.0	4.0	4.0	4.0
All-Red Time (s)	0.0	3.0	3.0	3.0
Lost Time Adjust (s)	1.0	-3.0	-3.0	-3.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag	
Lead-Lag Optimize?				
Recall Mode	None	C-Max	C-Max	None
Act Effct Green (s)	90.1	92.5	83.2	9.7
Actuated g/C Ratio	0.90	0.92	0.83	0.10
v/c Ratio	0.14	0.37	0.23	0.16
Control Delay	1.7	1.7	3.2	20.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	1.7	1.7	3.2	20.7
LOS	A	A	A	C
Approach Delay		1.7	3.2	20.7
Approach LOS		A	A	C

Intersection Summary			
Cycle Length: 100			
Actuated Cycle Length: 100			
Offset: 20 (20%), Referenced to phase 2:EBTL and 6:WBT, Start of Green			
Natural Cycle: 55			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.37			
Intersection Signal Delay: 2.4		Intersection LOS: A	
Intersection Capacity Utilization 43.4%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 2: Plains Rd E & Cooke Blvd





Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	91	1192	651	24
v/c Ratio	0.14	0.37	0.23	0.16
Control Delay	1.7	1.7	3.2	20.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	1.7	1.7	3.2	20.7
Queue Length 50th (m)	0.0	0.0	6.5	1.4
Queue Length 95th (m)	5.6	36.4	29.6	m6.5
Internal Link Dist (m)		129.1	115.2	320.6
Turn Bay Length (m)	40.0			
Base Capacity (vph)	730	3241	2826	395
Starvation Cap Reductn	0	324	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.12	0.41	0.23	0.06

Intersection Summary
m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	86	1132	580	38	6	17
Future Volume (vph)	86	1132	580	38	6	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.6	3.5	3.3	3.5
Total Lost time (s)	4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95	0.95		1.00	
Frpb, ped/bikes	1.00	1.00	1.00		0.99	
Flpb, ped/bikes	1.00	1.00	1.00		1.00	
Frt	1.00	1.00	0.99		0.90	
Flt Protected	0.95	1.00	1.00		0.99	
Satd. Flow (prot)	1725	3505	3394		1364	
Flt Permitted	0.38	1.00	1.00		0.99	
Satd. Flow (perm)	685	3505	3394		1364	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	91	1192	611	40	6	18
RTOR Reduction (vph)	0	0	2	0	17	0
Lane Group Flow (vph)	91	1192	649	0	7	0
Confl. Peds. (#/hr)	4			4	2	3
Heavy Vehicles (%)	1%	3%	5%	8%	17%	18%
Turn Type	pm+pt	NA	NA		Prot	
Protected Phases	5	2	6		8	
Permitted Phases	2					
Actuated Green, G (s)	82.9	82.9	74.6		3.1	
Effective Green, g (s)	81.9	85.9	77.6		6.1	
Actuated g/C Ratio	0.82	0.86	0.78		0.06	
Clearance Time (s)	3.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	605	3010	2633		83	
v/s Ratio Prot	0.01	c0.34	0.19		c0.01	
v/s Ratio Perm	0.12					
v/c Ratio	0.15	0.40	0.25		0.09	
Uniform Delay, d1	1.9	1.5	3.1		44.3	
Progression Factor	1.00	1.00	1.00		0.86	
Incremental Delay, d2	0.1	0.4	0.2		0.4	
Delay (s)	2.0	1.9	3.3		38.4	
Level of Service	A	A	A		D	
Approach Delay (s)		1.9	3.3		38.4	
Approach LOS		A	A		D	

Intersection Summary				
HCM 2000 Control Delay	2.8	HCM 2000 Level of Service	A	
HCM 2000 Volume to Capacity ratio	0.39			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	43.4%	ICU Level of Service	A	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	974	8	7	532	0	2	0	22	2	0	11
Future Volume (Veh/h)	5	974	8	7	532	0	2	0	22	2	0	11
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	5	1025	8	7	560	0	2	0	23	2	0	12
Pedestrians								9				
Lane Width (m)								3.6				
Walking Speed (m/s)								1.2				
Percent Blockage								1				
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (m)		139										
pX, platoon unblocked				0.94			0.94	0.94	0.94	0.94	0.94	
vC, conflicting volume	560			1042			1354	1622	526	1120	1626	280
vC1, stage 1 conf vol							1048	1048		574	574	
vC2, stage 2 conf vol							306	574		546	1052	
vCu, unblocked vol	560			915			1247	1533	365	998	1537	280
tC, single (s)	4.1			4.4			7.5	6.5	7.0	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.3			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	100			99			99	100	96	99	100	98
cM capacity (veh/h)	1021			625			258	283	581	385	278	697

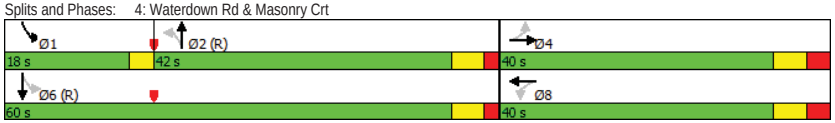
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	518	520	287	280	25	14
Volume Left	5	0	7	0	2	2
Volume Right	0	8	0	0	23	12
cSH	1021	1700	625	1700	528	624
Volume to Capacity	0.00	0.31	0.01	0.16	0.05	0.02
Queue Length 95th (m)	0.1	0.0	0.3	0.0	1.2	0.6
Control Delay (s)	0.1	0.0	0.4	0.0	12.2	10.9
Lane LOS	A		A		B	B
Approach Delay (s)	0.1		0.2		12.2	10.9
Approach LOS					B	B

Intersection Summary					
Average Delay			0.4		
Intersection Capacity Utilization			40.7%	ICU Level of Service	A
Analysis Period (min)			15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	28	1	6	0	7	881	281	372
Future Volume (vph)	28	1	6	0	7	881	281	372
Turn Type	Perm	NA	Perm	NA	Perm	NA	pm+pt	NA
Protected Phases		4		8		2	1	6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	1	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	6.0	8.0
Minimum Split (s)	29.0	29.0	29.0	29.0	35.0	35.0	10.5	35.0
Total Split (s)	40.0	40.0	40.0	40.0	42.0	42.0	18.0	60.0
Total Split (%)	40.0%	40.0%	40.0%	40.0%	42.0%	42.0%	18.0%	60.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	2.0	2.0	0.0	2.0
Lost Time Adjust (s)		-3.0	-3.0	-3.0	-2.0	-2.0	1.0	-2.0
Total Lost Time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag					Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	None	C-Max
Act Effct Green (s)		13.9	13.9	13.9	60.3	60.3	81.1	81.9
Actuated g/C Ratio		0.14	0.14	0.14	0.60	0.60	0.81	0.82
v/c Ratio		0.31	0.03	0.16	0.02	0.50	0.56	0.15
Control Delay		35.2	35.3	0.7	12.7	14.4	8.8	2.8
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		35.2	35.3	0.7	12.7	14.4	8.8	2.8
LOS		D	D	A	B	B	A	A
Approach Delay		35.2		3.0		14.4		5.3
Approach LOS		D		A		B		A

Intersection Summary			
Cycle Length: 100			
Actuated Cycle Length: 100			
Offset: 22 (22%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 80			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.56			
Intersection Signal Delay: 10.9		Intersection LOS: B	
Intersection Capacity Utilization 61.8%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 4: Waterdown Rd & Masonry Crt



Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	42	6	83	7	1024	296	412
v/c Ratio	0.31	0.03	0.16	0.02	0.50	0.56	0.15
Control Delay	35.2	35.3	0.7	12.7	14.4	8.8	2.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.2	35.3	0.7	12.7	14.4	8.8	2.8
Queue Length 50th (m)	5.6	1.1	0.0	0.6	61.7	12.2	8.3
Queue Length 95th (m)	15.4	4.6	0.0	3.3	100.8	33.5	15.5
Internal Link Dist (m)	18.4		117.2		321.6		103.1
Turn Bay Length (m)		15.0		20.0		15.0	
Base Capacity (vph)	330	529	769	394	2053	535	2685
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.01	0.11	0.02	0.50	0.55	0.15

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	28	1	11	6	0	79	7	881	92	281	372	19
Future Volume (vph)	28	1	11	6	0	79	7	881	92	281	372	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.96		1.00	0.85		1.00	0.99		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1157		1745	1518		1219	3394		1745	3277	
Flt Permitted		0.75		0.80	1.00		0.51	1.00		0.20	1.00	
Satd. Flow (perm)		898		1471	1518		655	3394		364	3277	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	29	1	12	6	0	83	7	927	97	296	392	20
RTOR Reduction (vph)	0	11	0	0	73	0	0	5	0	0	2	0
Lane Group Flow (vph)	0	31	0	6	10	0	7	1019	0	296	410	0
Confl. Peds. (#/hr)	1					1	1		2	2		1
Heavy Vehicles (%)	54%	100%	45%	0%	0%	5%	43%	5%	1%	0%	7%	53%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		9.3		9.3	9.3		57.0	57.0		77.7	77.7	
Effective Green, g (s)		12.3		12.3	12.3		59.0	59.0		76.7	79.7	
Actuated g/C Ratio		0.12		0.12	0.12		0.59	0.59		0.77	0.80	
Clearance Time (s)		7.0		7.0	7.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)		5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		110		180	186		386	2002		509	2611	
v/s Ratio Prot					0.01			0.30		c0.10	0.13	
v/s Ratio Perm		c0.04		0.00			0.01			c0.35		
v/c Ratio		0.29		0.03	0.05		0.02	0.51		0.58	0.16	
Uniform Delay, d1		39.9		38.6	38.7		8.5	12.0		6.9	2.4	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		3.0		0.2	0.3		0.1	0.9		1.7	0.1	
Delay (s)		42.8		38.8	39.0		8.6	12.9		8.6	2.5	
Level of Service		D		D	D		A	B		A	A	
Approach Delay (s)		42.8			39.0			12.9			5.0	
Approach LOS		D			D			B			A	

Intersection Summary					
HCM 2000 Control Delay	11.8	HCM 2000 Level of Service		B	
HCM 2000 Volume to Capacity ratio	0.54				
Actuated Cycle Length (s)	100.0	Sum of lost time (s)		12.0	
Intersection Capacity Utilization	61.8%	ICU Level of Service		B	
Analysis Period (min)	15				
c Critical Lane Group					

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	332	27	13	40	1	36	1	117	2	0	3
Future Volume (Veh/h)	6	332	27	13	40	1	36	1	117	2	0	3
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	7	410	33	16	49	1	44	1	144	2	0	4
Pedestrians		1			7						5	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			1						0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		141										
pX, platoon unblocked				0.97			0.97	0.97	0.97	0.97	0.97	
vC, conflicting volume	55			443			527	528	434	678	544	56
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	55			409			496	496	399	652	513	56
tC, single (s)	4.1			4.1			7.2	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			90	100	77	99	100	100
cM capacity (veh/h)	1556			1125			453	453	631	279	443	1012

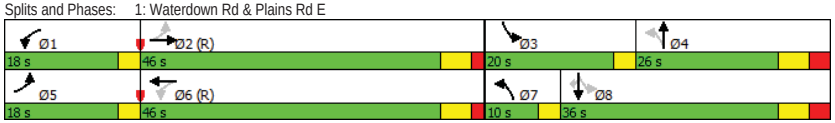
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	450	66	189	6
Volume Left	7	16	44	2
Volume Right	33	1	144	4
cSH	1556	1125	577	539
Volume to Capacity	0.00	0.01	0.33	0.01
Queue Length 95th (m)	0.1	0.3	11.4	0.3
Control Delay (s)	0.2	2.1	14.3	11.8
Lane LOS	A	A	B	B
Approach Delay (s)	0.2	2.1	14.3	11.8
Approach LOS			B	B

Intersection Summary			
Average Delay		4.2	
Intersection Capacity Utilization		37.8%	ICU Level of Service A
Analysis Period (min)		15	

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations									
Traffic Volume (vph)	194	520	58	1006	140	134	209	156	411
Future Volume (vph)	194	520	58	1006	140	134	209	156	411
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm
Protected Phases	5	2	1	6	7	4	3	8	
Permitted Phases	2		6		4		8		8
Detector Phase	5	2	1	6	7	4	3	8	8
Switch Phase									
Minimum Initial (s)	6.0	8.0	6.0	8.0	6.0	8.0	6.0	8.0	8.0
Minimum Split (s)	9.0	27.0	9.0	27.0	9.0	34.0	9.0	34.0	34.0
Total Split (s)	18.0	46.0	18.0	46.0	10.0	26.0	20.0	36.0	36.0
Total Split (%)	16.4%	41.8%	16.4%	41.8%	9.1%	23.6%	18.2%	32.7%	32.7%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	0.0	2.0	0.0	3.0	0.0	3.0	3.0
Lost Time Adjust (s)	1.0	-2.0	1.0	-2.0	1.0	-3.0	1.0	-3.0	-3.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?									
Recall Mode	None	C-Max	None	C-Max	None	None	None	None	None
Act Effct Green (s)	65.5	57.0	56.6	50.3	24.3	18.3	36.4	26.4	26.4
Actuated g/C Ratio	0.60	0.52	0.51	0.46	0.22	0.17	0.33	0.24	0.24
v/c Ratio	0.81	0.36	0.14	0.77	0.50	0.60	0.69	0.37	0.70
Control Delay	46.9	17.5	8.7	27.5	35.1	47.2	36.5	33.8	14.9
Queue Delay	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Total Delay	46.9	17.5	8.7	27.8	35.1	47.2	36.5	33.8	14.9
LOS	D	B	A	C	D	D	D	C	B
Approach Delay		24.5		26.9		41.9		24.5	
Approach LOS		C		C		D		C	

Intersection Summary			
Cycle Length: 110			
Actuated Cycle Length: 110			
Offset: 37 (34%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.81			
Intersection Signal Delay: 27.2		Intersection LOS: C	
Intersection Capacity Utilization 79.8%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 1: Waterdown Rd & Plains Rd E



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	198	629	59	1203	143	185	213	159	419
v/c Ratio	0.81	0.36	0.14	0.77	0.50	0.60	0.69	0.37	0.70
Control Delay	46.9	17.5	8.7	27.5	35.1	47.2	36.5	33.8	14.9
Queue Delay	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Total Delay	46.9	17.5	8.7	27.8	35.1	47.2	36.5	33.8	14.9
Queue Length 50th (m)	26.4	43.5	5.6	120.2	22.9	35.9	36.7	29.9	25.0
Queue Length 95th (m)	#60.2	64.4	4.9	#178.3	36.6	57.9	54.6	47.3	53.3
Internal Link Dist (m)		169.9		129.1		138.9		321.6	
Turn Bay Length (m)	30.0		40.0		30.0				40.0
Base Capacity (vph)	283	1766	519	1559	287	366	330	516	652
Starvation Cap Reductn	0	0	0	55	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.70	0.36	0.11	0.80	0.50	0.51	0.65	0.31	0.64

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	194	520	96	58	1006	172	140	134	47	209	156	411
Future Volume (vph)	194	520	96	58	1006	172	140	134	47	209	156	411
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		0.99	1.00		0.99	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.98		1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1662	3386		1650	3387		1698	1775		1661	1776	1440
Flt Permitted	0.09	1.00		0.40	1.00		0.66	1.00		0.27	1.00	1.00
Satd. Flow (perm)	151	3386		689	3387		1173	1775		477	1776	1440
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	198	531	98	59	1027	176	143	137	48	213	159	419
RTOR Reduction (vph)	0	11	0	0	11	0	0	12	0	0	0	250
Lane Group Flow (vph)	198	618	0	59	1192	0	143	173	0	213	159	169
Confl. Peds. (#/hr)	3		19	19		3	12		2	2		12
Heavy Vehicles (%)	5%	3%	3%	5%	4%	4%	2%	2%	4%	5%	7%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		8
Actuated Green, G (s)	63.6	54.5		54.4	48.3		22.3	15.3		33.4	23.4	23.4
Effective Green, g (s)	62.6	56.5		52.4	50.3		20.3	18.3		32.4	26.4	26.4
Actuated g/C Ratio	0.57	0.51		0.48	0.46		0.18	0.17		0.29	0.24	0.24
Clearance Time (s)	3.0	6.0		3.0	6.0		3.0	7.0		3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	241	1739		372	1548		245	295		292	426	345
v/s Ratio Prot	c0.08	0.18		0.01	0.35		0.03	0.10		c0.09	0.09	
v/s Ratio Perm	c0.38			0.07			0.08			c0.12		0.12
v/c Ratio	0.82	0.36		0.16	0.77		0.58	0.59		0.73	0.37	0.49
Uniform Delay, d1	26.3	15.9		15.7	25.0		40.1	42.4		32.0	34.9	36.0
Progression Factor	1.00	1.00		0.69	0.89		1.00	1.00		0.91	0.93	1.00
Incremental Delay, d2	19.7	0.6		0.2	3.4		3.5	3.0		8.6	0.5	1.1
Delay (s)	45.9	16.5		11.0	25.6		43.6	45.3		37.9	33.1	36.9
Level of Service	D	B		B	C		D	D		D	C	D
Approach Delay (s)		23.5			24.9			44.6			36.4	
Approach LOS		C			C			D			D	

Intersection Summary

HCM 2000 Control Delay	29.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	79.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBT	SBL
Lane Configurations				
Traffic Volume (vph)	5	786	1229	33
Future Volume (vph)	5	786	1229	33
Turn Type	pm+pt	NA	NA	Prot
Protected Phases	5	2	6	8
Permitted Phases	2			
Detector Phase	5	2	6	8
Switch Phase				
Minimum Initial (s)	6.0	8.0	8.0	6.0
Minimum Split (s)	9.0	26.0	26.0	19.0
Total Split (s)	16.0	78.0	62.0	32.0
Total Split (%)	14.5%	70.9%	56.4%	29.1%
Yellow Time (s)	3.0	4.0	4.0	4.0
All-Red Time (s)	0.0	3.0	3.0	3.0
Lost Time Adjust (s)	1.0	-3.0	-3.0	-3.0
Total Lost Time (s)	4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag	
Lead-Lag Optimize?				
Recall Mode	None	C-Max	C-Max	None
Act Effct Green (s)	93.4	94.2	92.4	11.2
Actuated g/C Ratio	0.85	0.86	0.84	0.10
v/c Ratio	0.01	0.26	0.45	0.34
Control Delay	1.8	2.0	4.1	30.4
Queue Delay	0.0	0.1	0.0	0.0
Total Delay	1.8	2.1	4.1	30.4
LOS	A	A	A	C
Approach Delay		2.1	4.1	30.4
Approach LOS		A	A	C

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Offset: 23 (21%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.45
Intersection Signal Delay: 4.2 — Intersection LOS: A
Intersection Capacity Utilization 48.0% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 2: Plains Rd E & Cooke Blvd



Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	5	810	1329	67
v/c Ratio	0.01	0.26	0.45	0.34
Control Delay	1.8	2.0	4.1	30.4
Queue Delay	0.0	0.1	0.0	0.0
Total Delay	1.8	2.1	4.1	30.4
Queue Length 50th (m)	0.2	15.3	31.6	6.9
Queue Length 95th (m)	m0.4	23.8	79.4	20.0
Internal Link Dist (m)		129.1	115.2	320.6
Turn Bay Length (m)	40.0			
Base Capacity (vph)	425	3060	2941	439
Starvation Cap Reductn	0	965	0	0
Spillback Cap Reductn	0	0	239	2
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.01	0.39	0.49	0.15

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	5	786	1229	60	33	32
Future Volume (vph)	5	786	1229	60	33	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.6	3.5	3.3	3.5
Total Lost time (s)	4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95	0.95		1.00	
Frpb, ped/bikes	1.00	1.00	1.00		0.99	
Flpb, ped/bikes	1.00	1.00	1.00		1.00	
Frt	1.00	1.00	0.99		0.93	
Flt Protected	0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1745	3574	3500		1631	
Flt Permitted	0.17	1.00	1.00		0.98	
Satd. Flow (perm)	318	3574	3500		1631	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	5	810	1267	62	34	33
RTOR Reduction (vph)	0	0	1	0	30	0
Lane Group Flow (vph)	5	810	1328	0	37	0
Confl. Peds. (#/hr)	4			4	2	3
Heavy Vehicles (%)	0%	1%	2%	8%	3%	0%
Turn Type	pm+pt	NA	NA		Prot	
Protected Phases	5	2	6		8	
Permitted Phases	2					
Actuated Green, G (s)	89.0	89.0	84.8		7.0	
Effective Green, g (s)	88.0	92.0	87.8		10.0	
Actuated g/C Ratio	0.80	0.84	0.80		0.09	
Clearance Time (s)	3.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	256	2989	2793		148	
v/s Ratio Prot	0.00	c0.23	c0.38		c0.02	
v/s Ratio Perm	0.02					
v/c Ratio	0.02	0.27	0.48		0.25	
Uniform Delay, d1	3.1	1.9	3.6		46.5	
Progression Factor	0.79	0.88	1.00		0.98	
Incremental Delay, d2	0.0	0.2	0.6		0.9	
Delay (s)	2.5	1.9	4.2		46.7	
Level of Service	A	A	A		D	
Approach Delay (s)		1.9	4.2		46.7	
Approach LOS		A	A		D	

Intersection Summary				
HCM 2000 Control Delay	4.6	HCM 2000 Level of Service	A	
HCM 2000 Volume to Capacity ratio	0.46			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	48.0%	ICU Level of Service	A	
Analysis Period (min)	15			
c Critical Lane Group				



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	762	5	30	1334	9	1	0	12	2	0	8
Future Volume (Veh/h)	10	762	5	30	1334	9	1	0	12	2	0	8
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	10	794	5	31	1390	9	1	0	13	2	0	8
Pedestrians					1			5			4	
Lane Width (m)					3.6			3.6			3.6	
Walking Speed (m/s)					1.2			1.2			1.2	
Percent Blockage					0			0			0	
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (m)		139										
pX, platoon unblocked				0.96			0.96	0.96	0.96	0.96	0.96	
vC, conflicting volume	1403			804			1586	2286	406	1892	2284	704
vC1, stage 1 conf vol							822	822		1460	1460	
vC2, stage 2 conf vol							765	1465		431	824	
vCu, unblocked vol	1403			711			1526	2256	295	1844	2254	704
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			96			100	100	98	98	100	98
cM capacity (veh/h)	491			858			250	160	675	127	165	383

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	407	402	726	704	14	10
Volume Left	10	0	31	0	1	2
Volume Right	0	5	0	9	13	8
cSH	491	1700	858	1700	602	273
Volume to Capacity	0.02	0.24	0.04	0.41	0.02	0.04
Queue Length 95th (m)	0.5	0.0	0.9	0.0	0.6	0.9
Control Delay (s)	0.6	0.0	0.9	0.0	11.1	18.7
Lane LOS	A		A		B	C
Approach Delay (s)	0.3		0.5		11.1	18.7
Approach LOS					B	C

Intersection Summary				
Average Delay	0.6			
Intersection Capacity Utilization	69.0%	ICU Level of Service	C	
Analysis Period (min)	15			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	19	0	35	0	10	498	37	726
Future Volume (vph)	19	0	35	0	10	498	37	726
Turn Type	Perm	NA	Perm	NA	Perm	NA	pm+pt	NA
Protected Phases		4		8		2	1	6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	1	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	6.0	8.0
Minimum Split (s)	29.0	29.0	29.0	29.0	35.0	35.0	10.5	35.0
Total Split (s)	32.0	32.0	32.0	32.0	60.0	60.0	18.0	78.0
Total Split (%)	29.1%	29.1%	29.1%	29.1%	54.5%	54.5%	16.4%	70.9%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	2.0	2.0	0.0	2.0
Lost Time Adjust (s)		-3.0	-3.0	-3.0	-2.0	-2.0	1.0	-2.0
Total Lost Time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag					Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	None	C-Max
Act Effct Green (s)		14.0	14.0	14.0	82.3	82.3	88.0	88.0
Actuated g/C Ratio		0.13	0.13	0.13	0.75	0.75	0.80	0.80
v/c Ratio		0.26	0.24	0.43	0.03	0.21	0.06	0.28
Control Delay		7.1	45.8	2.3	8.7	7.8	2.9	3.3
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		7.1	45.8	2.3	8.7	7.8	2.9	3.3
LOS		A	D	A	A	A	A	A
Approach Delay		7.1		7.6		7.9		3.3
Approach LOS		A		A		A		A

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Offset: 72 (65%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.43
Intersection Signal Delay: 5.6 — Intersection LOS: A
Intersection Capacity Utilization 55.0% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 4: Waterdown Rd & Masonry Crt



Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	26	36	259	10	533	39	774
v/c Ratio	0.26	0.24	0.43	0.03	0.21	0.06	0.28
Control Delay	7.1	45.8	2.3	8.7	7.8	2.9	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.1	45.8	2.3	8.7	7.8	2.9	3.3
Queue Length 50th (m)	0.0	7.5	0.0	0.8	32.0	1.4	18.0
Queue Length 95th (m)	1.4	17.0	0.0	m1.5	48.0	4.2	30.1
Internal Link Dist (m)	18.4		117.2		321.6		103.1
Turn Bay Length (m)		15.0		20.0		15.0	
Base Capacity (vph)	139	305	735	363	2598	733	2785
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.12	0.35	0.03	0.21	0.05	0.28

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	19	0	6	35	0	249	10	498	13	37	726	17
Future Volume (vph)	19	0	6	35	0	249	10	498	13	37	726	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.97		1.00	0.85		1.00	1.00		1.00	1.00	
Flt Protected		0.96		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1423		1541	1540		1288	3471		1717	3480	
Flt Permitted		0.25		0.74	1.00		0.36	1.00		0.42	1.00	
Satd. Flow (perm)		373		1200	1540		486	3471		767	3480	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	20	0	6	36	0	259	10	519	14	39	756	18
RTOR Reduction (vph)	0	23	0	0	226	0	0	1	0	0	1	0
Lane Group Flow (vph)	0	3	0	36	33	0	10	532	0	39	773	0
Confl. Peds. (#/hr)	4		1	1		4	1		3	3		1
Heavy Vehicles (%)	26%	0%	17%	17%	0%	3%	40%	3%	23%	5%	2%	59%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		11.0		11.0	11.0		79.2	79.2		86.0	86.0	
Effective Green, g (s)		14.0		14.0	14.0		81.2	81.2		85.0	88.0	
Actuated g/C Ratio		0.13		0.13	0.13		0.74	0.74		0.77	0.80	
Clearance Time (s)		7.0		7.0	7.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)		5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		47		152	196		358	2562		616	2784	
v/s Ratio Prot					0.02			0.15		0.00	c0.22	
v/s Ratio Perm		0.01		c0.03			0.02			0.05		
v/c Ratio		0.07		0.24	0.17		0.03	0.21		0.06	0.28	
Uniform Delay, d1		42.3		43.2	42.8		3.8	4.5		3.0	2.8	
Progression Factor		1.00		1.00	1.00		1.54	1.58		1.00	1.00	
Incremental Delay, d2		1.3		1.7	0.9		0.1	0.1		0.0	0.2	
Delay (s)		43.6		44.9	43.7		6.0	7.2		3.1	3.1	
Level of Service		D		D	D		A	A		A	A	
Approach Delay (s)		43.6			43.8			7.2			3.1	
Approach LOS		D			D			A			A	

Intersection Summary				
HCM 2000 Control Delay	12.2	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.28			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	55.0%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	32	8	46	178	1	115	0	9	1	1	7
Future Volume (Veh/h)	2	32	8	46	178	1	115	0	9	1	1	7
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	2	40	10	57	220	1	142	0	11	1	1	9
Pedestrians					3			2			3	
Lane Width (m)					3.6			3.6			3.6	
Walking Speed (m/s)					1.2			1.2			1.2	
Percent Blockage					0			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		141										
pX, platoon unblocked												
vC, conflicting volume	224			52			395	389	50	400	394	224
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	224			52			395	389	50	400	394	224
tC, single (s)	4.6			4.1			7.1	6.5	6.2	7.1	6.5	6.8
tC, 2 stage (s)												
tF (s)	2.7			2.2			3.5	4.0	3.3	3.5	4.0	3.8
p0 queue free %	100			96			73	100	99	100	100	99
cM capacity (veh/h)	1104			1564			534	526	1020	537	523	695

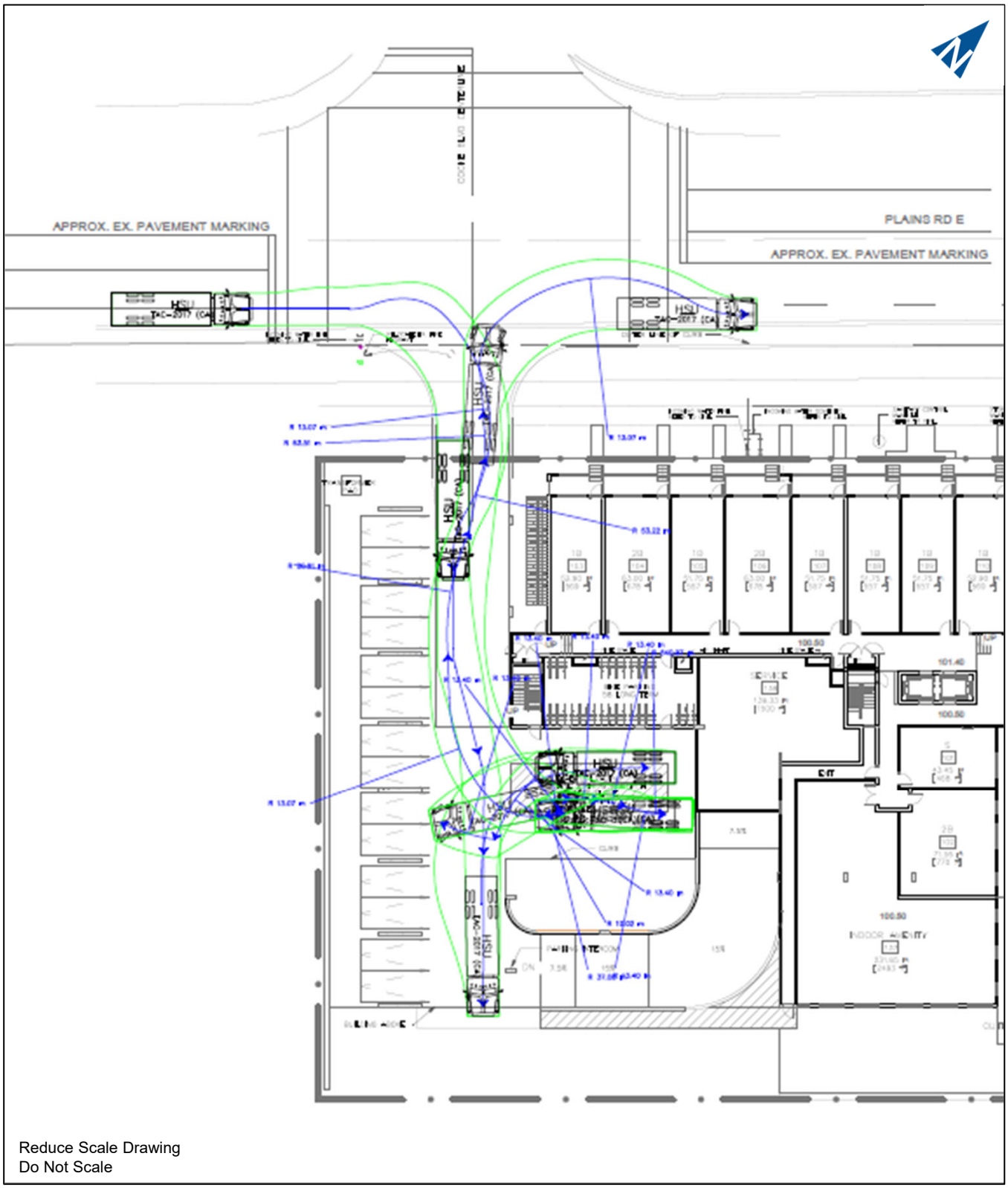
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	52	278	153	11
Volume Left	2	57	142	1
Volume Right	10	1	11	9
cSH	1104	1564	553	658
Volume to Capacity	0.00	0.04	0.28	0.02
Queue Length 95th (m)	0.0	0.9	9.0	0.4
Control Delay (s)	0.3	1.8	14.0	10.6
Lane LOS	A	A	B	B
Approach Delay (s)	0.3	1.8	14.0	10.6
Approach LOS			B	B

Intersection Summary				
Average Delay	5.6			
Intersection Capacity Utilization	38.9%	ICU Level of Service	A	
Analysis Period (min)	15			

Appendix D

Vehicle Swept Path Analysis





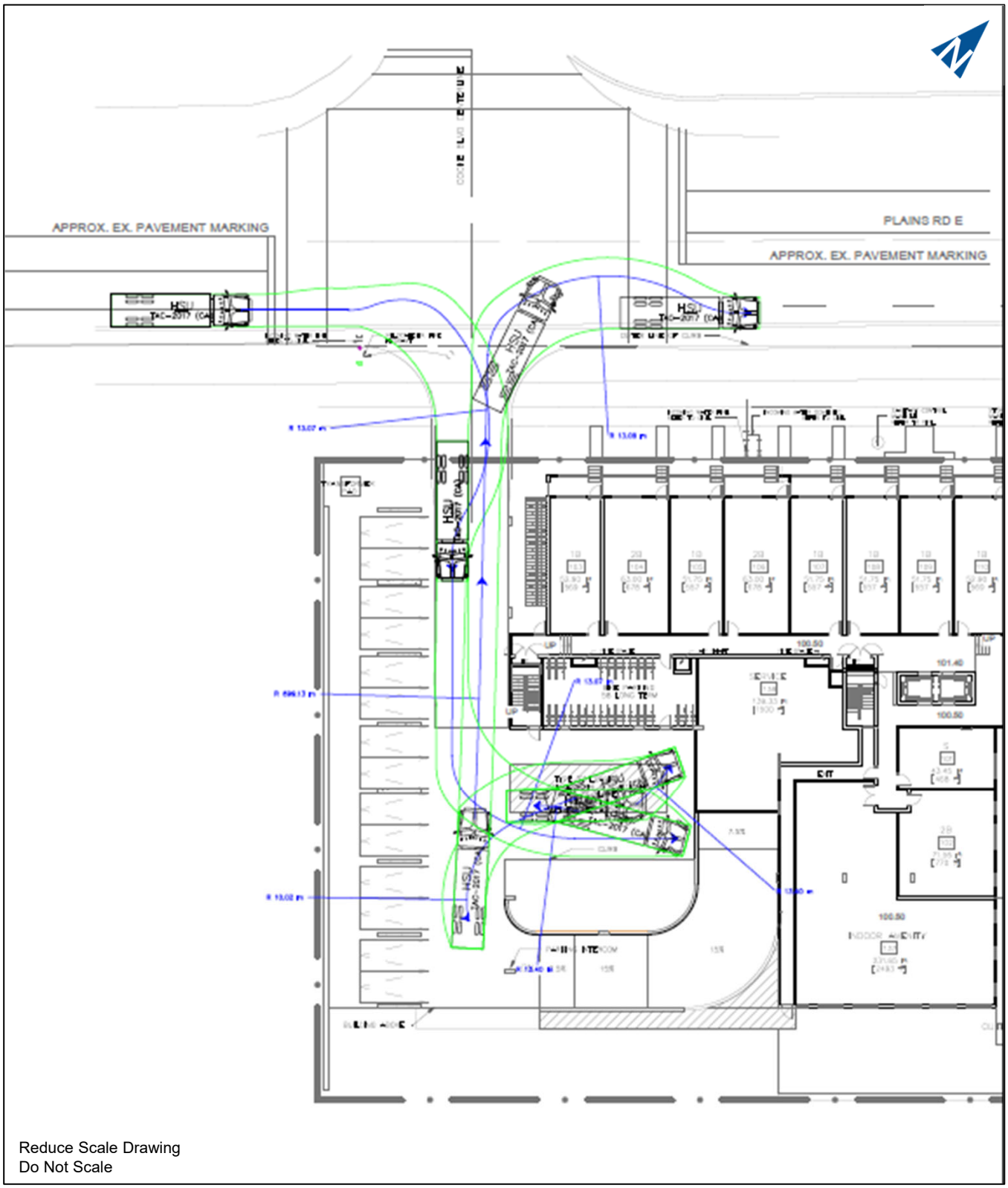
Reduce Scale Drawing
Do Not Scale

paradigm
TRANSPORTATION SOLUTIONS LIMITED

Loading Zone
TAC Heavy Single Unit (HSU)
Back In Maneuver

40-70 Plains Road East TIA
190488

Figure 1



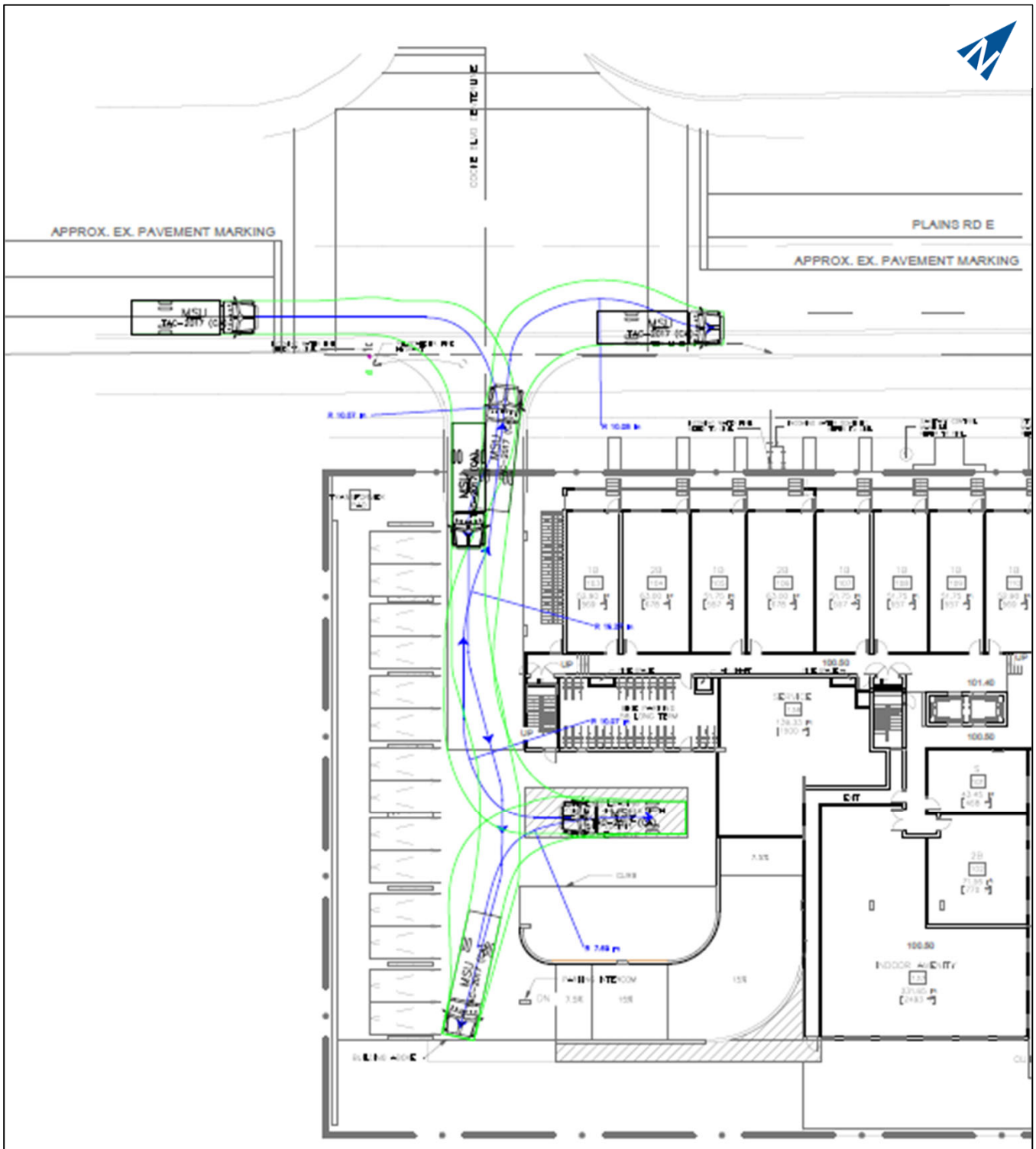
Reduce Scale Drawing
Do Not Scale

paradigm TRANSPORTATION SOLUTIONS LIMITED

Loading Zone
TAC Heavy Single Unit (HSU)
Front In Maneuver

40-70 Plains Road East TIA
190488

Figure 2

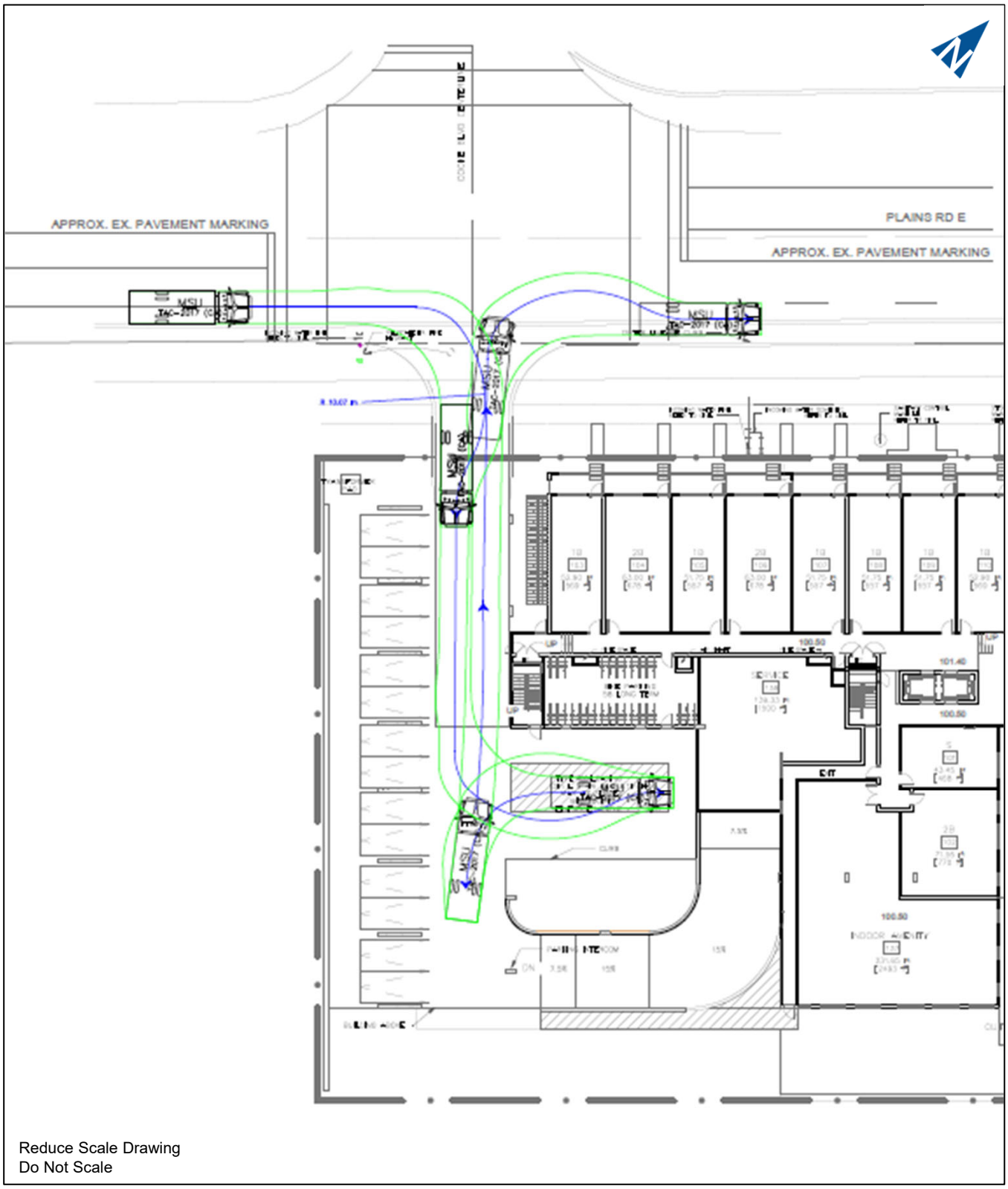


Reduce Scale Drawing
Do Not Scale

Loading Zone
TAC Medium Single Unit (MSU)
Back In Maneuver

40-70 Plains Road East TIA
190488

Figure 3

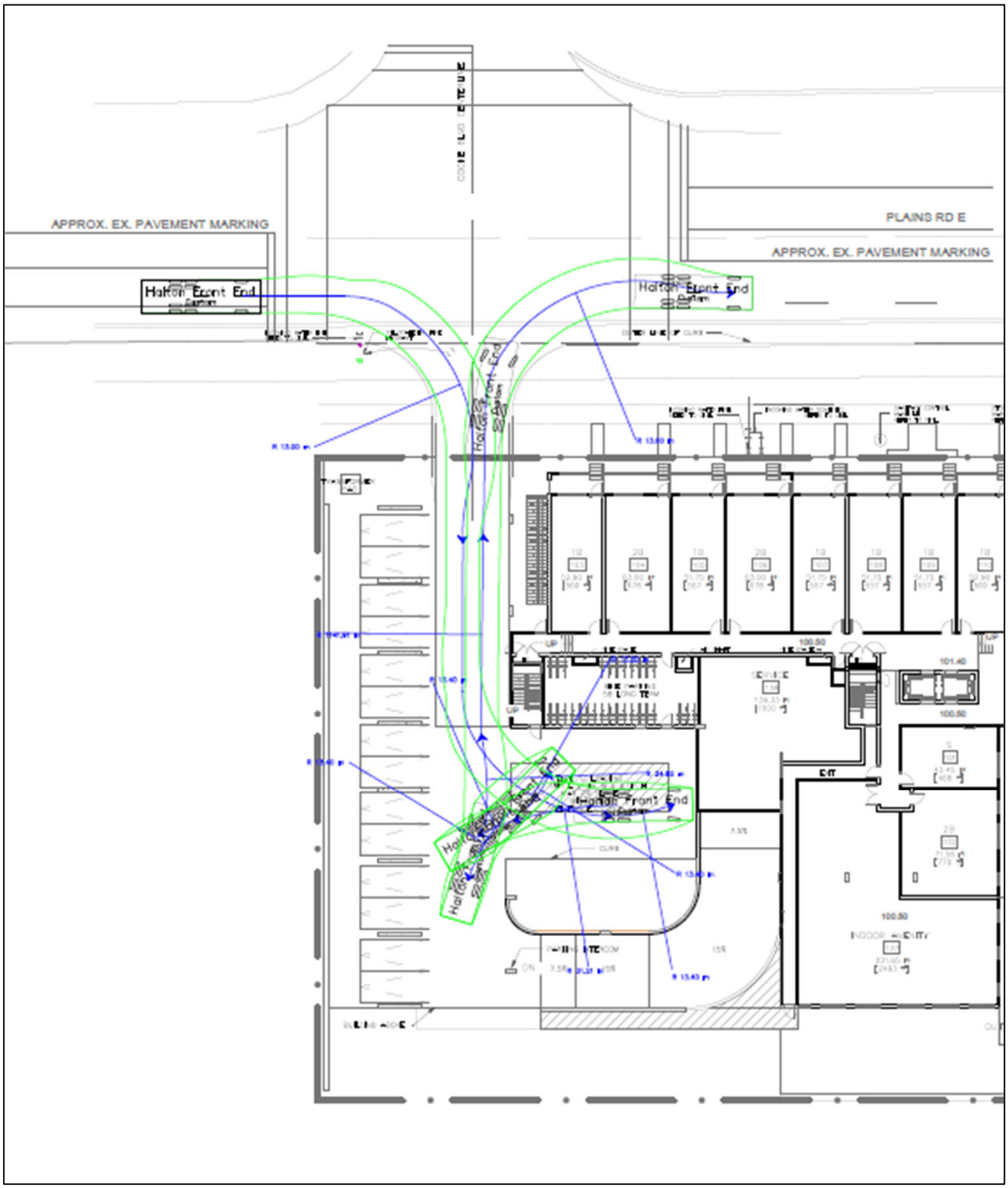


Reduce Scale Drawing
Do Not Scale

Loading Zone
TAC Medium Single Unit (MSU)
Front In Maneuver

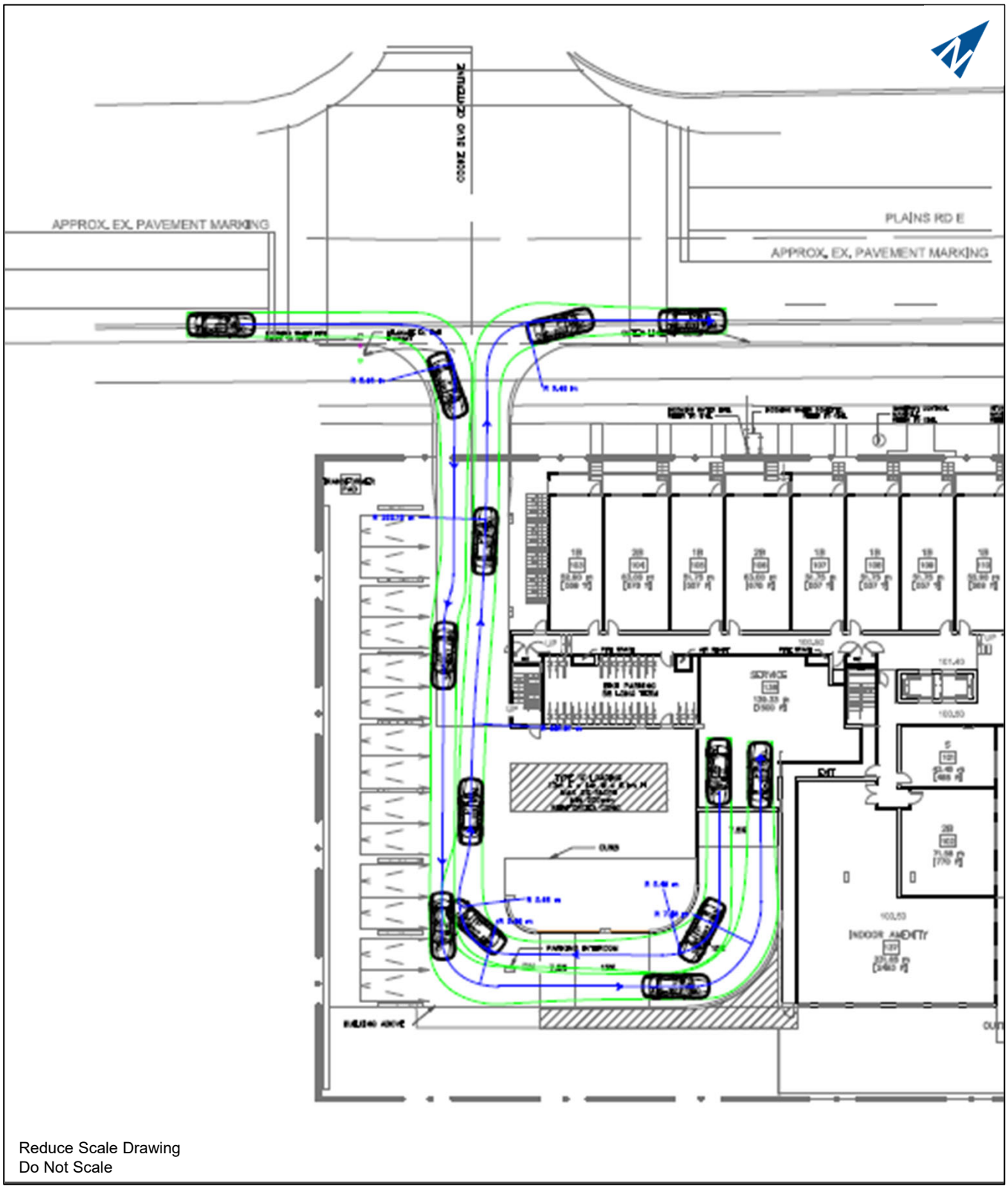
40-70 Plains Road East TIA
190488

Figure 4



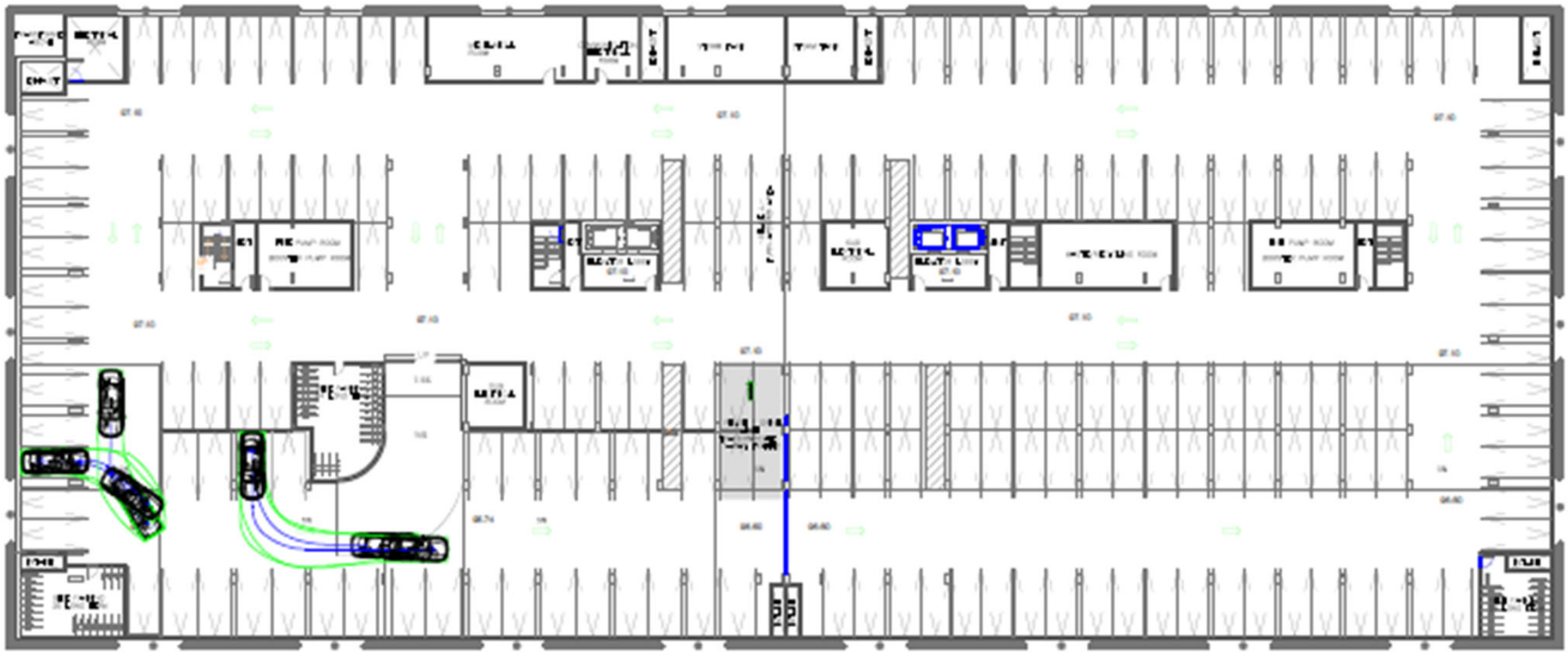
paradigm TRANSPORTATION SOLUTIONS LIMITED

Loading Zone
Halton Front End
Loading Garbage Truck



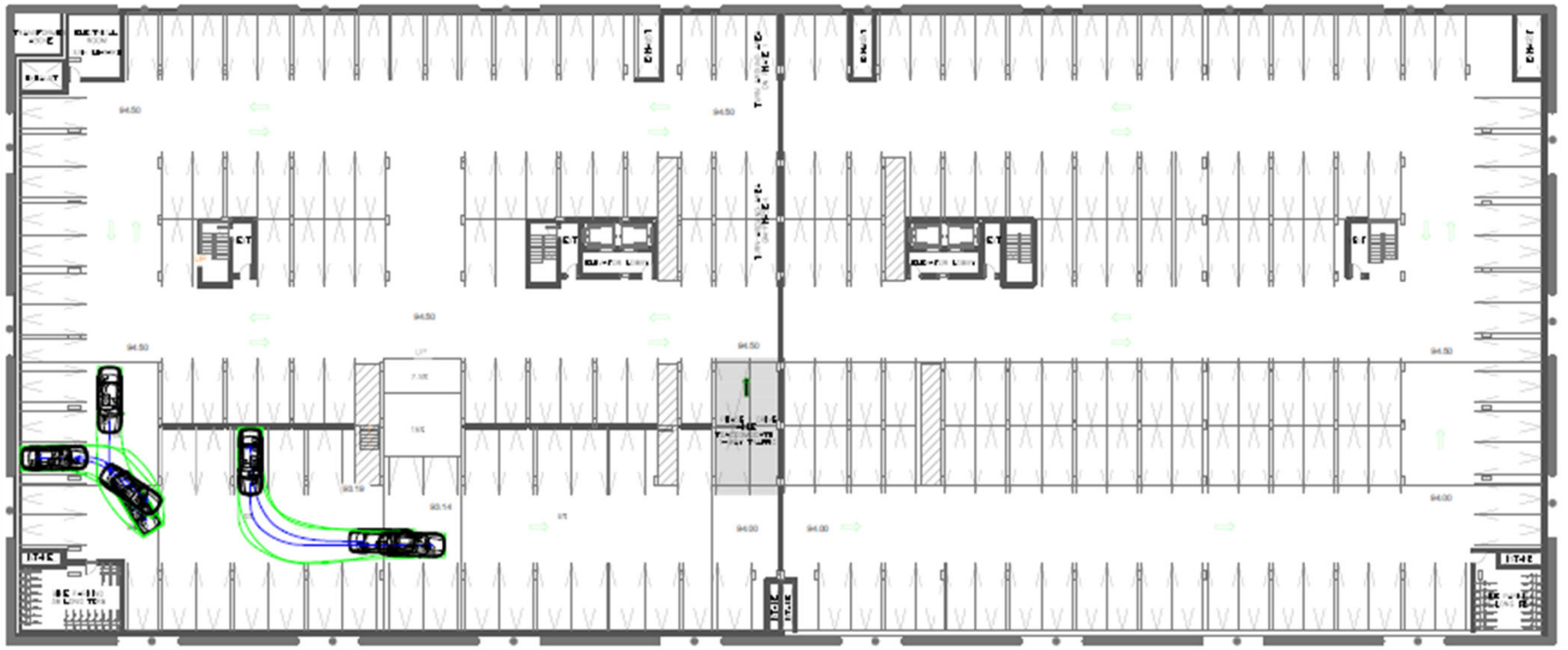
Reduce Scale Drawing
Do Not Scale

UG Ramp
TAC Passenger Car (P)
To/From Underground



NTS

Underground Parking Maneuver
TAC Passenger Car (P)
One-Way Drive Aisle P1



NTS

Underground Parking Maneuver
TAC Passenger Car (P)
One-Way Drive Aisle P2

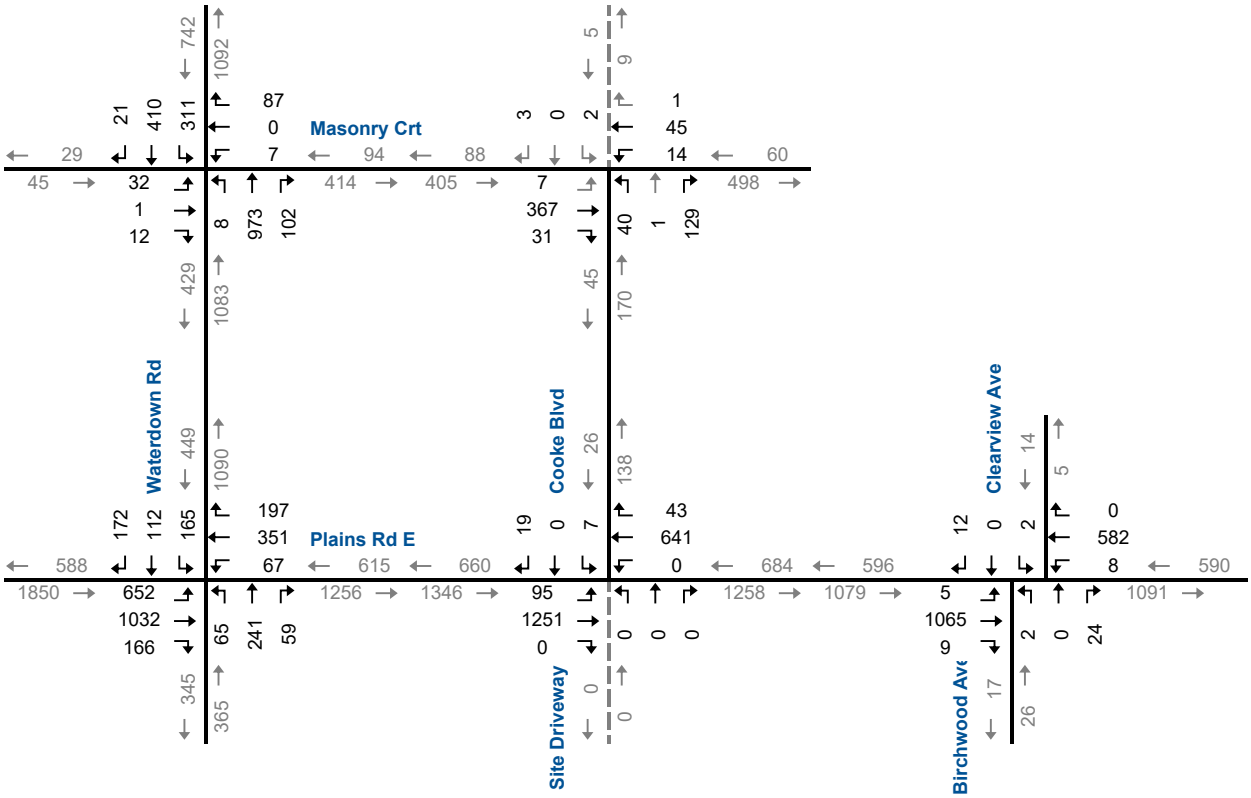
Appendix E

Detailed Background Traffic Forecast

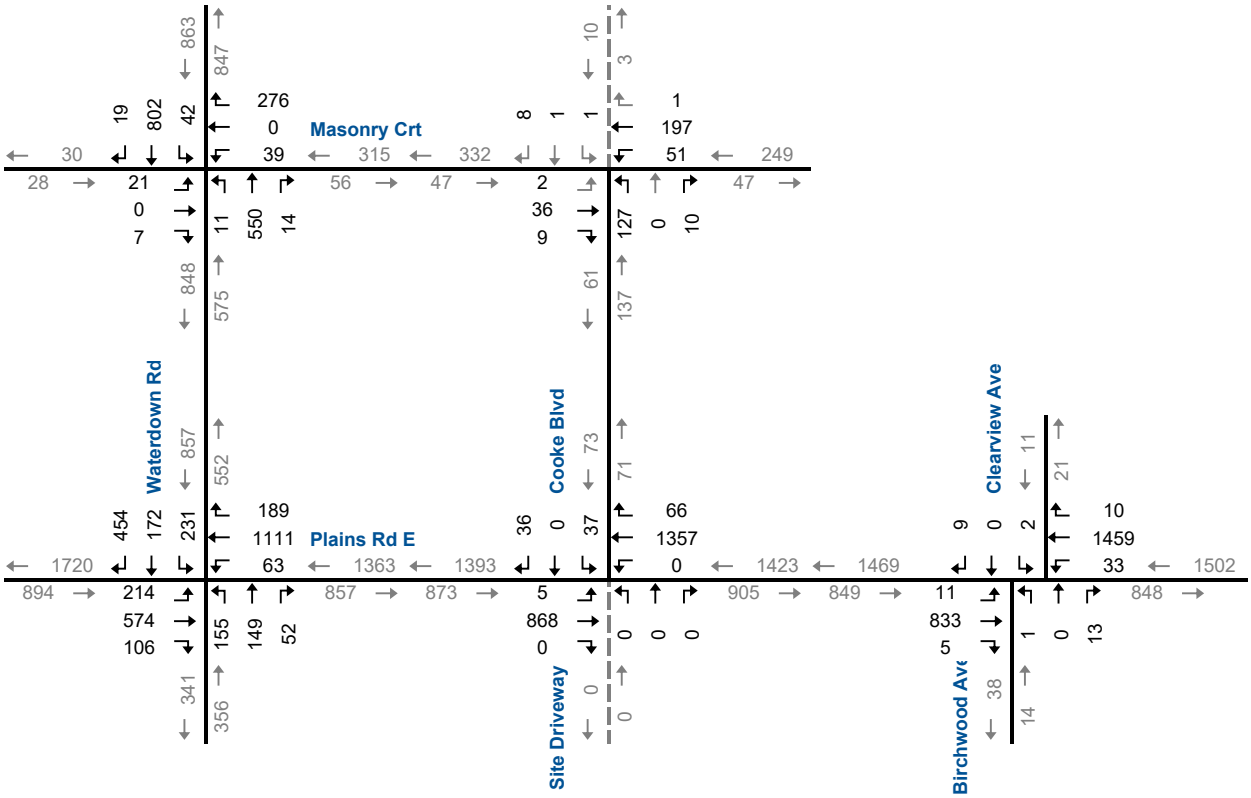


Generlaized Background Growth (Year 2029)

AM Peak Hour

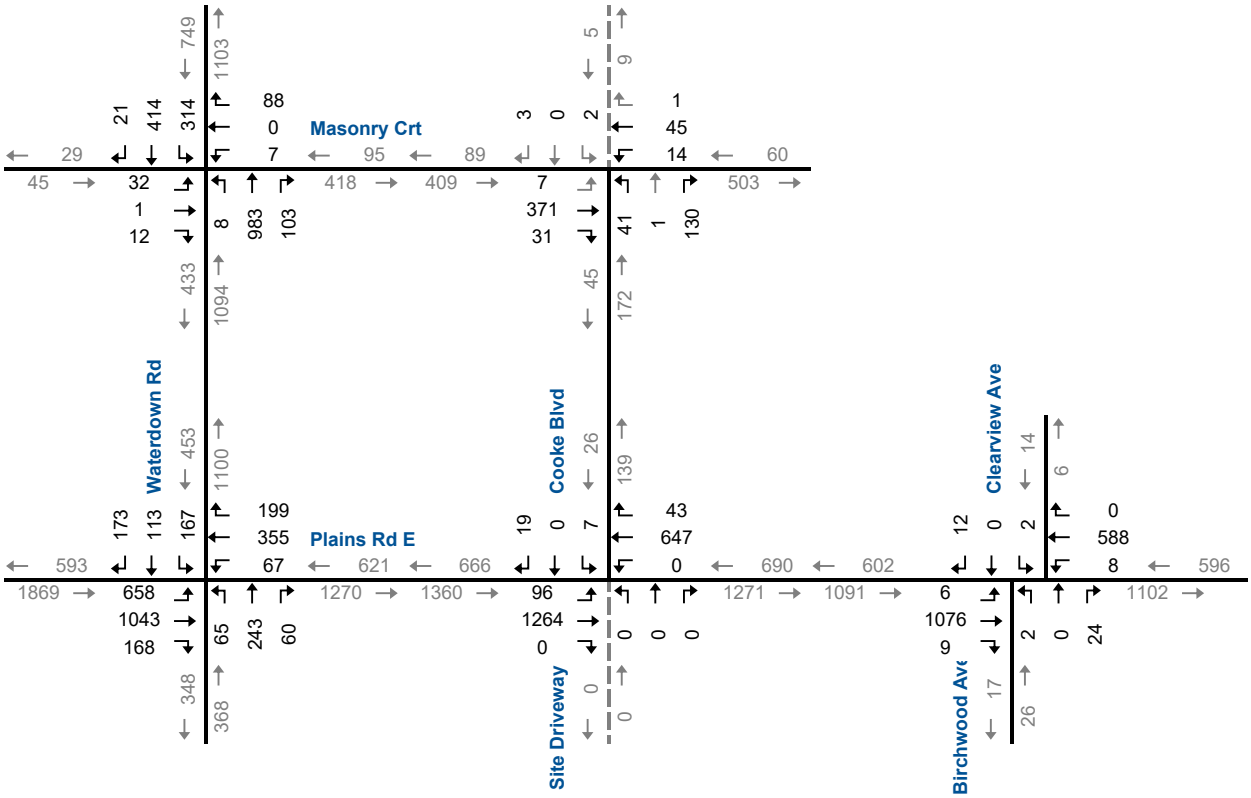


PM Peak Hour

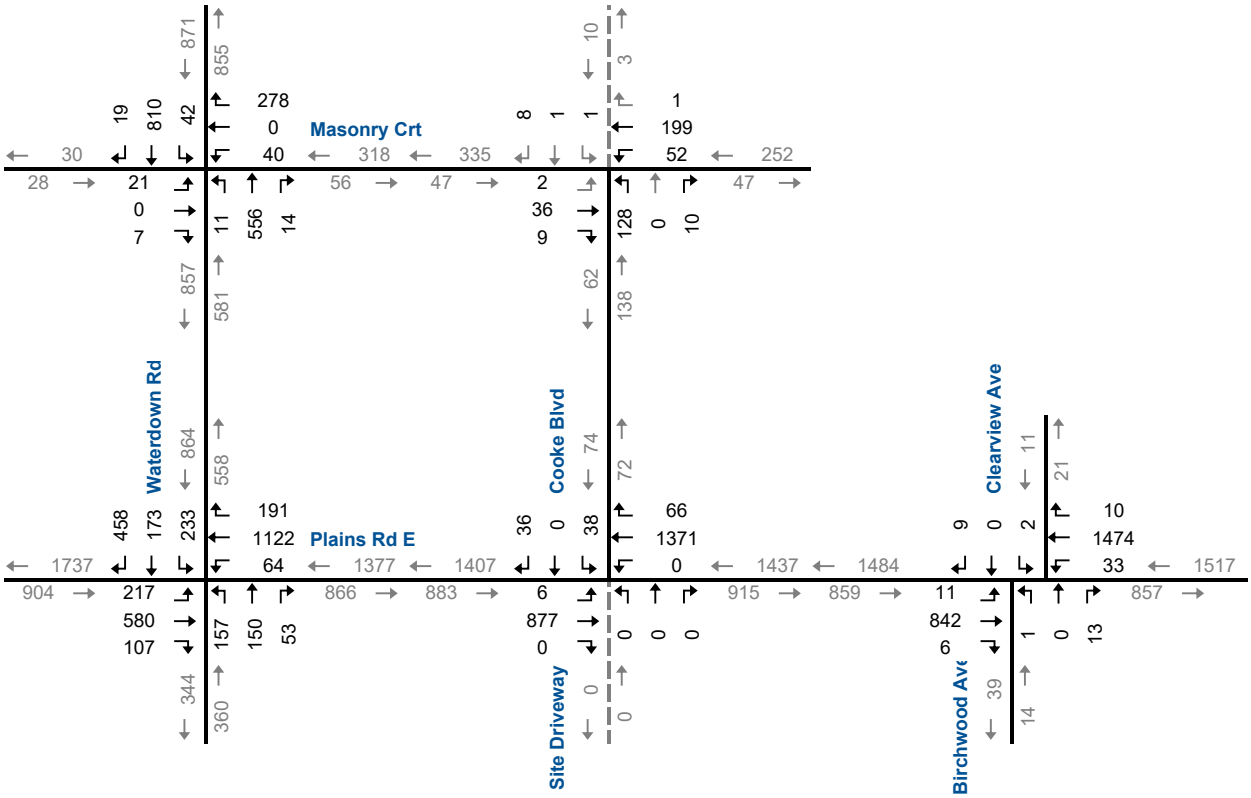


Generlaized Background Growth (Year 2030)

AM Peak Hour

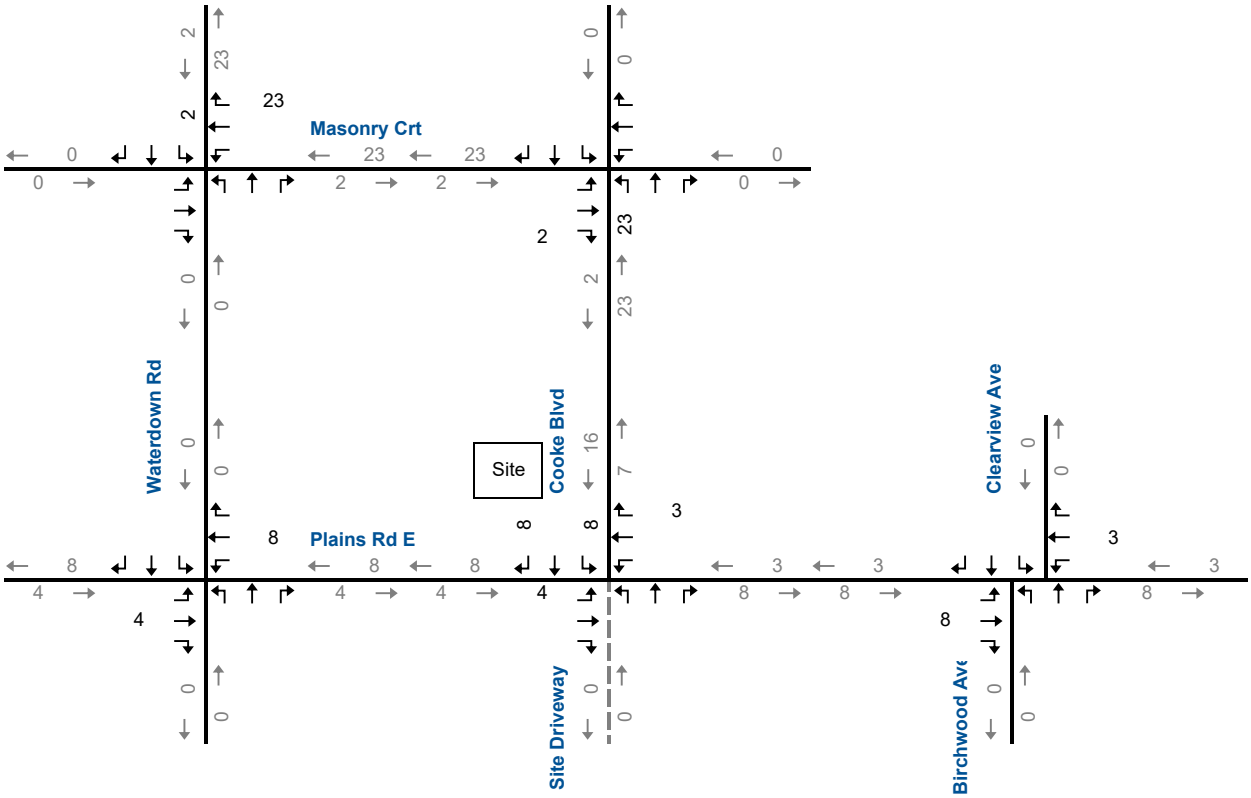


PM Peak Hour

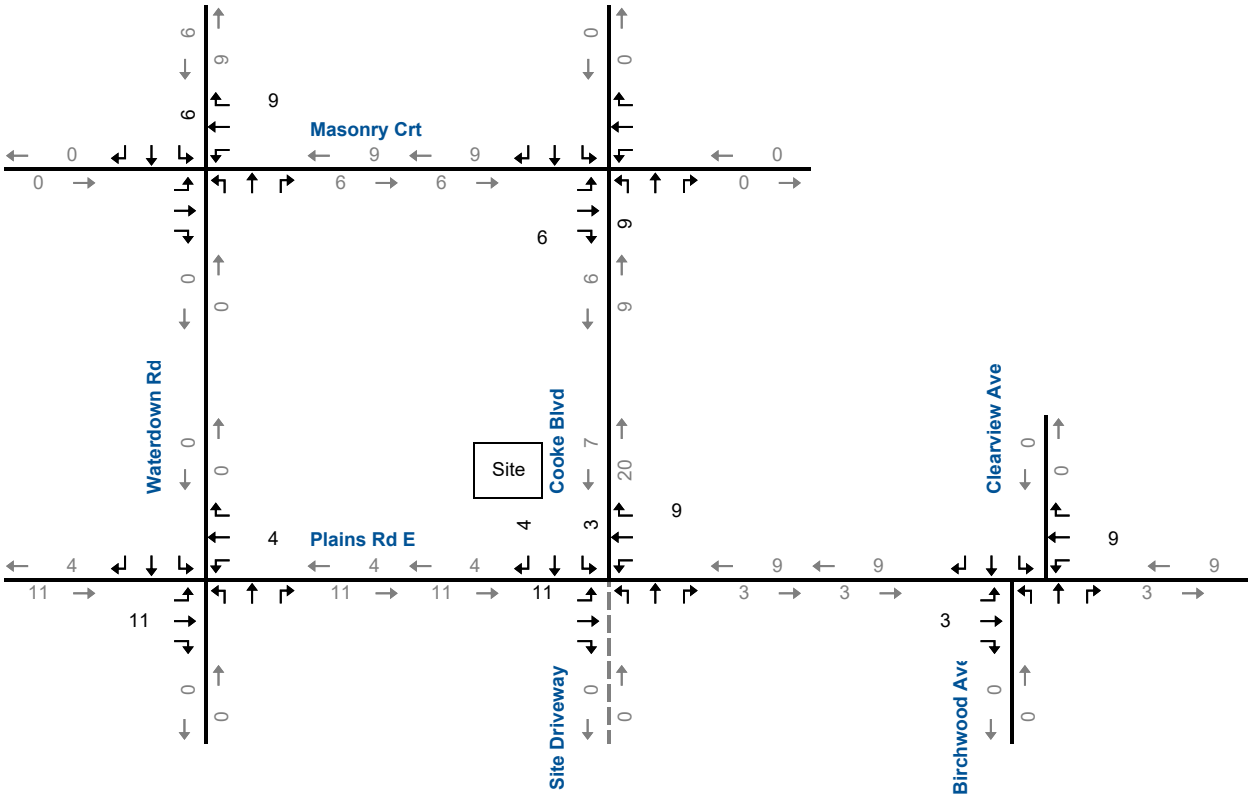


Adjacent Development #1 - 35 Plains Road East

AM Peak Hour

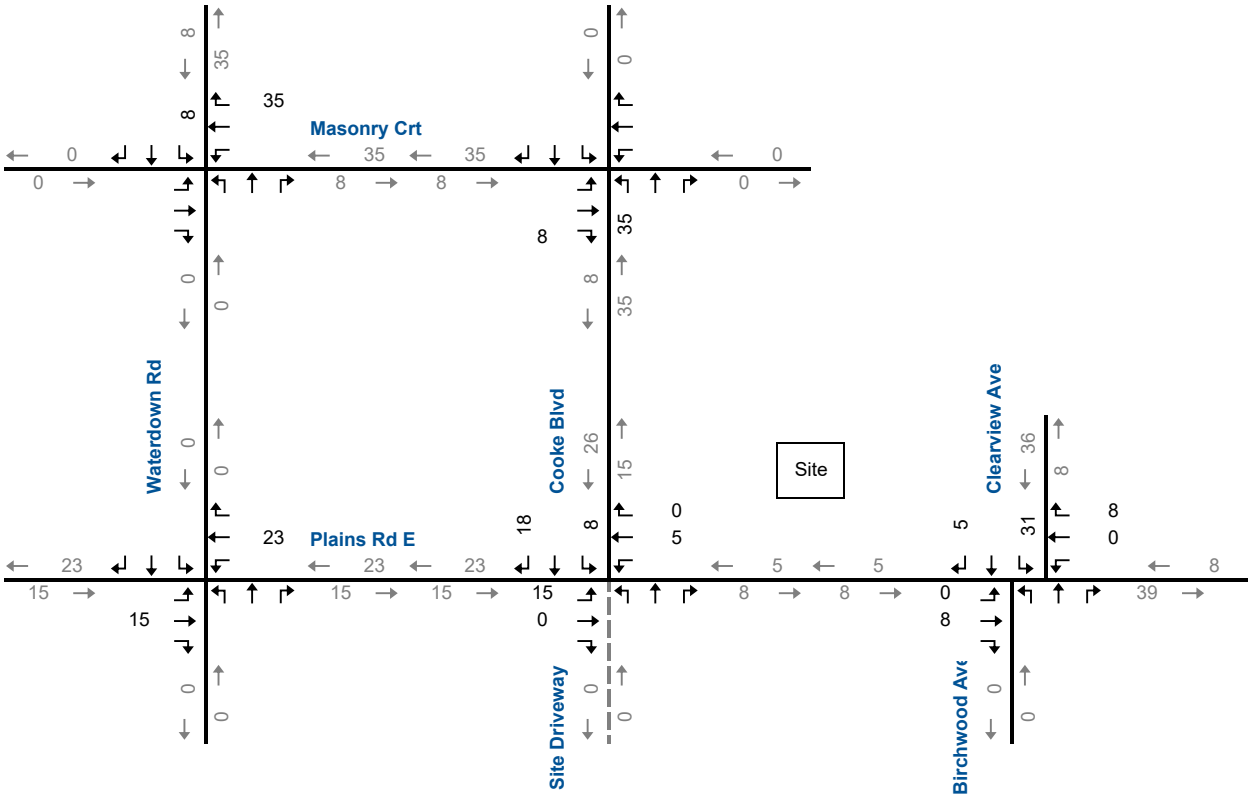


PM Peak Hour

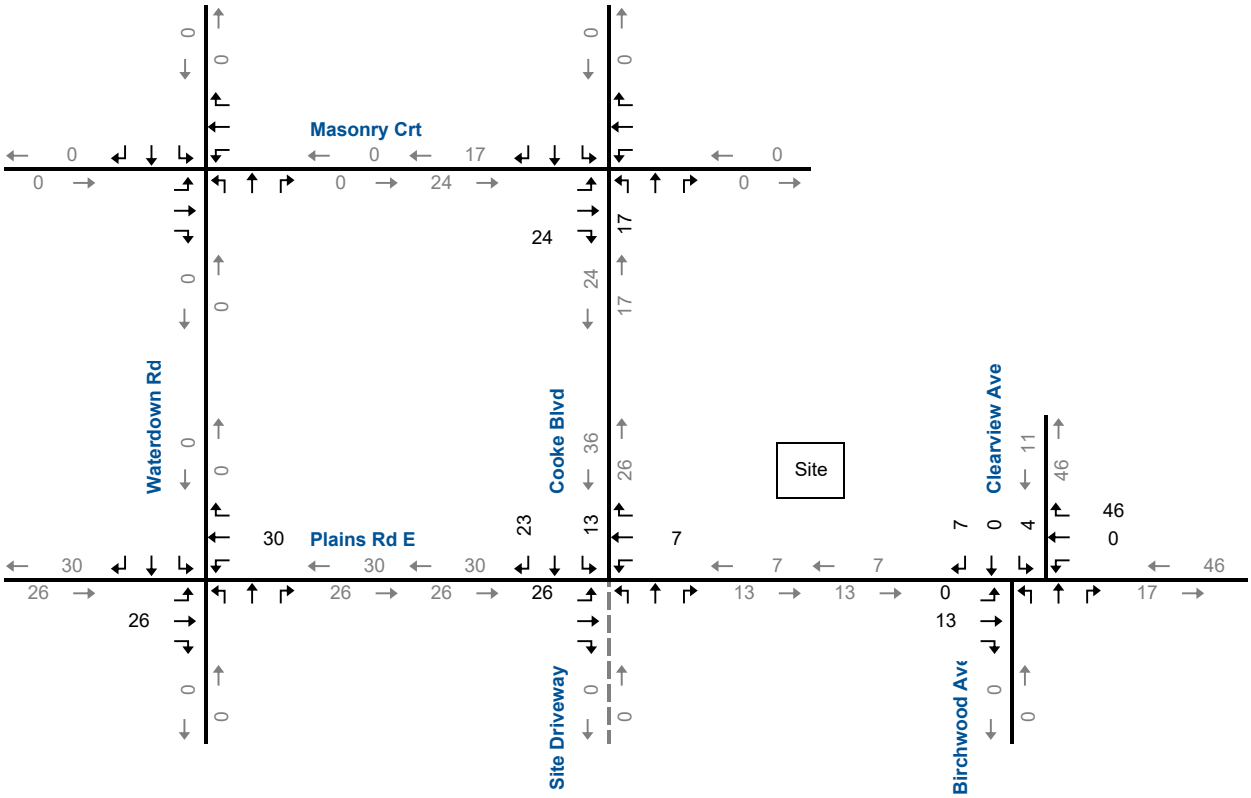


Adjacent Development #2 - 53-71 Plains Road East

AM Peak Hour

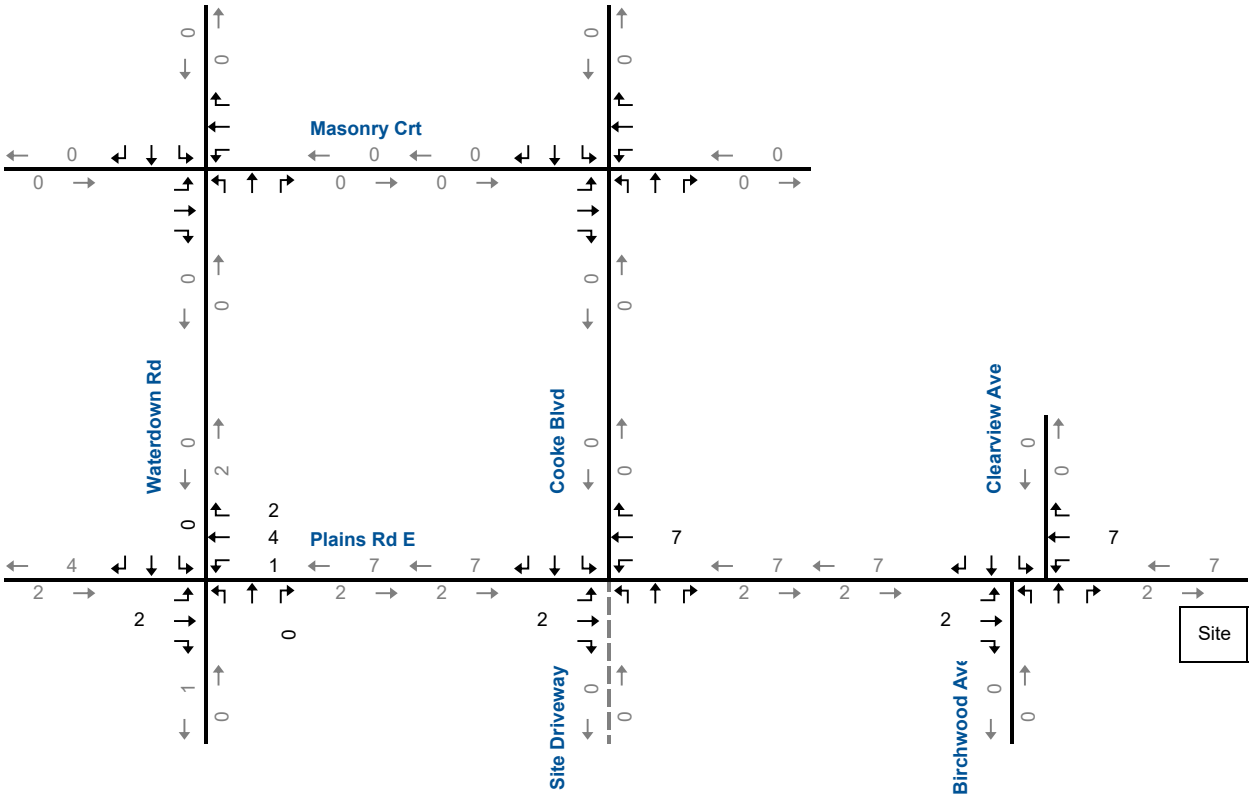


PM Peak Hour

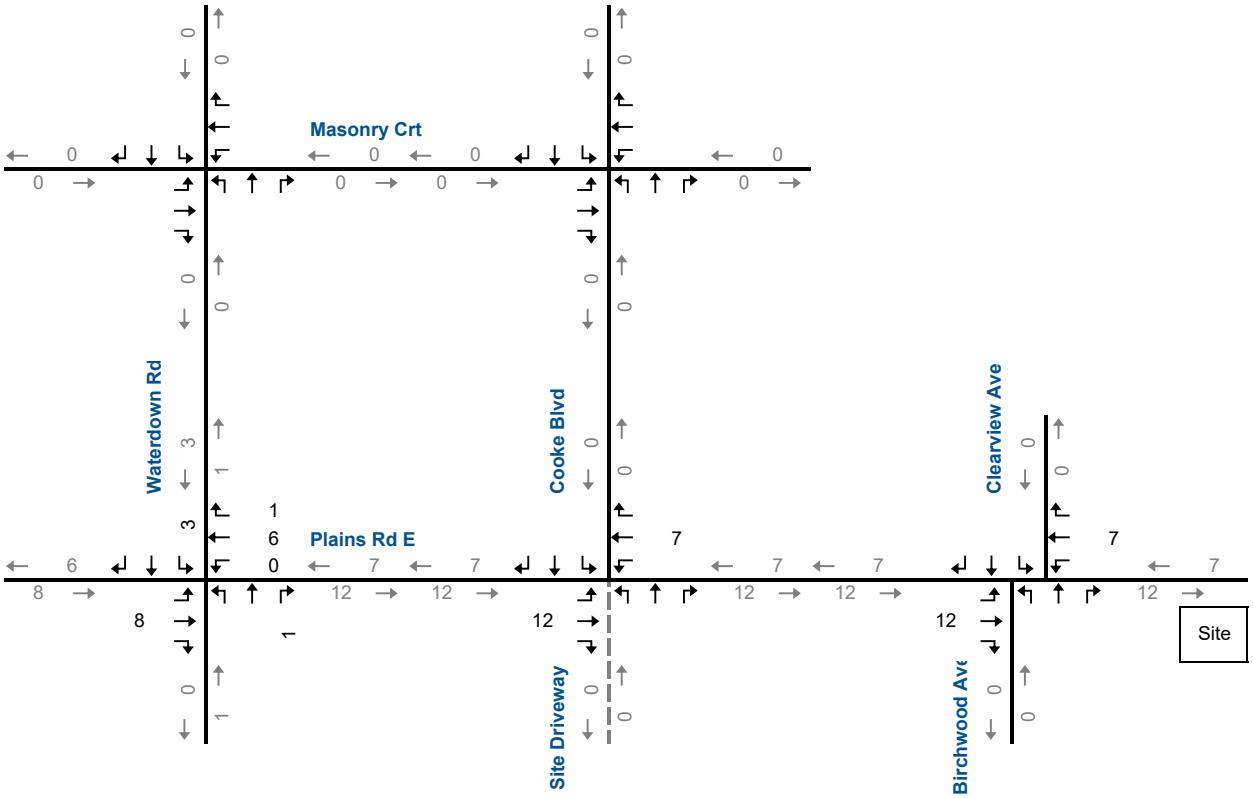


Adjacent Development #3 - 92 Plains Road East

AM Peak Hour

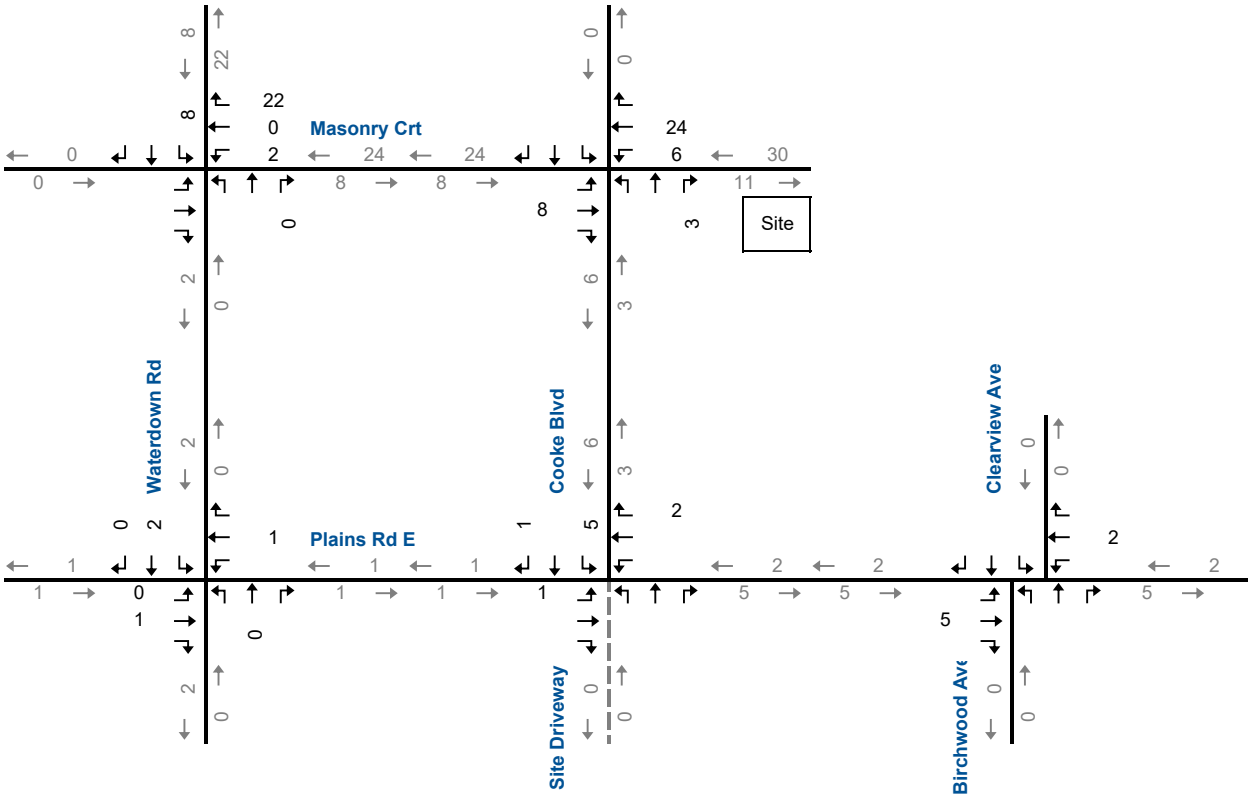


PM Peak Hour

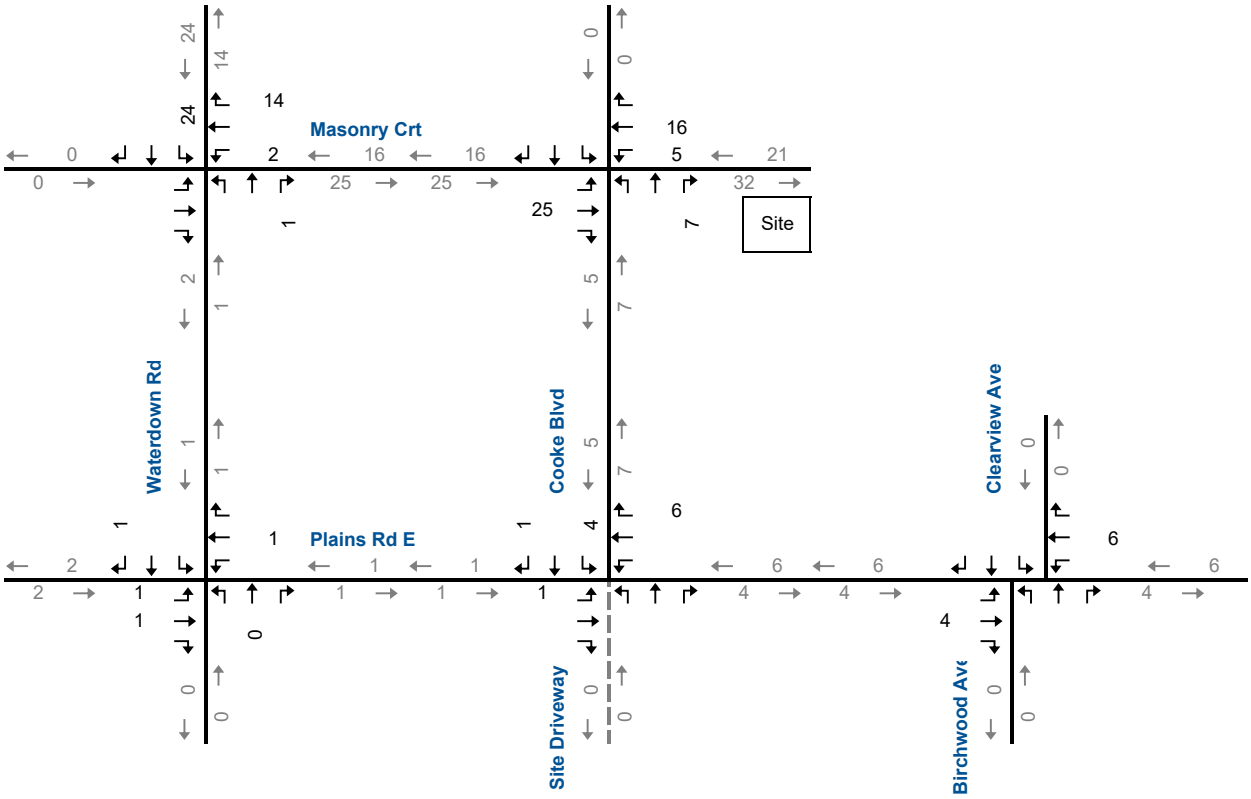


Adjacent Development #4 - 1085 Clearview Ave & 1082, 1086 &1090

AM Peak Hour

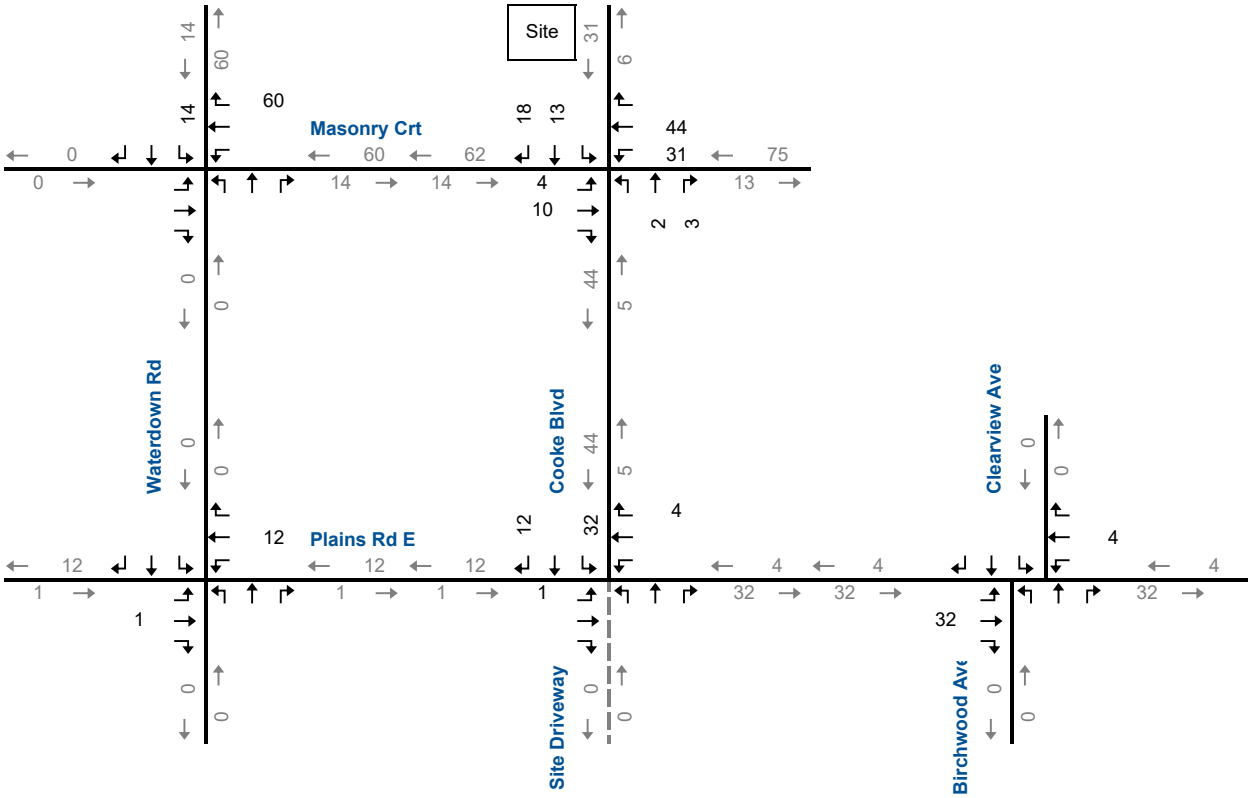


PM Peak Hour

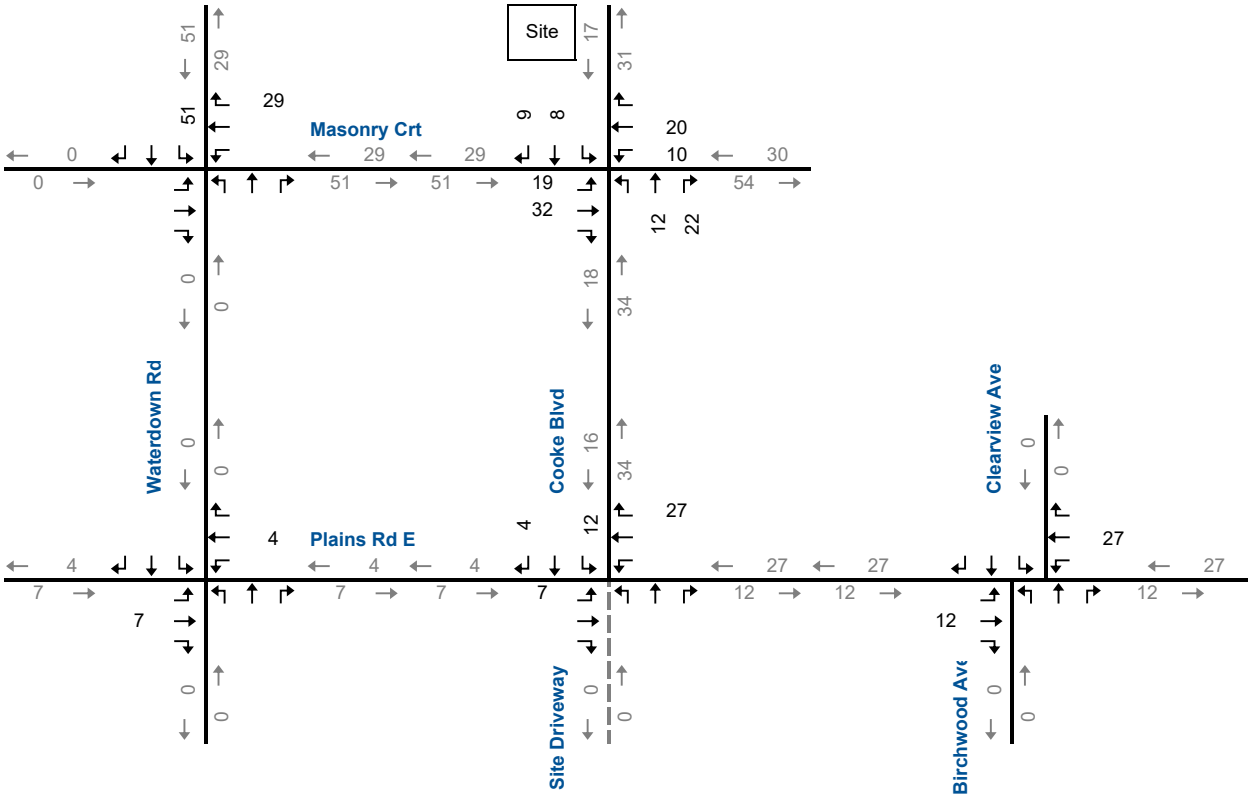


Adjacent Development #5 - 101 Masonry Court

AM Peak Hour

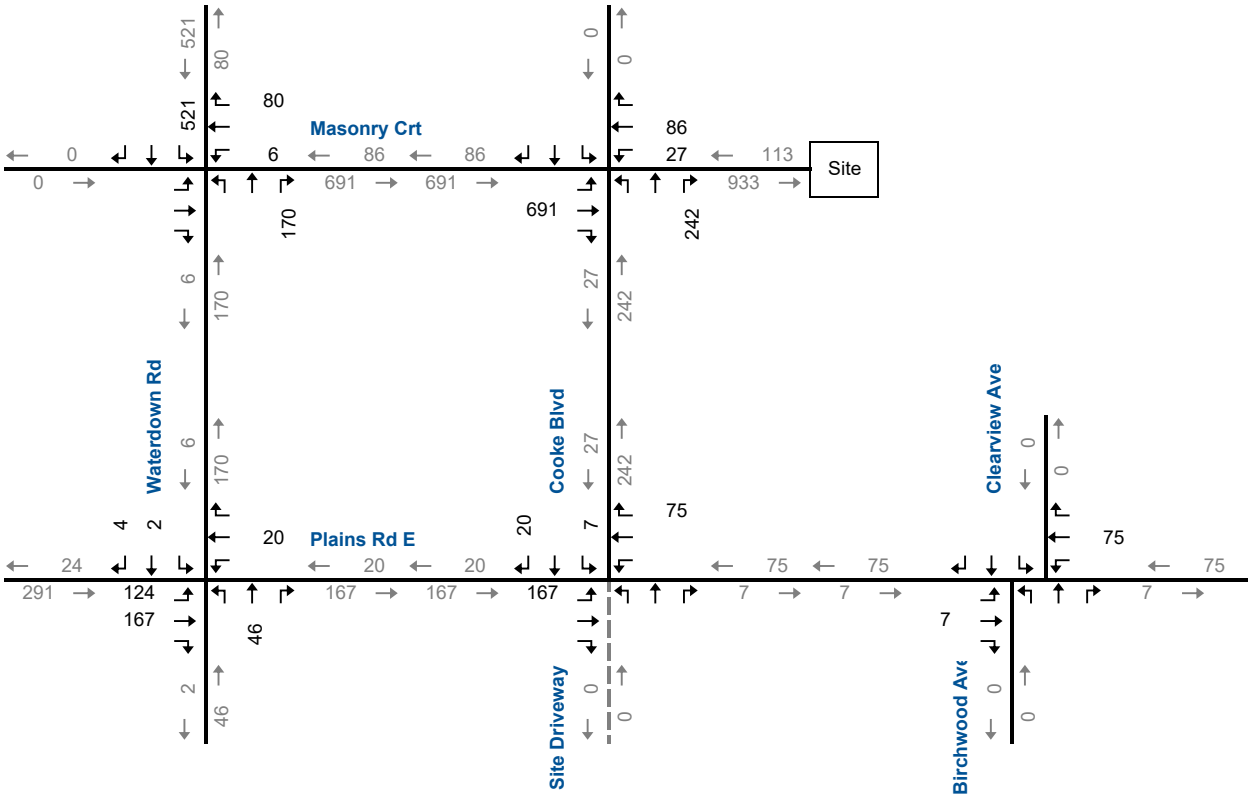


PM Peak Hour

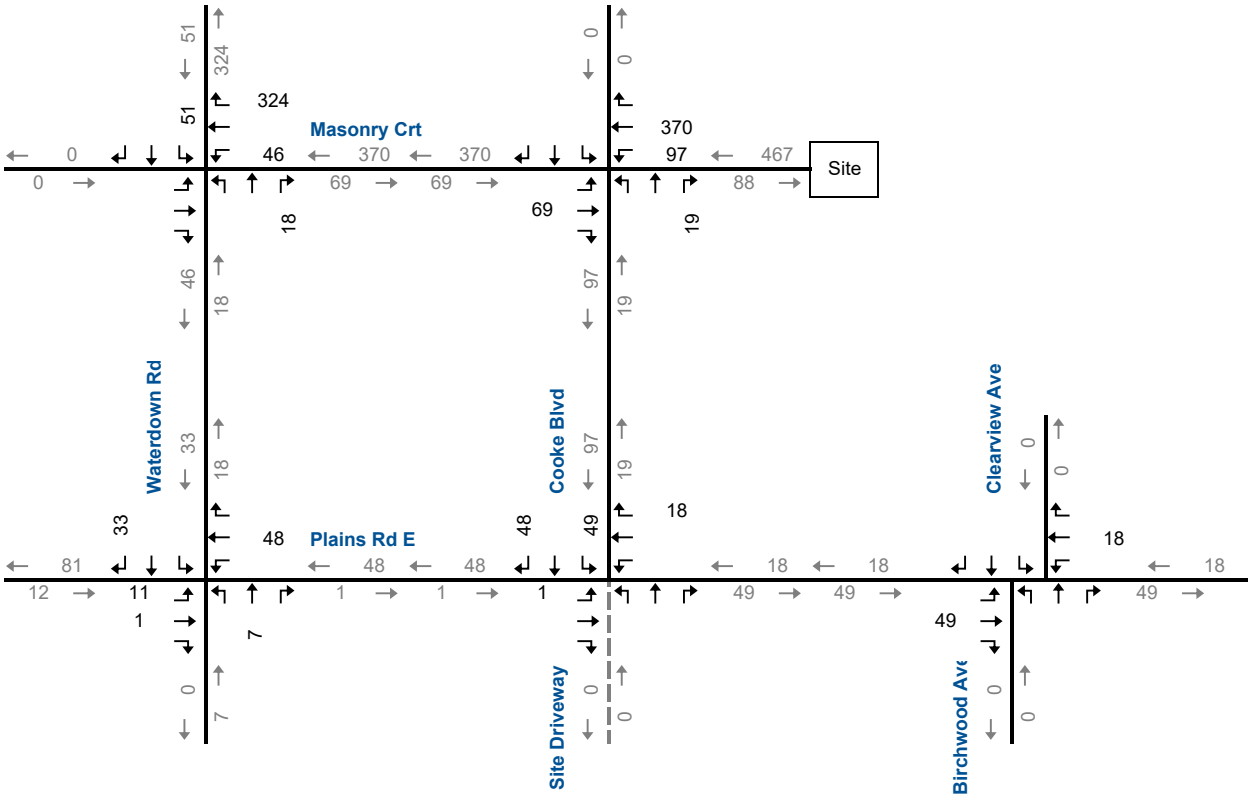


Adjacent Development #6 - Aldershot GO Station Parking Lot

AM Peak Hour



PM Peak Hour



Appendix F

Background Traffic Operations – Phase 1



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	826	1477	72	658	69	368	176	123	187
v/c Ratio	1.17	0.77	0.52	0.94	0.20	0.84	1.31	0.27	0.37
Control Delay	118.2	24.7	30.7	56.1	30.8	60.8	215.7	36.7	13.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	118.2	24.7	30.7	56.1	30.8	60.8	215.7	36.7	13.5
Queue Length 50th (m)	~231.4	150.1	7.8	79.0	12.0	84.3	~38.5	25.1	0.0
Queue Length 95th (m)	#310.6	182.5	16.3	#112.5	23.5	#132.1	m#85.4	m42.7	m28.2
Internal Link Dist (m)		169.9		129.1		138.9		321.6	
Turn Bay Length (m)	30.0		40.0		30.0				40.0
Base Capacity (vph)	709	1913	139	703	341	456	134	453	503
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	0.77	0.52	0.94	0.20	0.81	1.31	0.27	0.37

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	776	1222	166	68	419	199	65	287	59	165	116	176
Future Volume (vph)	776	1222	166	68	419	199	65	287	59	165	116	176
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.95		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1662	3412		1660	3280		1691	1802		1661	1776	1428
Flt Permitted	0.16	1.00		0.20	1.00		0.64	1.00		0.15	1.00	1.00
Satd. Flow (perm)	287	3412		343	3280		1141	1802		265	1776	1428
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	826	1300	177	72	446	212	69	305	63	176	123	187
RTOR Reduction (vph)	0	9	0	0	47	0	0	6	0	0	0	140
Lane Group Flow (vph)	826	1468	0	72	611	0	69	362	0	176	123	47
Confl. Peds. (#/hr)	6		19	19		6	17		7	7		17
Heavy Vehicles (%)	5%	3%	3%	5%	4%	4%	2%	2%	4%	5%	7%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		8
Actuated Green, G (s)	71.8	63.8		26.4	21.4		31.0	26.2		33.4	27.4	27.4
Effective Green, g (s)	70.8	65.8		24.4	23.4		29.0	29.2		31.4	30.4	30.4
Actuated g/C Ratio	0.59	0.55		0.20	0.19		0.24	0.24		0.26	0.25	0.25
Clearance Time (s)	3.0	6.0		3.0	6.0		3.0	7.0		3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	700	1870		113	639		293	438		127	449	361
v/s Ratio Prot	c0.46	0.43		0.02	0.19		0.01	0.20		c0.06	0.07	
v/s Ratio Perm	c0.24			0.11			0.05			c0.30		0.03
v/c Ratio	1.18	0.79		0.64	0.96		0.24	0.83		1.39	0.27	0.13
Uniform Delay, d1	30.6	21.5		39.9	47.8		36.0	43.0		42.9	35.9	34.6
Progression Factor	1.00	1.00		0.83	0.81		1.00	1.00		0.97	0.96	2.20
Incremental Delay, d2	95.3	3.4		10.6	25.2		0.4	12.1		214.5	0.3	0.2
Delay (s)	125.9	24.9		43.8	63.8		36.4	55.1		256.0	34.8	76.1
Level of Service	F	C		D	E		D	E		F	C	E
Approach Delay (s)		61.1			61.9			52.1			130.8	
Approach LOS		E			E			D			F	

Intersection Summary

HCM 2000 Control Delay	68.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.20		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	103.2%	ICU Level of Service	G
Analysis Period (min)	15		

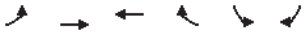
c Critical Lane Group



Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	298	1319	821	153
v/c Ratio	0.58	0.48	0.37	0.62
Control Delay	6.3	1.8	10.7	41.9
Queue Delay	0.0	0.4	0.0	0.0
Total Delay	6.3	2.2	10.7	41.9
Queue Length 50th (m)	5.9	14.2	41.5	25.7
Queue Length 95th (m)	m8.1	m16.5	76.3	m37.9
Internal Link Dist (m)		129.1	115.2	320.6
Turn Bay Length (m)	40.0			
Base Capacity (vph)	700	2748	2203	338
Starvation Cap Reductn	0	821	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.43	0.68	0.37	0.45

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	283	1253	653	127	67	78
Future Volume (vph)	283	1253	653	127	67	78
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.6	3.5	3.3	3.5
Total Lost time (s)	4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95	0.95		1.00	
Frpb, ped/bikes	1.00	1.00	0.99		0.99	
Flpb, ped/bikes	1.00	1.00	1.00		1.00	
Frt	1.00	1.00	0.98		0.93	
Flt Protected	0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1726	3505	3321		1401	
Flt Permitted	0.29	1.00	1.00		0.98	
Satd. Flow (perm)	521	3505	3321		1401	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	298	1319	687	134	71	82
RTOR Reduction (vph)	0	0	8	0	37	0
Lane Group Flow (vph)	298	1319	813	0	116	0
Confl. Peds. (#/hr)	4			4	2	3
Heavy Vehicles (%)	1%	3%	5%	8%	17%	18%
Turn Type	pm+pt	NA	NA		Prot	
Protected Phases	5	2	6		8	
Permitted Phases	2					
Actuated Green, G (s)	91.1	91.1	76.3		14.9	
Effective Green, g (s)	90.1	94.1	79.3		17.9	
Actuated g/C Ratio	0.75	0.78	0.66		0.15	
Clearance Time (s)	3.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	499	2748	2194		208	
v/s Ratio Prot	c0.05	0.38	0.24		c0.08	
v/s Ratio Perm	c0.39					
v/c Ratio	0.60	0.48	0.37		0.56	
Uniform Delay, d1	5.8	4.5	9.1		47.4	
Progression Factor	0.90	0.28	1.00		0.95	
Incremental Delay, d2	1.1	0.4	0.5		3.1	
Delay (s)	6.4	1.6	9.6		48.0	
Level of Service	A	A	A		D	
Approach Delay (s)		2.5	9.6		48.0	
Approach LOS		A	A		D	

Intersection Summary

HCM 2000 Control Delay	7.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	56.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	1127	9	8	673	8	2	0	24	33	0	17
Future Volume (Veh/h)	5	1127	9	8	673	8	2	0	24	33	0	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	5	1186	9	8	708	8	2	0	25	35	0	18
Pedestrians								9				
Lane Width (m)								3.6				
Walking Speed (m/s)								1.2				
Percent Blockage								1				
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (m)		139										
pX, platoon unblocked				0.88			0.88	0.88	0.88	0.88	0.88	
vC, conflicting volume	716			1204			1598	1942	606	1356	1942	358
vC1, stage 1 conf vol							1210	1210		728	728	
vC2, stage 2 conf vol							388	732		628	1214	
vCu, unblocked vol	716			951			1400	1792	269	1124	1793	358
tC, single (s)	4.1			4.4			7.5	6.5	7.0	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.3			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	99			99			99	100	96	89	100	97
cM capacity (veh/h)	894			564			226	242	626	331	238	619

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	598	602	362	362	27	53
Volume Left	5	0	8	0	2	35
Volume Right	0	9	0	8	25	18
cSH	894	1700	564	1700	554	393
Volume to Capacity	0.01	0.35	0.01	0.21	0.05	0.13
Queue Length 95th (m)	0.1	0.0	0.3	0.0	1.2	3.7
Control Delay (s)	0.2	0.0	0.5	0.0	11.8	15.6
Lane LOS	A		A		B	C
Approach Delay (s)	0.1		0.2		11.8	15.6
Approach LOS					B	C

Intersection Summary					
Average Delay	0.7				
Intersection Capacity Utilization	51.1%	ICU Level of Service		A	
Analysis Period (min)	15				



Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	48	16	323	8	1310	909	454
v/c Ratio	1.07	0.07	0.44	0.04	1.16	1.17	0.18
Control Delay	195.9	40.5	1.9	20.2	102.5	117.0	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	195.9	40.5	1.9	20.2	102.5	117.0	4.1
Queue Length 50th (m)	~10.0	3.4	0.0	1.2	~107.6	~253.2	12.8
Queue Length 95th (m)	#34.3	9.6	0.0	m1.0	m#182.6	#355.7	21.7
Internal Link Dist (m)	18.4		117.2		321.6		103.1
Turn Bay Length (m)		15.0		20.0		15.0	
Base Capacity (vph)	55	289	785	209	1133	780	2547
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.87	0.06	0.41	0.04	1.16	1.17	0.18

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	1	12	15	0	307	8	973	272	864	410	21
Future Volume (vph)	32	1	12	15	0	307	8	973	272	864	410	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00		1.00	0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.96		1.00	0.85		1.00	0.97		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1159		1745	1517		1219	3336		1745	3277	
Flt Permitted		0.18		0.76	1.00		0.49	1.00		0.10	1.00	
Satd. Flow (perm)		218		1389	1517		629	3336		179	3277	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	34	1	13	16	0	323	8	1024	286	909	432	22
RTOR Reduction (vph)	0	11	0	0	272	0	0	21	0	0	2	0
Lane Group Flow (vph)	0	37	0	16	51	0	8	1289	0	909	452	0
Confl. Peds. (#/hr)	1					1	1		2	2		1
Heavy Vehicles (%)	54%	100%	45%	0%	0%	5%	43%	5%	1%	0%	7%	53%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		15.8		15.8	15.8		38.0	38.0		91.2	91.2	
Effective Green, g (s)		18.8		18.8	18.8		40.0	40.0		90.2	93.2	
Actuated g/C Ratio		0.16		0.16	0.16		0.33	0.33		0.75	0.78	
Clearance Time (s)		7.0		7.0	7.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)		5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		34		217	237		209	1112		776	2545	
v/s Ratio Prot					0.03			c0.39		c0.48	0.14	
v/s Ratio Perm		c0.17		0.01			0.01			0.40		
v/c Ratio		1.09		0.07	0.21		0.04	1.16		1.17	0.18	
Uniform Delay, d1		50.6		43.2	44.1		27.0	40.0		30.9	3.5	
Progression Factor		1.00		1.00	1.00		0.74	0.83		1.00	1.00	
Incremental Delay, d2		182.4		0.3	0.9		0.0	72.5		90.6	0.2	
Delay (s)		233.0		43.5	45.1		19.9	105.5		121.6	3.6	
Level of Service		F		D	D		B	F		F	A	
Approach Delay (s)		233.0			45.0			105.0			82.3	
Approach LOS		F			D			F			F	

Intersection Summary				
HCM 2000 Control Delay	90.3	HCM 2000 Level of Service	F	
HCM 2000 Volume to Capacity ratio	1.15			
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	122.6%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	1076	41	78	199	1	98	3	377	2	13	21
Future Volume (Veh/h)	11	1076	41	78	199	1	98	3	377	2	13	21
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	14	1328	51	96	246	1	121	4	465	2	16	26
Pedestrians		1			7						5	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			1						0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		141										
pX, platoon unblocked				0.69			0.69	0.69	0.69	0.69	0.69	
vC, conflicting volume	252			1379			1855	1826	1360	2299	1850	252
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	252			1325			2013	1971	1298	2656	2007	252
tC, single (s)	4.1			4.1			7.2	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			74			0	87	0	0	47	97
cM capacity (veh/h)	1320			365			13	32	137	0	30	787

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	1393	343	590	44
Volume Left	14	96	121	2
Volume Right	51	1	465	26
cSH	1320	365	47	0
Volume to Capacity	0.01	0.26	12.59	Err
Queue Length 95th (m)	0.3	8.3	Err	Err
Control Delay (s)	0.5	9.2	Err	Err
Lane LOS	A	A	F	F
Approach Delay (s)	0.5	9.2	Err	Err
Approach LOS			F	F

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	109.1%	ICU Level of Service	H	
Analysis Period (min)	15			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	231	749	64	1423	158	213	239	176	498
v/c Ratio	0.91	0.42	0.19	0.95	0.50	0.49	0.85	0.38	0.91
Control Delay	64.9	17.8	8.8	33.2	33.5	36.4	46.7	24.1	37.0
Queue Delay	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	0.0
Total Delay	64.9	17.8	8.8	36.3	33.5	36.4	46.7	24.1	37.0
Queue Length 50th (m)	36.9	56.4	3.6	~173.4	24.4	36.8	41.4	32.5	75.4
Queue Length 95th (m)	#86.6	73.1	m5.4	#219.2	40.7	59.7	#47.2	39.4	#121.6
Internal Link Dist (m)		169.9		129.1		138.9		321.6	
Turn Bay Length (m)	30.0		40.0		30.0				40.0
Base Capacity (vph)	257	1779	339	1498	318	495	281	516	588
Starvation Cap Reductn	0	0	0	42	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.90	0.42	0.19	0.98	0.50	0.43	0.85	0.34	0.85

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	226	628	106	63	1204	190	155	156	53	234	172	488
Future Volume (vph)	226	628	106	63	1204	190	155	156	53	234	172	488
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		0.99	1.00		0.99	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.98		1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1662	3395		1653	3392		1701	1777		1661	1776	1440
Flt Permitted	0.08	1.00		0.35	1.00		0.56	1.00		0.39	1.00	1.00
Satd. Flow (perm)	142	3395		605	3392		1010	1777		679	1776	1440
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	231	641	108	64	1229	194	158	159	54	239	176	498
RTOR Reduction (vph)	0	11	0	0	11	0	0	11	0	0	0	177
Lane Group Flow (vph)	231	738	0	64	1412	0	158	202	0	239	176	321
Confl. Peds. (#/hr)	3		19	19		3	12		2	2		12
Heavy Vehicles (%)	5%	3%	3%	5%	4%	4%	2%	2%	4%	5%	7%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		8
Actuated Green, G (s)	62.6	54.7		51.1	46.2		29.4	23.4		33.4	25.4	25.4
Effective Green, g (s)	61.6	56.7		49.1	48.2		27.4	26.4		31.4	28.4	28.4
Actuated g/C Ratio	0.56	0.52		0.45	0.44		0.25	0.24		0.29	0.26	0.26
Clearance Time (s)	3.0	6.0		3.0	6.0		3.0	7.0		3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	250	1749		307	1486		282	426		256	458	371
v/s Ratio Prot	c0.10	0.22		0.01	c0.42		0.03	0.11		c0.06	0.10	
v/s Ratio Perm	0.41			0.09			0.11			0.21		c0.22
v/c Ratio	0.92	0.42		0.21	0.95		0.56	0.47		0.93	0.38	0.86
Uniform Delay, d1	32.6	16.5		17.6	29.7		35.5	35.8		38.0	33.6	39.0
Progression Factor	1.00	1.00		0.66	0.67		1.00	1.00		0.66	0.67	0.80
Incremental Delay, d2	36.8	0.7		0.3	11.4		2.5	0.8		36.9	0.5	17.5
Delay (s)	69.4	17.3		11.9	31.2		38.1	36.7		62.0	22.9	48.8
Level of Service	E	B		B	C		D	D		E	C	D
Approach Delay (s)		29.5			30.4			37.3			47.3	
Approach LOS		C			C			D			D	

Intersection Summary

HCM 2000 Control Delay	35.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

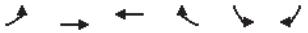
c Critical Lane Group



Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	53	907	1543	242
v/c Ratio	0.26	0.34	0.67	0.70
Control Delay	8.2	5.4	14.0	43.2
Queue Delay	0.0	0.1	0.8	0.1
Total Delay	8.2	5.5	14.8	43.3
Queue Length 50th (m)	3.1	33.2	107.4	42.0
Queue Length 95th (m)	m5.2	m36.8	146.5	67.2
Internal Link Dist (m)		129.1	115.2	320.6
Turn Bay Length (m)	40.0			
Base Capacity (vph)	214	2631	2316	402
Starvation Cap Reductn	0	432	0	0
Spillback Cap Reductn	0	0	433	5
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.25	0.41	0.82	0.61

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	51	880	1371	126	118	116
Future Volume (vph)	51	880	1371	126	118	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.6	3.5	3.3	3.5
Total Lost time (s)	4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95	0.95		1.00	
Frpb, ped/bikes	1.00	1.00	1.00		0.99	
Flpb, ped/bikes	1.00	1.00	1.00		1.00	
Frt	1.00	1.00	0.99		0.93	
Flt Protected	0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1745	3574	3468		1630	
Flt Permitted	0.10	1.00	1.00		0.98	
Satd. Flow (perm)	176	3574	3468		1630	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	53	907	1413	130	122	120
RTOR Reduction (vph)	0	0	5	0	34	0
Lane Group Flow (vph)	53	907	1538	0	208	0
Confl. Peds. (#/hr)	4			4	2	3
Heavy Vehicles (%)	0%	1%	2%	8%	3%	0%
Turn Type	pm+pt	NA	NA		Prot	
Protected Phases	5	2	6		8	
Permitted Phases	2					
Actuated Green, G (s)	78.0	78.0	69.7		18.0	
Effective Green, g (s)	77.0	81.0	72.7		21.0	
Actuated g/C Ratio	0.70	0.74	0.66		0.19	
Clearance Time (s)	3.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	184	2631	2292		311	
v/s Ratio Prot	0.01	c0.25	c0.44		c0.13	
v/s Ratio Perm	0.19					
v/c Ratio	0.29	0.34	0.67		0.67	
Uniform Delay, d1	10.3	5.1	11.4		41.3	
Progression Factor	1.17	0.92	1.00		0.95	
Incremental Delay, d2	0.8	0.3	1.6		5.4	
Delay (s)	12.7	5.0	12.9		44.5	
Level of Service	B	A	B		D	
Approach Delay (s)		5.4	12.9		44.5	
Approach LOS		A	B		D	

Intersection Summary

HCM 2000 Control Delay	13.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	926	5	33	1526	56	1	0	13	6	0	16
Future Volume (Veh/h)	11	926	5	33	1526	56	1	0	13	6	0	16
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	11	965	5	34	1590	58	1	0	14	6	0	17
Pedestrians					1			5			4	
Lane Width (m)					3.6			3.6			3.6	
Walking Speed (m/s)					1.2			1.2			1.2	
Percent Blockage					0			0			0	
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (m)		139										
pX, platoon unblocked				0.91			0.91	0.91	0.91	0.91	0.91	
vC, conflicting volume	1652			975			1874	2714	491	2210	2688	828
vC1, stage 1 conf vol							994	994		1691	1691	
vC2, stage 2 conf vol							880	1720		520	997	
vCu, unblocked vol	1652			782			1767	2687	252	2135	2658	828
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			96			100	100	98	93	100	95
cM capacity (veh/h)	395			768			201	117	685	91	127	317

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	494	488	829	853	15	23
Volume Left	11	0	34	0	1	6
Volume Right	0	5	0	58	14	17
cSH	395	1700	768	1700	590	193
Volume to Capacity	0.03	0.29	0.04	0.50	0.03	0.12
Queue Length 95th (m)	0.7	0.0	1.1	0.0	0.6	3.2
Control Delay (s)	0.9	0.0	1.2	0.0	11.3	26.2
Lane LOS	A		A		B	D
Approach Delay (s)	0.4		0.6		11.3	26.2
Approach LOS					B	D

Intersection Summary				
Average Delay	0.8			
Intersection Capacity Utilization	78.0%	ICU Level of Service	D	
Analysis Period (min)	15			



Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	29	91	679	11	607	181	855
v/c Ratio	0.13	0.23	0.85	0.05	0.38	0.40	0.41
Control Delay	2.1	24.3	22.0	21.9	19.1	15.9	15.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	2.1	24.3	22.0	21.9	19.1	15.9	15.0
Queue Length 50th (m)	0.0	14.5	56.2	1.3	44.0	18.0	52.8
Queue Length 95th (m)	1.4	21.8	90.0	m3.0	m72.5	39.7	90.6
Internal Link Dist (m)	18.4		117.2		321.6		103.1
Turn Bay Length (m)		15.0		20.0		15.0	
Base Capacity (vph)	283	565	952	209	1607	495	2071
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.16	0.71	0.05	0.38	0.37	0.41

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	21	0	7	87	0	652	11	550	33	174	802	19
Future Volume (vph)	21	0	7	87	0	652	11	550	33	174	802	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.97		1.00	0.85		1.00	0.99		1.00	1.00	
Flt Protected		0.96		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1425		1541	1540		1289	3433		1718	3480	
Flt Permitted		0.36		0.74	1.00		0.33	1.00		0.32	1.00	
Satd. Flow (perm)		533		1197	1540		449	3433		579	3480	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	22	0	7	91	0	679	11	573	34	181	835	20
RTOR Reduction (vph)	0	19	0	0	285	0	0	3	0	0	1	0
Lane Group Flow (vph)	0	10	0	91	394	0	11	604	0	181	854	0
Confl. Peds. (#/hr)	4		1	1		4	1		3	3		1
Heavy Vehicles (%)	26%	0%	17%	17%	0%	3%	40%	3%	23%	5%	2%	59%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		33.5		33.5	33.5		49.4	49.4		63.5	63.5	
Effective Green, g (s)		36.5		36.5	36.5		51.4	51.4		62.5	65.5	
Actuated g/C Ratio		0.33		0.33	0.33		0.47	0.47		0.57	0.60	
Clearance Time (s)		7.0		7.0	7.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)		5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		176		397	511		209	1604		433	2072	
v/s Ratio Prot					c0.26			0.18		0.04	c0.25	
v/s Ratio Perm		0.02		0.08			0.02			0.20		
v/c Ratio		0.05		0.23	0.77		0.05	0.38		0.42	0.41	
Uniform Delay, d1		25.0		26.6	33.0		16.0	18.9		12.4	11.9	
Progression Factor		1.00		1.00	1.00		0.84	0.82		1.00	1.00	
Incremental Delay, d2		0.3		0.6	8.3		0.3	0.4		0.7	0.6	
Delay (s)		25.3		27.2	41.3		13.7	16.0		13.1	12.5	
Level of Service		C		C	D		B	B		B	B	
Approach Delay (s)		25.3			39.6			16.0			12.6	
Approach LOS		C			D			B			B	

Intersection Summary				
HCM 2000 Control Delay	22.1	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.56			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	84.6%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	21	162	39	163	603	1	153	12	58	1	9	17
Future Volume (Veh/h)	21	162	39	163	603	1	153	12	58	1	9	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	26	200	48	201	744	1	189	15	72	1	11	21
Pedestrians					3			2			3	
Lane Width (m)					3.6			3.6			3.6	
Walking Speed (m/s)					1.2			1.2			1.2	
Percent Blockage					0			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		141										
pX, platoon unblocked				0.96			0.96	0.96	0.96	0.96	0.96	
vC, conflicting volume	748			250			1451	1428	229	1508	1452	748
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	748			203			1449	1425	182	1508	1450	748
tC, single (s)	4.6			4.1			7.1	6.5	6.2	7.1	6.5	6.8
tC, 2 stage (s)												
tF (s)	2.7			2.2			3.5	4.0	3.3	3.5	4.0	3.8
p0 queue free %	96			85			0	86	91	99	89	94
cM capacity (veh/h)	678			1329			77	107	832	67	104	334

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	274	946	276	33
Volume Left	26	201	189	1
Volume Right	48	1	72	21
cSH	678	1329	103	179
Volume to Capacity	0.04	0.15	2.69	0.18
Queue Length 95th (m)	1.0	4.3	205.7	5.2
Control Delay (s)	1.4	3.5	853.6	29.5
Lane LOS	A	A	F	D
Approach Delay (s)	1.4	3.5	853.6	29.5
Approach LOS			F	D

Intersection Summary				
Average Delay	157.1			
Intersection Capacity Utilization	82.4%	ICU Level of Service	E	
Analysis Period (min)	15			

Appendix G

Background Traffic Operations – Full Build-Out

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	832	1491	72	664	69	371	178	124	188
v/c Ratio	1.18	0.78	0.52	0.94	0.20	0.85	1.33	0.27	0.37
Control Delay	122.4	25.0	30.8	57.5	30.8	61.1	221.4	36.7	13.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	122.4	25.0	30.8	57.5	30.8	61.1	221.4	36.7	13.5
Queue Length 50th (m)	~234.5	152.8	7.8	80.0	12.0	85.2	~39.9	25.4	0.0
Queue Length 95th (m)	#313.7	185.6	16.2	#113.5	23.5	#134.2	m#87.0	m42.9	m28.5
Internal Link Dist (m)		169.9		129.1		138.9		321.6	
Turn Bay Length (m)	30.0		40.0		30.0				40.0
Base Capacity (vph)	707	1911	139	703	341	456	134	454	505
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.18	0.78	0.52	0.94	0.20	0.81	1.33	0.27	0.37

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	782	1233	168	68	423	201	65	289	60	167	117	177
Future Volume (vph)	782	1233	168	68	423	201	65	289	60	167	117	177
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.95		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1662	3411		1660	3280		1691	1802		1661	1776	1428
Flt Permitted	0.16	1.00		0.20	1.00		0.64	1.00		0.15	1.00	1.00
Satd. Flow (perm)	287	3411		343	3280		1138	1802		264	1776	1428
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	832	1312	179	72	450	214	69	307	64	178	124	188
RTOR Reduction (vph)	0	9	0	0	47	0	0	6	0	0	0	140
Lane Group Flow (vph)	832	1482	0	72	617	0	69	365	0	178	124	48
Confl. Peds. (#/hr)	6		19	19		6	17		7	7		17
Heavy Vehicles (%)	5%	3%	3%	5%	4%	4%	2%	2%	4%	5%	7%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		8
Actuated Green, G (s)	71.7	63.8		26.3	21.4		31.1	26.3		33.5	27.5	27.5
Effective Green, g (s)	70.7	65.8		24.3	23.4		29.1	29.3		31.5	30.5	30.5
Actuated g/C Ratio	0.59	0.55		0.20	0.19		0.24	0.24		0.26	0.25	0.25
Clearance Time (s)	3.0	6.0		3.0	6.0		3.0	7.0		3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	699	1870		112	639		293	439		127	451	362
v/s Ratio Prot	c0.46	0.43		0.02	0.19		0.01	0.20		c0.06	0.07	
v/s Ratio Perm	c0.24			0.11			0.05			c0.31		0.03
v/c Ratio	1.19	0.79		0.64	0.96		0.24	0.83		1.40	0.27	0.13
Uniform Delay, d1	30.6	21.7		40.0	47.9		35.9	43.0		42.9	35.9	34.5
Progression Factor	1.00	1.00		0.83	0.81		1.00	1.00		0.97	0.96	2.20
Incremental Delay, d2	99.5	3.5		11.3	26.9		0.4	12.6		220.8	0.3	0.2
Delay (s)	130.1	25.2		44.5	65.6		36.3	55.6		262.3	34.8	76.3
Level of Service	F	C		D	E		D	E		F	C	E
Approach Delay (s)		62.8			63.5			52.6			133.3	
Approach LOS		E			E			D			F	

Intersection Summary

HCM 2000 Control Delay	70.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.22		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	104.0%	ICU Level of Service	G
Analysis Period (min)	15		

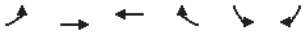
c Critical Lane Group



Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	299	1333	828	153
v/c Ratio	0.58	0.49	0.38	0.62
Control Delay	6.5	1.8	10.8	41.9
Queue Delay	0.0	0.4	0.0	0.0
Total Delay	6.5	2.2	10.8	41.9
Queue Length 50th (m)	5.9	14.4	42.1	25.7
Queue Length 95th (m)	m8.1	m16.8	77.2	m38.0
Internal Link Dist (m)		129.1	115.2	320.6
Turn Bay Length (m)	40.0			
Base Capacity (vph)	697	2748	2202	338
Starvation Cap Reductn	0	820	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.43	0.69	0.38	0.45

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	284	1266	659	127	67	78
Future Volume (vph)	284	1266	659	127	67	78
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.6	3.5	3.3	3.5
Total Lost time (s)	4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95	0.95		1.00	
Frpb, ped/bikes	1.00	1.00	0.99		0.99	
Flpb, ped/bikes	1.00	1.00	1.00		1.00	
Frt	1.00	1.00	0.98		0.93	
Flt Protected	0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1726	3505	3322		1401	
Flt Permitted	0.28	1.00	1.00		0.98	
Satd. Flow (perm)	516	3505	3322		1401	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	299	1333	694	134	71	82
RTOR Reduction (vph)	0	0	8	0	37	0
Lane Group Flow (vph)	299	1333	820	0	116	0
Confl. Peds. (#/hr)	4			4	2	3
Heavy Vehicles (%)	1%	3%	5%	8%	17%	18%
Turn Type	pm+pt	NA	NA		Prot	
Protected Phases	5	2	6		8	
Permitted Phases	2					
Actuated Green, G (s)	91.1	91.1	76.3		14.9	
Effective Green, g (s)	90.1	94.1	79.3		17.9	
Actuated g/C Ratio	0.75	0.78	0.66		0.15	
Clearance Time (s)	3.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	496	2748	2195		208	
v/s Ratio Prot	c0.05	0.38	0.25		c0.08	
v/s Ratio Perm	c0.40					
v/c Ratio	0.60	0.49	0.37		0.56	
Uniform Delay, d1	5.9	4.5	9.2		47.4	
Progression Factor	0.93	0.28	1.00		0.95	
Incremental Delay, d2	1.2	0.3	0.5		3.1	
Delay (s)	6.7	1.6	9.7		48.1	
Level of Service	A	A	A		D	
Approach Delay (s)		2.5	9.7		48.1	
Approach LOS		A	A		D	

Intersection Summary

HCM 2000 Control Delay	7.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	56.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	1138	9	8	679	8	2	0	24	33	0	17
Future Volume (Veh/h)	6	1138	9	8	679	8	2	0	24	33	0	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	6	1198	9	8	715	8	2	0	25	35	0	18
Pedestrians								9				
Lane Width (m)								3.6				
Walking Speed (m/s)								1.2				
Percent Blockage								1				
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (m)		139										
pX, platoon unblocked				0.87			0.87	0.87	0.87	0.87	0.87	
vC, conflicting volume	723			1216			1615	1962	612	1371	1963	362
vC1, stage 1 conf vol							1224	1224		735	735	
vC2, stage 2 conf vol							392	739		636	1228	
vCu, unblocked vol	723			959			1415	1813	268	1136	1813	362
tC, single (s)	4.1			4.4			7.5	6.5	7.0	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.3			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	99			99			99	100	96	89	100	97
cM capacity (veh/h)	889			559			222	239	625	327	235	615

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	605	608	366	366	27	53
Volume Left	6	0	8	0	2	35
Volume Right	0	9	0	8	25	18
cSH	889	1700	559	1700	551	389
Volume to Capacity	0.01	0.36	0.01	0.21	0.05	0.14
Queue Length 95th (m)	0.2	0.0	0.3	0.0	1.2	3.7
Control Delay (s)	0.2	0.0	0.5	0.0	11.9	15.7
Lane LOS	A		A		B	C
Approach Delay (s)	0.1		0.2		11.9	15.7
Approach LOS					B	C

Intersection Summary					
Average Delay	0.7				
Intersection Capacity Utilization	52.1%	ICU Level of Service		A	
Analysis Period (min)	15				

Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	48	16	324	8	1322	913	458
v/c Ratio	1.07	0.07	0.44	0.04	1.17	1.17	0.18
Control Delay	195.9	40.5	1.9	20.5	107.0	119.0	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	195.9	40.5	1.9	20.5	107.0	119.0	4.1
Queue Length 50th (m)	~10.0	3.4	0.0	0.0	~113.4	~255.3	12.9
Queue Length 95th (m)	#34.3	9.6	0.0	m1.0	m#183.2	#357.8	22.0
Internal Link Dist (m)	18.4		117.2		321.6		103.1
Turn Bay Length (m)		15.0		20.0		15.0	
Base Capacity (vph)	55	289	784	208	1133	780	2547
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.87	0.06	0.41	0.04	1.17	1.17	0.18

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	1	12	15	0	308	8	983	273	867	414	21
Future Volume (vph)	32	1	12	15	0	308	8	983	273	867	414	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00		1.00	0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.96		1.00	0.85		1.00	0.97		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1159		1745	1517		1219	3336		1745	3278	
Flt Permitted		0.18		0.76	1.00		0.49	1.00		0.10	1.00	
Satd. Flow (perm)		218		1389	1517		626	3336		179	3278	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	34	1	13	16	0	324	8	1035	287	913	436	22
RTOR Reduction (vph)	0	11	0	0	273	0	0	21	0	0	2	0
Lane Group Flow (vph)	0	37	0	16	51	0	8	1301	0	913	456	0
Confl. Peds. (#/hr)	1					1	1		2	2		1
Heavy Vehicles (%)	54%	100%	45%	0%	0%	5%	43%	5%	1%	0%	7%	53%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		15.8		15.8	15.8		38.0	38.0		91.2	91.2	
Effective Green, g (s)		18.8		18.8	18.8		40.0	40.0		90.2	93.2	
Actuated g/C Ratio		0.16		0.16	0.16		0.33	0.33		0.75	0.78	
Clearance Time (s)		7.0		7.0	7.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)		5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		34		217	237		208	1112		776	2545	
v/s Ratio Prot					0.03			c0.39		c0.48	0.14	
v/s Ratio Perm		c0.17		0.01			0.01			0.40		
v/c Ratio		1.09		0.07	0.21		0.04	1.17		1.18	0.18	
Uniform Delay, d1		50.6		43.2	44.2		27.0	40.0		30.9	3.5	
Progression Factor		1.00		1.00	1.00		0.74	0.82		1.00	1.00	
Incremental Delay, d2		182.4		0.3	0.9		0.0	77.3		92.7	0.2	
Delay (s)		233.0		43.5	45.1		20.1	110.3		123.6	3.6	
Level of Service		F		D	D		C	F		F	A	
Approach Delay (s)		233.0			45.0			109.7			83.5	
Approach LOS		F			D			F			F	

Intersection Summary				
HCM 2000 Control Delay	92.9	HCM 2000 Level of Service	F	
HCM 2000 Volume to Capacity ratio	1.16			
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	123.2%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	1080	41	78	199	1	99	3	378	2	13	21
Future Volume (Veh/h)	11	1080	41	78	199	1	99	3	378	2	13	21
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	14	1333	51	96	246	1	122	4	467	2	16	26
Pedestrians		1			7						5	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			1						0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		141										
pX, platoon unblocked				0.69			0.69	0.69	0.69	0.69	0.69	
vC, conflicting volume	252			1384			1860	1830	1366	2306	1856	252
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	252			1331			2023	1981	1304	2672	2017	252
tC, single (s)	4.1			4.1			7.2	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			73			0	87	0	0	46	97
cM capacity (veh/h)	1320			361			13	31	135	0	29	787

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	1398	343	593	44
Volume Left	14	96	122	2
Volume Right	51	1	467	26
cSH	1320	361	45	0
Volume to Capacity	0.01	0.27	13.12	Err
Queue Length 95th (m)	0.3	8.4	Err	Err
Control Delay (s)	0.5	9.3	Err	Err
Lane LOS	A	A	F	F
Approach Delay (s)	0.5	9.3	Err	Err
Approach LOS			F	F

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	109.3%	ICU Level of Service	H	
Analysis Period (min)	15			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	234	756	65	1436	160	215	241	177	502
v/c Ratio	0.91	0.43	0.19	0.97	0.50	0.49	0.85	0.38	0.91
Control Delay	64.6	18.0	8.8	36.0	33.5	36.3	46.8	23.8	37.8
Queue Delay	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0
Total Delay	64.6	18.0	8.8	40.8	33.5	36.3	46.8	23.8	37.8
Queue Length 50th (m)	37.6	57.2	3.6	~182.2	24.7	37.2	41.8	32.7	76.9
Queue Length 95th (m)	#87.8	74.0	m5.4	#221.2	41.2	60.5	#47.6	38.8	#124.8
Internal Link Dist (m)		169.9		129.1		138.9		321.6	
Turn Bay Length (m)	30.0		40.0		30.0				40.0
Base Capacity (vph)	259	1771	335	1484	320	495	282	516	587
Starvation Cap Reductn	0	0	0	42	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.90	0.43	0.19	1.00	0.50	0.43	0.85	0.34	0.86

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	229	634	107	64	1215	192	157	157	54	236	173	492
Future Volume (vph)	229	634	107	64	1215	192	157	157	54	236	173	492
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		0.99	1.00		0.99	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.98		1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1662	3395		1653	3392		1701	1776		1661	1776	1440
Flt Permitted	0.08	1.00		0.34	1.00		0.56	1.00		0.39	1.00	1.00
Satd. Flow (perm)	143	3395		600	3392		1008	1776		677	1776	1440
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	234	647	109	65	1240	196	160	160	55	241	177	502
RTOR Reduction (vph)	0	11	0	0	11	0	0	11	0	0	0	176
Lane Group Flow (vph)	234	745	0	65	1425	0	160	204	0	241	177	326
Confl. Peds. (#/hr)	3		19	19		3	12		2	2		12
Heavy Vehicles (%)	5%	3%	3%	5%	4%	4%	2%	2%	4%	5%	7%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		8
Actuated Green, G (s)	62.4	54.5		50.7	45.8		29.6	23.6		33.6	25.6	25.6
Effective Green, g (s)	61.4	56.5		48.7	47.8		27.6	26.6		31.6	28.6	28.6
Actuated g/C Ratio	0.56	0.51		0.44	0.43		0.25	0.24		0.29	0.26	0.26
Clearance Time (s)	3.0	6.0		3.0	6.0		3.0	7.0		3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	253	1743		302	1473		284	429		257	461	374
v/s Ratio Prot	c0.11	0.22		0.01	c0.42		0.03	0.11		c0.06	0.10	
v/s Ratio Perm	0.41			0.09			0.12			0.21		c0.23
v/c Ratio	0.92	0.43		0.22	0.97		0.56	0.47		0.94	0.38	0.87
Uniform Delay, d1	32.8	16.7		17.8	30.3		35.5	35.7		37.9	33.5	38.9
Progression Factor	1.00	1.00		0.66	0.67		1.00	1.00		0.66	0.66	0.80
Incremental Delay, d2	36.7	0.8		0.3	13.8		2.6	0.8		37.5	0.5	18.4
Delay (s)	69.4	17.4		12.1	34.0		38.0	36.5		62.4	22.6	49.6
Level of Service	E	B		B	C		D	D		E	C	D
Approach Delay (s)		29.7			33.1			37.2			47.7	
Approach LOS		C			C			D			D	

Intersection Summary

HCM 2000 Control Delay	36.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	54	916	1558	243
v/c Ratio	0.26	0.35	0.67	0.70
Control Delay	8.6	5.4	14.2	43.5
Queue Delay	0.0	0.1	0.9	0.1
Total Delay	8.6	5.5	15.1	43.6
Queue Length 50th (m)	3.2	33.5	109.7	42.4
Queue Length 95th (m)	m5.2	m37.1	149.1	68.0
Internal Link Dist (m)		129.1	115.2	320.6
Turn Bay Length (m)	40.0			
Base Capacity (vph)	211	2628	2312	401
Starvation Cap Reductn	0	421	0	0
Spillback Cap Reductn	0	0	434	4
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.26	0.42	0.83	0.61

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	52	889	1385	126	119	116
Future Volume (vph)	52	889	1385	126	119	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.6	3.5	3.3	3.5
Total Lost time (s)	4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95	0.95		1.00	
Frpb, ped/bikes	1.00	1.00	1.00		0.99	
Flpb, ped/bikes	1.00	1.00	1.00		1.00	
Frt	1.00	1.00	0.99		0.93	
Flt Protected	0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1745	3574	3469		1631	
Flt Permitted	0.09	1.00	1.00		0.98	
Satd. Flow (perm)	171	3574	3469		1631	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	54	916	1428	130	123	120
RTOR Reduction (vph)	0	0	5	0	33	0
Lane Group Flow (vph)	54	916	1553	0	210	0
Confl. Peds. (#/hr)	4			4	2	3
Heavy Vehicles (%)	0%	1%	2%	8%	3%	0%
Turn Type	pm+pt	NA	NA		Prot	
Protected Phases	5	2	6		8	
Permitted Phases	2					
Actuated Green, G (s)	77.9	77.9	69.6		18.1	
Effective Green, g (s)	76.9	80.9	72.6		21.1	
Actuated g/C Ratio	0.70	0.74	0.66		0.19	
Clearance Time (s)	3.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	181	2628	2289		312	
v/s Ratio Prot	0.01	c0.26	c0.45		c0.13	
v/s Ratio Perm	0.20					
v/c Ratio	0.30	0.35	0.68		0.67	
Uniform Delay, d1	10.6	5.2	11.5		41.2	
Progression Factor	1.22	0.91	1.00		0.95	
Incremental Delay, d2	0.8	0.3	1.6		5.6	
Delay (s)	13.6	5.0	13.2		44.7	
Level of Service	B	A	B		D	
Approach Delay (s)		5.5	13.2		44.7	
Approach LOS		A	B		D	

Intersection Summary				
HCM 2000 Control Delay	13.2	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.67			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	63.7%	ICU Level of Service	B	
Analysis Period (min)	15			

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	935	6	33	1541	56	1	0	13	6	0	16
Future Volume (Veh/h)	11	935	6	33	1541	56	1	0	13	6	0	16
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	11	974	6	34	1605	58	1	0	14	6	0	17
Pedestrians					1			5			4	
Lane Width (m)					3.6			3.6			3.6	
Walking Speed (m/s)					1.2			1.2			1.2	
Percent Blockage					0			0			0	
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (m)		139										
pX, platoon unblocked				0.91			0.91	0.91	0.91	0.91	0.91	
vC, conflicting volume	1667			985			1892	2739	496	2230	2713	836
vC1, stage 1 conf vol							1004	1004		1706	1706	
vC2, stage 2 conf vol							888	1735		524	1007	
vCu, unblocked vol	1667			789			1784	2714	252	2155	2685	836
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			96			99	100	98	93	100	95
cM capacity (veh/h)	389			762			199	115	683	89	125	314

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	498	493	836	860	15	23
Volume Left	11	0	34	0	1	6
Volume Right	0	6	0	58	14	17
cSH	389	1700	762	1700	588	189
Volume to Capacity	0.03	0.29	0.04	0.51	0.03	0.12
Queue Length 95th (m)	0.7	0.0	1.1	0.0	0.6	3.3
Control Delay (s)	0.9	0.0	1.2	0.0	11.3	26.6
Lane LOS	A		A		B	D
Approach Delay (s)	0.4		0.6		11.3	26.6
Approach LOS					B	D

Intersection Summary					
Average Delay	0.8				
Intersection Capacity Utilization	78.4%	ICU Level of Service		D	
Analysis Period (min)	15				



Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	29	92	681	11	613	181	864
v/c Ratio	0.13	0.23	0.85	0.05	0.38	0.41	0.42
Control Delay	2.1	24.2	22.2	21.9	19.1	16.1	15.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	2.1	24.2	22.2	21.9	19.1	16.1	15.2
Queue Length 50th (m)	0.0	14.6	57.2	1.2	44.8	18.1	53.9
Queue Length 95th (m)	1.4	22.0	91.1	m2.8	m72.5	39.7	91.7
Internal Link Dist (m)	18.4		117.2		321.6		103.1
Turn Bay Length (m)		15.0		20.0		15.0	
Base Capacity (vph)	284	565	951	206	1599	490	2065
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.16	0.72	0.05	0.38	0.37	0.42

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	21	0	7	88	0	654	11	556	33	174	810	19
Future Volume (vph)	21	0	7	88	0	654	11	556	33	174	810	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00		1.00	0.98		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.97		1.00	0.85		1.00	0.99		1.00	1.00	
Flt Protected		0.96		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1425		1541	1540		1289	3434		1718	3480	
Flt Permitted		0.36		0.74	1.00		0.33	1.00		0.32	1.00	
Satd. Flow (perm)		535		1197	1540		445	3434		572	3480	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	22	0	7	92	0	681	11	579	34	181	844	20
RTOR Reduction (vph)	0	19	0	0	282	0	0	3	0	0	1	0
Lane Group Flow (vph)	0	10	0	92	399	0	11	610	0	181	863	0
Confl. Peds. (#/hr)	4		1	1		4	1		3	3		1
Heavy Vehicles (%)	26%	0%	17%	17%	0%	3%	40%	3%	23%	5%	2%	59%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		33.8		33.8	33.8		49.1	49.1		63.2	63.2	
Effective Green, g (s)		36.8		36.8	36.8		51.1	51.1		62.2	65.2	
Actuated g/C Ratio		0.33		0.33	0.33		0.46	0.46		0.57	0.59	
Clearance Time (s)		7.0		7.0	7.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)		5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		178		400	515		206	1595		428	2062	
v/s Ratio Prot					c0.26			0.18		0.04	c0.25	
v/s Ratio Perm		0.02		0.08			0.02			0.20		
v/c Ratio		0.05		0.23	0.77		0.05	0.38		0.42	0.42	
Uniform Delay, d1		24.8		26.4	32.9		16.2	19.2		12.6	12.1	
Progression Factor		1.00		1.00	1.00		0.83	0.82		1.00	1.00	
Incremental Delay, d2		0.3		0.6	8.3		0.3	0.4		0.7	0.6	
Delay (s)		25.1		27.0	41.2		13.8	16.1		13.3	12.8	
Level of Service		C		C	D		B	B		B	B	
Approach Delay (s)		25.1			39.5			16.1			12.8	
Approach LOS		C			D			B			B	

Intersection Summary				
HCM 2000 Control Delay	22.1	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.57			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	84.7%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	21	162	39	164	605	1	154	12	58	1	9	17
Future Volume (Veh/h)	21	162	39	164	605	1	154	12	58	1	9	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	26	200	48	202	747	1	190	15	72	1	11	21
Pedestrians					3			2			3	
Lane Width (m)					3.6			3.6			3.6	
Walking Speed (m/s)					1.2			1.2			1.2	
Percent Blockage					0			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		141										
pX, platoon unblocked				0.96			0.96	0.96	0.96	0.96	0.96	
vC, conflicting volume	751			250			1456	1433	229	1513	1456	750
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	751			203			1454	1430	181	1513	1455	750
tC, single (s)	4.6			4.1			7.1	6.5	6.2	7.1	6.5	6.8
tC, 2 stage (s)												
tF (s)	2.7			2.2			3.5	4.0	3.3	3.5	4.0	3.8
p0 queue free %	96			85			0	86	91	98	89	94
cM capacity (veh/h)	676			1329			76	106	832	67	103	333

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	274	950	277	33
Volume Left	26	202	190	1
Volume Right	48	1	72	21
cSH	676	1329	101	178
Volume to Capacity	0.04	0.15	2.73	0.19
Queue Length 95th (m)	1.0	4.3	207.6	5.3
Control Delay (s)	1.4	3.5	872.3	29.7
Lane LOS	A	A	F	D
Approach Delay (s)	1.4	3.5	872.3	29.7
Approach LOS			F	D

Intersection Summary				
Average Delay	160.6			
Intersection Capacity Utilization	82.6%	ICU Level of Service	E	
Analysis Period (min)	15			

Appendix H

Total Traffic Operations – Phase 1



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	826	1482	77	682	69	370	181	123	187
v/c Ratio	1.27	0.82	0.51	0.92	0.19	0.80	1.24	0.26	0.36
Control Delay	159.9	27.5	30.0	57.1	26.0	51.3	181.7	33.4	6.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	159.9	27.5	30.0	57.1	26.0	51.3	181.7	33.4	6.6
Queue Length 50th (m)	~227.7	151.0	7.4	72.3	10.4	74.4	~31.8	21.7	0.0
Queue Length 95th (m)	#304.6	186.7	14.6	#108.2	20.7	110.2	#78.0	37.9	17.1
Internal Link Dist (m)		169.9		129.1		138.9		321.6	
Turn Bay Length (m)	30.0		40.0		30.0				40.0
Base Capacity (vph)	651	1805	152	741	371	498	146	487	528
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.27	0.82	0.51	0.92	0.19	0.74	1.24	0.25	0.35

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	776	1227	166	72	427	214	65	287	61	170	116	176
Future Volume (vph)	776	1227	166	72	427	214	65	287	61	170	116	176
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.95		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1662	3414		1660	3274		1692	1801		1661	1776	1431
Flt Permitted	0.17	1.00		0.21	1.00		0.66	1.00		0.16	1.00	1.00
Satd. Flow (perm)	299	3414		360	3274		1172	1801		274	1776	1431
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	826	1305	177	77	454	228	69	305	65	181	123	187
RTOR Reduction (vph)	0	9	0	0	57	0	0	7	0	0	0	137
Lane Group Flow (vph)	826	1473	0	77	625	0	69	363	0	181	123	50
Confl. Peds. (#/hr)	6		19	19		6	17		7	7		17
Heavy Vehicles (%)	5%	3%	3%	5%	4%	4%	2%	2%	4%	5%	7%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		8
Actuated Green, G (s)	62.7	54.7		25.4	20.4		30.1	25.3		32.5	26.5	26.5
Effective Green, g (s)	61.7	56.7		23.4	22.4		28.1	28.3		30.5	29.5	29.5
Actuated g/C Ratio	0.56	0.52		0.21	0.20		0.26	0.26		0.28	0.27	0.27
Clearance Time (s)	3.0	6.0		3.0	6.0		3.0	7.0		3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	642	1759		123	666		317	463		139	476	383
v/s Ratio Prot	c0.45	0.43		0.02	0.19		0.01	0.20		c0.06	0.07	
v/s Ratio Perm	c0.27			0.11			0.05			c0.30		0.04
v/c Ratio	1.29	0.84		0.63	0.94		0.22	0.78		1.30	0.26	0.13
Uniform Delay, d1	29.0	22.7		35.9	43.1		31.8	38.0		38.2	31.6	30.5
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	140.5	4.9		9.6	22.6		0.3	8.4		178.5	0.3	0.2
Delay (s)	169.5	27.7		45.5	65.7		32.1	46.4		216.6	31.9	30.7
Level of Service	F	C		D	E		C	D		F	C	C
Approach Delay (s)		78.4			63.6			44.2			99.5	
Approach LOS		E			E			D			F	

Intersection Summary

HCM 2000 Control Delay	74.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	104.3%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	298	1332	3	821	45	153
v/c Ratio	0.58	0.50	0.01	0.40	0.22	0.60
Control Delay	8.7	5.7	13.7	11.5	28.3	27.1
Queue Delay	0.0	0.6	0.0	0.0	0.0	0.0
Total Delay	8.7	6.3	13.7	11.5	28.3	27.1
Queue Length 50th (m)	13.5	42.5	0.2	36.9	5.6	14.6
Queue Length 95th (m)	30.6	77.6	2.1	75.8	14.6	m25.6
Internal Link Dist (m)		129.1		115.2	28.9	320.6
Turn Bay Length (m)	40.0		15.0			
Base Capacity (vph)	678	2688	218	2073	304	349
Starvation Cap Reductn	0	868	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.73	0.01	0.40	0.15	0.44

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	283	1253	12	3	653	127	27	2	13	67	0	78
Future Volume (vph)	283	1253	12	3	653	127	27	2	13	67	0	78
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		7.0	4.0			4.0			4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	1.00		1.00	0.98			0.96			0.93	
Flt Protected	0.95	1.00		0.95	1.00			0.97			0.98	
Satd. Flow (prot)	1727	3500		1711	3322			1729			1449	
Flt Permitted	0.28	1.00		0.21	1.00			0.71			0.85	
Satd. Flow (perm)	502	3500		370	3322			1275			1266	
Peak-hour factor, PHF	0.95	0.95	0.92	0.92	0.95	0.95	0.92	0.92	0.92	0.95	0.92	0.95
Adj. Flow (vph)	298	1319	13	3	687	134	29	2	14	71	0	82
RTOR Reduction (vph)	0	0	0	0	10	0	0	12	0	0	64	0
Lane Group Flow (vph)	298	1332	0	3	811	0	0	33	0	0	89	0
Confl. Peds. (#/hr)	4					4				2		3
Heavy Vehicles (%)	1%	3%	2%	2%	5%	8%	2%	2%	2%	17%	2%	18%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	73.7	73.7		59.1	59.1			12.3			12.3	
Effective Green, g (s)	72.7	76.7		59.1	62.1			15.3			15.3	
Actuated g/C Ratio	0.73	0.77		0.59	0.62			0.15			0.15	
Clearance Time (s)	3.0	7.0		7.0	7.0			7.0			7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	494	2684		218	2062			195			193	
v/s Ratio Prot	c0.06	0.38			0.24							
v/s Ratio Perm	c0.37			0.01				0.03			c0.07	
v/c Ratio	0.60	0.50		0.01	0.39			0.17			0.46	
Uniform Delay, d1	5.9	4.4		8.4	9.5			36.8			38.6	
Progression Factor	1.00	1.00		1.00	1.00			1.00			0.92	
Incremental Delay, d2	2.1	0.7		0.1	0.6			0.4			1.7	
Delay (s)	8.0	5.0		8.5	10.1			37.2			37.0	
Level of Service	A	A		A	B			D			D	
Approach Delay (s)		5.6			10.1			37.2			37.0	
Approach LOS		A			B			D			D	

Intersection Summary

HCM 2000 Control Delay	9.3	HCM 2000 Level of Service	A	
HCM 2000 Volume to Capacity ratio	0.57			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	64.0%	ICU Level of Service	C	
Analysis Period (min)	15			

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	1140	9	8	676	8	2	0	24	33	0	17
Future Volume (Veh/h)	5	1140	9	8	676	8	2	0	24	33	0	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	5	1200	9	8	712	8	2	0	25	35	0	18
Pedestrians								9				
Lane Width (m)								3.6				
Walking Speed (m/s)								1.2				
Percent Blockage								1				
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (m)		139										
pX, platoon unblocked				0.87			0.87	0.87	0.87	0.87	0.87	
vC, conflicting volume	720			1218			1614	1960	614	1367	1960	360
vC1, stage 1 conf vol							1224	1224		732	732	
vC2, stage 2 conf vol							390	736		635	1228	
vCu, unblocked vol	720			942			1399	1798	244	1114	1799	360
tC, single (s)	4.1			4.4			7.5	6.5	7.0	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.3			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	99			99			99	100	96	89	100	97
cM capacity (veh/h)	891			562			226	241	643	331	237	617

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	605	609	364	364	27	53
Volume Left	5	0	8	0	2	35
Volume Right	0	9	0	8	25	18
cSH	891	1700	562	1700	565	393
Volume to Capacity	0.01	0.36	0.01	0.21	0.05	0.13
Queue Length 95th (m)	0.1	0.0	0.3	0.0	1.2	3.7
Control Delay (s)	0.2	0.0	0.5	0.0	11.7	15.6
Lane LOS	A		A		B	C
Approach Delay (s)	0.1		0.2		11.7	15.6
Approach LOS					B	C

Intersection Summary					
Average Delay	0.7				
Intersection Capacity Utilization	51.5%	ICU Level of Service		A	
Analysis Period (min)	15				



Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	48	16	325	8	1326	909	459
v/c Ratio	0.92	0.07	0.63	0.03	1.03	1.32	0.18
Control Delay	141.9	34.6	9.3	20.2	62.4	181.5	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	141.9	34.6	9.3	20.2	62.4	181.5	3.6
Queue Length 50th (m)	7.3	2.9	0.0	1.0	~149.8	~222.7	10.0
Queue Length 95th (m)	#27.8	8.4	19.8	4.2	#193.6	#327.7	20.1
Internal Link Dist (m)	18.4		117.2		321.6		103.1
Turn Bay Length (m)		15.0		20.0		15.0	
Base Capacity (vph)	105	513	763	237	1293	687	2521
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.03	0.43	0.03	1.03	1.32	0.18

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	1	12	15	0	309	8	988	272	864	415	21
Future Volume (vph)	32	1	12	15	0	309	8	988	272	864	415	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00		1.00	0.99		1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.96		1.00	0.85		1.00	0.97		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1159		1745	1518		1219	3338		1745	3279	
Flt Permitted		0.22		0.78	1.00		0.49	1.00		0.10	1.00	
Satd. Flow (perm)		270		1425	1518		626	3338		188	3279	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	34	1	13	16	0	325	8	1040	286	909	437	22
RTOR Reduction (vph)	0	11	0	0	276	0	0	25	0	0	2	0
Lane Group Flow (vph)	0	37	0	16	49	0	8	1301	0	909	457	0
Confl. Peds. (#/hr)	1					1	1		2	2		1
Heavy Vehicles (%)	54%	100%	45%	0%	0%	5%	43%	5%	1%	0%	7%	53%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		12.2		12.2	12.2		36.0	36.0		74.8	74.8	
Effective Green, g (s)		15.2		15.2	15.2		38.0	38.0		73.8	76.8	
Actuated g/C Ratio		0.15		0.15	0.15		0.38	0.38		0.74	0.77	
Clearance Time (s)		7.0		7.0	7.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)		5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		41		216	230		237	1268		680	2518	
v/s Ratio Prot					0.03			0.39		c0.46	0.14	
v/s Ratio Perm		c0.14		0.01			0.01			c0.52		
v/c Ratio		0.90		0.07	0.21		0.03	1.03		1.34	0.18	
Uniform Delay, d1		41.7		36.4	37.2		19.5	31.0		27.7	3.1	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		106.5		0.3	1.0		0.3	32.2		161.4	0.2	
Delay (s)		148.1		36.7	38.2		19.7	63.2		189.1	3.3	
Level of Service		F		D	D		B	E		F	A	
Approach Delay (s)		148.1			38.1			62.9			126.7	
Approach LOS		F			D			E			F	

Intersection Summary				
HCM 2000 Control Delay	89.7	HCM 2000 Level of Service	F	
HCM 2000 Volume to Capacity ratio	1.26			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	123.2%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	1076	41	78	199	1	100	3	377	2	13	21
Future Volume (Veh/h)	11	1076	41	78	199	1	100	3	377	2	13	21
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	14	1328	51	96	246	1	123	4	465	2	16	26
Pedestrians		1			7						5	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			1						0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		141										
pX, platoon unblocked				0.67			0.67	0.67	0.67	0.67	0.67	
vC, conflicting volume	252			1379			1855	1826	1360	2299	1850	252
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	252			1319			2031	1987	1291	2695	2024	252
tC, single (s)	4.1			4.1			7.2	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			73			0	87	0	0	43	97
cM capacity (veh/h)	1320			355			12	30	134	0	28	787

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	1393	343	592	44
Volume Left	14	96	123	2
Volume Right	51	1	465	26
cSH	1320	355	42	0
Volume to Capacity	0.01	0.27	14.03	Err
Queue Length 95th (m)	0.3	8.6	Err	Err
Control Delay (s)	0.5	9.6	Err	Err
Lane LOS	A	A	F	F
Approach Delay (s)	0.5	9.6	Err	Err
Approach LOS			F	F

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	109.2%	ICU Level of Service	H	
Analysis Period (min)	15			

Queues
1: Waterdown Rd & Plains Rd E

Phase 1 Total PM
190488



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	240	791	70	1503	165	228	261	183	519
v/c Ratio	0.91	0.43	0.20	0.96	0.59	0.64	1.11	0.46	0.72
Control Delay	62.9	17.6	12.2	45.6	39.1	45.1	122.0	40.0	9.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	62.9	17.6	12.2	45.6	39.1	45.1	122.0	40.0	9.2
Queue Length 50th (m)	37.9	54.7	5.9	162.8	28.2	44.2	~54.2	36.1	0.0
Queue Length 95th (m)	65.6	84.1	14.0	#280.5	42.2	65.3	#81.5	53.6	29.6
Internal Link Dist (m)		169.9		129.1		138.9		321.6	
Turn Bay Length (m)	30.0		40.0		30.0				40.0
Base Capacity (vph)	471	1825	378	1564	281	494	236	532	792
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.51	0.43	0.19	0.96	0.59	0.46	1.11	0.34	0.66

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
1: Waterdown Rd & Plains Rd E

Phase 1 Total PM
190488



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	226	637	106	66	1216	196	155	156	58	245	172	488
Future Volume (vph)	226	637	106	66	1216	196	155	156	58	245	172	488
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00		1.00	0.99		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.98		1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1662	3396		1655	3389		1697	1767		1660	1776	1431
Flt Permitted	0.08	1.00		0.32	1.00		0.54	1.00		0.26	1.00	1.00
Satd. Flow (perm)	136	3396		562	3389		972	1767		455	1776	1431
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	240	678	113	70	1294	209	165	166	62	261	183	519
RTOR Reduction (vph)	0	10	0	0	9	0	0	14	0	0	0	403
Lane Group Flow (vph)	240	781	0	70	1494	0	165	214	0	261	183	116
Confl. Peds. (#/hr)	6		19	19		6	17		7	7		17
Heavy Vehicles (%)	5%	3%	3%	5%	4%	4%	2%	2%	4%	5%	7%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		8
Actuated Green, G (s)	65.5	56.1		54.9	48.5		25.5	18.5		31.5	21.5	21.5
Effective Green, g (s)	64.5	58.1		52.9	50.5		23.5	21.5		29.5	24.5	24.5
Actuated g/C Ratio	0.59	0.53		0.48	0.46		0.21	0.20		0.27	0.22	0.22
Clearance Time (s)	3.0	6.0		3.0	6.0		3.0	7.0		3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	260	1793		323	1555		247	345		220	395	318
v/s Ratio Prot	c0.11	0.23		0.01	c0.44		0.04	0.12		c0.10	0.10	
v/s Ratio Perm	0.43			0.09			0.11			c0.22		0.08
v/c Ratio	0.92	0.44		0.22	0.96		0.67	0.62		1.19	0.46	0.36
Uniform Delay, d1	33.6	15.9		15.6	28.8		38.8	40.5		37.9	37.1	36.2
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	35.7	0.8		0.3	15.3		6.7	3.5		120.2	0.9	0.7
Delay (s)	69.3	16.7		15.9	44.1		45.5	44.0		158.1	37.9	36.9
Level of Service	E	B		B	D		D	D		F	D	D
Approach Delay (s)		28.9			42.8			44.6			69.9	
Approach LOS		C			D			D			E	

Intersection Summary

HCM 2000 Control Delay	46.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	93.5%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	54	953	22	1576	31	246
v/c Ratio	0.29	0.39	0.07	0.75	0.11	0.75
Control Delay	9.9	7.3	12.8	18.3	24.1	37.6
Queue Delay	0.0	0.4	0.0	0.0	0.0	0.0
Total Delay	9.9	7.7	12.8	18.3	24.1	37.6
Queue Length 50th (m)	3.1	37.9	1.9	117.4	3.9	32.4
Queue Length 95th (m)	8.2	58.3	6.7	176.6	10.8	59.1
Internal Link Dist (m)		129.1		115.2	28.9	320.6
Turn Bay Length (m)	40.0		15.0			
Base Capacity (vph)	270	2452	320	2109	374	399
Starvation Cap Reductn	0	849	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.59	0.07	0.75	0.08	0.62

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	51	880	25	20	1371	126	21	1	6	118	0	116
Future Volume (vph)	51	880	25	20	1371	126	21	1	6	118	0	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		7.0	4.0			4.0			4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	1.00		1.00	0.99			0.97			0.93	
Flt Protected	0.95	1.00		0.95	1.00			0.96			0.98	
Satd. Flow (prot)	1728	3491		1711	3378			1741			1456	
Flt Permitted	0.08	1.00		0.30	1.00			0.73			0.82	
Satd. Flow (perm)	137	3491		541	3378			1319			1231	
Peak-hour factor, PHF	0.95	0.95	0.92	0.92	0.95	0.95	0.92	0.92	0.92	0.95	0.92	0.95
Adj. Flow (vph)	54	926	27	22	1443	133	23	1	7	124	0	122
RTOR Reduction (vph)	0	2	0	0	5	0	0	5	0	0	59	0
Lane Group Flow (vph)	54	951	0	22	1571	0	0	26	0	0	187	0
Confl. Peds. (#/hr)	4					4				2		3
Heavy Vehicles (%)	1%	3%	2%	2%	5%	8%	2%	2%	2%	17%	2%	18%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	67.2	67.2		58.7	58.7			18.8			18.8	
Effective Green, g (s)	66.2	70.2		58.7	61.7			21.8			21.8	
Actuated g/C Ratio	0.66	0.70		0.59	0.62			0.22			0.22	
Clearance Time (s)	3.0	7.0		7.0	7.0			7.0			7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	162	2450		317	2084			287			268	
v/s Ratio Prot	0.01	c0.27			c0.47							
v/s Ratio Perm	0.21			0.04				0.02			c0.15	
v/c Ratio	0.33	0.39		0.07	0.75			0.09			0.70	
Uniform Delay, d1	12.5	6.1		8.9	13.7			31.2			36.0	
Progression Factor	1.00	1.00		1.00	1.00			1.00			0.95	
Incremental Delay, d2	1.2	0.5		0.4	2.6			0.1			7.6	
Delay (s)	13.7	6.6		9.3	16.3			31.3			41.9	
Level of Service	B	A		A	B			C			D	
Approach Delay (s)		7.0			16.2			31.3			41.9	
Approach LOS		A			B			C			D	

Intersection Summary					
HCM 2000 Control Delay	15.3	HCM 2000 Level of Service		B	
HCM 2000 Volume to Capacity ratio	0.73				
Actuated Cycle Length (s)	100.0	Sum of lost time (s)		12.0	
Intersection Capacity Utilization	63.2%	ICU Level of Service		B	
Analysis Period (min)	15				
c Critical Lane Group					



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	932	5	33	1546	56	1	0	13	6	0	16
Future Volume (Veh/h)	11	932	5	33	1546	56	1	0	13	6	0	16
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	12	981	5	35	1627	59	1	0	14	6	0	17
Pedestrians								9				
Lane Width (m)								3.6				
Walking Speed (m/s)								1.2				
Percent Blockage								1				
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (m)		139										
pX, platoon unblocked				0.90			0.90	0.90	0.90	0.90	0.90	
vC, conflicting volume	1686			995			1917	2772	502	2255	2746	843
vC1, stage 1 conf vol							1016	1016		1726	1726	
vC2, stage 2 conf vol							900	1756		528	1019	
vCu, unblocked vol	1686			761			1790	2746	210	2168	2716	843
tC, single (s)	4.1			4.4			7.5	6.5	7.0	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.3			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	97			95			99	100	98	93	100	94
cM capacity (veh/h)	384			687			196	111	699	86	122	293

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	502	496	848	872	15	23
Volume Left	12	0	35	0	1	6
Volume Right	0	5	0	59	14	17
cSH	384	1700	687	1700	597	180
Volume to Capacity	0.03	0.29	0.05	0.51	0.03	0.13
Queue Length 95th (m)	0.8	0.0	1.3	0.0	0.6	3.4
Control Delay (s)	1.0	0.0	1.4	0.0	11.2	27.9
Lane LOS	A		A		B	D
Approach Delay (s)	0.5		0.7		11.2	27.9
Approach LOS					B	D

Intersection Summary					
Average Delay	0.9				
Intersection Capacity Utilization	78.2%	ICU Level of Service		D	
Analysis Period (min)	15				



Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	29	92	687	12	620	183	876
v/c Ratio	0.16	0.22	0.90	0.06	0.38	0.40	0.43
Control Delay	2.6	24.7	28.0	19.8	19.5	12.6	12.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	2.6	24.7	28.0	19.8	19.5	12.6	12.3
Queue Length 50th (m)	0.0	12.7	52.7	1.4	45.1	17.3	52.6
Queue Length 95th (m)	1.2	24.7	#129.8	5.6	64.4	28.8	68.1
Internal Link Dist (m)	18.4		117.2		321.6		103.1
Turn Bay Length (m)		15.0		20.0		15.0	
Base Capacity (vph)	195	487	815	196	1614	514	2020
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.19	0.84	0.06	0.38	0.36	0.43

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis — Phase 1 Total PM
4: Waterdown Rd & Masonry Crt — 190488



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	21	0	7	87	0	653	11	556	33	174	813	19
Future Volume (vph)	21	0	7	87	0	653	11	556	33	174	813	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.97		1.00	0.85		1.00	0.99		1.00	1.00	
Flt Protected		0.96		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1166		1745	1518		1220	3412		1744	3328	
Flt Permitted		0.35		0.74	1.00		0.32	1.00		0.32	1.00	
Satd. Flow (perm)		428		1356	1518		416	3412		580	3328	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	22	0	7	92	0	687	12	585	35	183	856	20
RTOR Reduction (vph)	0	20	0	0	288	0	0	4	0	0	2	0
Lane Group Flow (vph)	0	9	0	92	399	0	12	616	0	183	874	0
Confl. Peds. (#/hr)	1					1	1		2	2		1
Heavy Vehicles (%)	54%	100%	45%	0%	0%	5%	43%	5%	1%	0%	7%	53%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		28.4		28.4	28.4		45.2	45.2		58.6	58.6	
Effective Green, g (s)		31.4		31.4	31.4		47.2	47.2		57.6	60.6	
Actuated g/C Ratio		0.31		0.31	0.31		0.47	0.47		0.58	0.61	
Clearance Time (s)		7.0		7.0	7.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)		5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		134		425	476		196	1610		443	2016	
v/s Ratio Prot					c0.26			0.18		0.04	c0.26	
v/s Ratio Perm		0.02		0.07			0.03			0.20		
v/c Ratio		0.07		0.22	0.84		0.06	0.38		0.41	0.43	
Uniform Delay, d1		24.0		25.2	31.9		14.4	17.0		10.9	10.5	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.5		0.5	13.5		0.6	0.7		0.6	0.7	
Delay (s)		24.5		25.8	45.4		15.0	17.7		11.6	11.2	
Level of Service		C		C	D		B	B		B	B	
Approach Delay (s)		24.5			43.1			17.7			11.3	
Approach LOS		C			D			B			B	

Intersection Summary				
HCM 2000 Control Delay	23.0	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.60			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	84.4%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Unsignalized Intersection Capacity Analysis — Phase 1 Total PM
5: Cooke Blvd & Masonry Crt — 190488



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	21	162	39	163	603	1	154	12	58	1	9	17
Future Volume (Veh/h)	21	162	39	163	603	1	154	12	58	1	9	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	26	200	48	201	744	1	190	15	72	1	11	21
Pedestrians		1			7						5	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			1						0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		141										
pX, platoon unblocked				0.97			0.97	0.97	0.97	0.97	0.97	
vC, conflicting volume	750			248			1450	1428	231	1514	1452	750
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	750			206			1448	1426	188	1514	1450	750
tC, single (s)	4.1			4.1			7.2	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			85			0	86	91	99	90	95
cM capacity (veh/h)	865			1333			78	108	826	67	105	412

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	274	946	277	33
Volume Left	26	201	190	1
Volume Right	48	1	72	21
cSH	865	1333	104	193
Volume to Capacity	0.03	0.15	2.67	0.17
Queue Length 95th (m)	0.7	4.2	205.4	4.8
Control Delay (s)	1.2	3.5	840.9	27.4
Lane LOS	A	A	F	D
Approach Delay (s)	1.2	3.5	840.9	27.4
Approach LOS			F	D

Intersection Summary				
Average Delay	155.2			
Intersection Capacity Utilization	82.4%	ICU Level of Service	E	
Analysis Period (min)	15			

Appendix I

Total Traffic Operations – Full Build-Out





Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	832	1502	82	716	69	376	187	124	188
v/c Ratio	1.28	0.84	0.54	0.96	0.19	0.81	1.28	0.26	0.36
Control Delay	166.3	28.3	31.9	63.6	25.9	51.9	198.1	33.3	6.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	166.3	28.3	31.9	63.6	25.9	51.9	198.1	33.3	6.6
Queue Length 50th (m)	~230.6	154.8	7.9	76.5	10.4	76.0	~34.8	22.0	0.0
Queue Length 95th (m)	#307.9	191.2	16.0	#116.1	20.7	#113.8	#81.6	38.3	17.1
Internal Link Dist (m)		169.9		129.1		138.9		321.6	
Turn Bay Length (m)	30.0		40.0		30.0				40.0
Base Capacity (vph)	648	1798	153	745	372	497	146	488	530
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.28	0.84	0.54	0.96	0.19	0.76	1.28	0.25	0.35

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	782	1244	168	77	441	232	65	289	65	176	117	177
Future Volume (vph)	782	1244	168	77	441	232	65	289	65	176	117	177
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.95		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1662	3414		1660	3267		1692	1798		1661	1776	1431
Flt Permitted	0.17	1.00		0.21	1.00		0.66	1.00		0.16	1.00	1.00
Satd. Flow (perm)	299	3414		360	3267		1170	1798		272	1776	1431
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	832	1323	179	82	469	247	69	307	69	187	124	188
RTOR Reduction (vph)	0	9	0	0	63	0	0	7	0	0	0	137
Lane Group Flow (vph)	832	1493	0	82	653	0	69	369	0	187	124	51
Confl. Peds. (#/hr)	6		19	19		6	17		7	7		17
Heavy Vehicles (%)	5%	3%	3%	5%	4%	4%	2%	2%	4%	5%	7%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		8
Actuated Green, G (s)	62.5	54.5		25.4	20.4		30.3	25.5		32.7	26.7	26.7
Effective Green, g (s)	61.5	56.5		23.4	22.4		28.3	28.5		30.7	29.7	29.7
Actuated g/C Ratio	0.56	0.51		0.21	0.20		0.26	0.26		0.28	0.27	0.27
Clearance Time (s)	3.0	6.0		3.0	6.0		3.0	7.0		3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	639	1753		123	665		319	465		139	479	386
v/s Ratio Prot	c0.45	0.44		0.02	0.20		0.01	0.20		c0.06	0.07	
v/s Ratio Perm	c0.28			0.12			0.05			c0.31		0.04
v/c Ratio	1.30	0.85		0.67	0.98		0.22	0.79		1.35	0.26	0.13
Uniform Delay, d1	29.0	23.1		36.4	43.6		31.6	38.0		38.1	31.5	30.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	147.1	5.4		12.8	30.8		0.3	9.0		195.5	0.3	0.2
Delay (s)	176.2	28.6		49.3	74.4		32.0	47.0		233.6	31.8	30.5
Level of Service	F	C		D	E		C	D		F	C	C
Approach Delay (s)		81.2			71.8			44.7			106.9	
Approach LOS		F			E			D			F	

Intersection Summary

HCM 2000 Control Delay	78.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.27		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	106.2%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	299	1360	7	828	96	153
v/c Ratio	0.58	0.51	0.03	0.40	0.49	0.61
Control Delay	8.8	5.9	14.2	11.8	37.5	28.0
Queue Delay	0.0	0.6	0.0	0.0	0.0	0.0
Total Delay	8.8	6.5	14.2	11.8	37.5	28.0
Queue Length 50th (m)	13.7	44.0	0.5	37.6	14.3	14.7
Queue Length 95th (m)	31.1	81.2	3.7	77.2	28.3	m25.4
Internal Link Dist (m)		129.1		115.2	28.9	320.6
Turn Bay Length (m)	40.0		15.0			
Base Capacity (vph)	675	2678	211	2063	283	337
Starvation Cap Reductn	0	848	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.74	0.03	0.40	0.34	0.45

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	284	1266	25	6	659	127	58	4	27	67	0	78
Future Volume (vph)	284	1266	25	6	659	127	58	4	27	67	0	78
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		7.0	4.0			4.0			4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	1.00		1.00	0.98			0.96			0.93	
Flt Protected	0.95	1.00		0.95	1.00			0.97			0.98	
Satd. Flow (prot)	1727	3495		1711	3323			1730			1450	
Flt Permitted	0.27	1.00		0.20	1.00			0.65			0.82	
Satd. Flow (perm)	496	3495		360	3323			1165			1211	
Peak-hour factor, PHF	0.95	0.95	0.92	0.92	0.95	0.95	0.92	0.92	0.92	0.95	0.92	0.95
Adj. Flow (vph)	299	1333	27	7	694	134	63	4	29	71	0	82
RTOR Reduction (vph)	0	1	0	0	10	0	0	17	0	0	64	0
Lane Group Flow (vph)	299	1359	0	7	818	0	0	79	0	0	89	0
Confl. Peds. (#/hr)	4					4				2		3
Heavy Vehicles (%)	1%	3%	2%	2%	5%	8%	2%	2%	2%	17%	2%	18%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	73.6	73.6		58.8	58.8			12.4			12.4	
Effective Green, g (s)	72.6	76.6		58.8	61.8			15.4			15.4	
Actuated g/C Ratio	0.73	0.77		0.59	0.62			0.15			0.15	
Clearance Time (s)	3.0	7.0		7.0	7.0			7.0			7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	493	2677		211	2053			179			186	
v/s Ratio Prot	c0.07	0.39			0.25							
v/s Ratio Perm	c0.37			0.02				0.07			c0.07	
v/c Ratio	0.61	0.51		0.03	0.40			0.44			0.48	
Uniform Delay, d1	6.0	4.5		8.7	9.7			38.4			38.6	
Progression Factor	1.00	1.00		1.00	1.00			1.00			0.92	
Incremental Delay, d2	2.1	0.7		0.3	0.6			1.7			1.8	
Delay (s)	8.1	5.2		8.9	10.3			40.1			37.3	
Level of Service	A	A		A	B			D			D	
Approach Delay (s)		5.7			10.2			40.1			37.3	
Approach LOS		A			B			D			D	

Intersection Summary					
HCM 2000 Control Delay	10.0	HCM 2000 Level of Service		B	
HCM 2000 Volume to Capacity ratio	0.58				
Actuated Cycle Length (s)	100.0	Sum of lost time (s)		12.0	
Intersection Capacity Utilization	64.8%	ICU Level of Service		C	
Analysis Period (min)	15				

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	1165	9	8	685	8	2	0	24	33	0	17
Future Volume (Veh/h)	6	1165	9	8	685	8	2	0	24	33	0	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	6	1226	9	8	721	8	2	0	25	35	0	18
Pedestrians								9				
Lane Width (m)								3.6				
Walking Speed (m/s)								1.2				
Percent Blockage								1				
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (m)		139										
pX, platoon unblocked				0.86			0.86	0.86	0.86	0.86	0.86	
vC, conflicting volume	729			1244			1646	1996	626	1391	1997	364
vC1, stage 1 conf vol							1252	1252		741	741	
vC2, stage 2 conf vol							394	745		650	1256	
vCu, unblocked vol	729			960			1427	1834	242	1130	1835	364
tC, single (s)	4.1			4.4			7.5	6.5	7.0	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.3			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	99			99			99	100	96	89	100	97
cM capacity (veh/h)	884			550			218	235	640	327	231	613

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	619	622	368	368	27	53
Volume Left	6	0	8	0	2	35
Volume Right	0	9	0	8	25	18
cSH	884	1700	550	1700	560	388
Volume to Capacity	0.01	0.37	0.01	0.22	0.05	0.14
Queue Length 95th (m)	0.2	0.0	0.4	0.0	1.2	3.8
Control Delay (s)	0.2	0.0	0.5	0.0	11.8	15.7
Lane LOS	A		A		B	C
Approach Delay (s)	0.1		0.2		11.8	15.7
Approach LOS					B	C

Intersection Summary					
Average Delay	0.7				
Intersection Capacity Utilization	52.9%	ICU Level of Service		A	
Analysis Period (min)	15				



Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	48	16	328	8	1354	913	467
v/c Ratio	0.92	0.07	0.63	0.03	1.05	1.33	0.19
Control Delay	140.6	34.5	9.5	20.2	68.9	185.0	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	140.6	34.5	9.5	20.2	68.9	185.0	3.7
Queue Length 50th (m)	7.3	2.9	0.0	1.0	~156.4	~224.4	10.2
Queue Length 95th (m)	#27.7	8.3	20.6	4.2	#200.2	#330.6	20.7
Internal Link Dist (m)	18.4		117.2		321.6		103.1
Turn Bay Length (m)		15.0		20.0		15.0	
Base Capacity (vph)	105	513	762	235	1293	685	2519
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.03	0.43	0.03	1.05	1.33	0.19

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis — Phase 2 Total AM
4: Waterdown Rd & Masonry Crt — 190488

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	1	12	15	0	312	8	1014	273	867	423	21
Future Volume (vph)	32	1	12	15	0	312	8	1014	273	867	423	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.96		1.00	0.85		1.00	0.97		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1159		1745	1518		1219	3339		1745	3280	
Flt Permitted		0.22		0.78	1.00		0.48	1.00		0.10	1.00	
Satd. Flow (perm)		270		1425	1518		621	3339		188	3280	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	34	1	13	16	0	328	8	1067	287	913	445	22
RTOR Reduction (vph)	0	11	0	0	278	0	0	24	0	0	2	0
Lane Group Flow (vph)	0	37	0	16	50	0	8	1330	0	913	465	0
Confl. Peds. (#/hr)	1					1	1		2	2		1
Heavy Vehicles (%)	54%	100%	45%	0%	0%	5%	43%	5%	1%	0%	7%	53%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		12.2		12.2	12.2		36.0	36.0		74.8	74.8	
Effective Green, g (s)		15.2		15.2	15.2		38.0	38.0		73.8	76.8	
Actuated g/C Ratio		0.15		0.15	0.15		0.38	0.38		0.74	0.77	
Clearance Time (s)		7.0		7.0	7.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)		5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		41		216	230		235	1268		680	2519	
v/s Ratio Prot					0.03			0.40		c0.47	0.14	
v/s Ratio Perm		c0.14		0.01			0.01			c0.52		
v/c Ratio		0.90		0.07	0.22		0.03	1.05		1.34	0.18	
Uniform Delay, d1		41.7		36.4	37.2		19.5	31.0		27.7	3.1	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		106.5		0.3	1.0		0.3	39.1		163.9	0.2	
Delay (s)		148.1		36.7	38.2		19.7	70.1		191.6	3.3	
Level of Service		F		D	D		B	E		F	A	
Approach Delay (s)		148.1			38.1			69.8			127.9	
Approach LOS		F			D			E			F	

Intersection Summary				
HCM 2000 Control Delay	93.1	HCM 2000 Level of Service	F	
HCM 2000 Volume to Capacity ratio	1.26			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	124.3%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Unsignalized Intersection Capacity Analysis — Phase 2 Total AM
5: Cooke Blvd & Masonry Crt — 190488

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	1080	41	78	199	1	103	3	378	2	13	21
Future Volume (Veh/h)	11	1080	41	78	199	1	103	3	378	2	13	21
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	14	1333	51	96	246	1	127	4	467	2	16	26
Pedestrians		1			7						5	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			1						0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		141										
pX, platoon unblocked				0.66			0.66	0.66	0.66	0.66	0.66	
vC, conflicting volume	252			1384			1860	1830	1366	2306	1856	252
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	252			1326			2041	1997	1298	2712	2035	252
tC, single (s)	4.1			4.1			7.2	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			73			0	86	0	0	42	97
cM capacity (veh/h)	1320			351			11	29	132	0	27	787

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	1398	343	598	44
Volume Left	14	96	127	2
Volume Right	51	1	467	26
cSH	1320	351	40	0
Volume to Capacity	0.01	0.27	14.97	Err
Queue Length 95th (m)	0.3	8.7	Err	Err
Control Delay (s)	0.5	9.7	Err	Err
Lane LOS	A	A	F	F
Approach Delay (s)	0.5	9.7	Err	Err
Approach LOS			F	F

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	109.5%	ICU Level of Service	H	
Analysis Period (min)	15			



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	244	809	74	1537	167	234	276	184	523
v/c Ratio	0.91	0.45	0.21	0.99	0.59	0.64	1.17	0.46	0.72
Control Delay	62.9	18.1	12.5	52.9	38.9	45.0	144.9	39.6	9.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	62.9	18.1	12.5	52.9	38.9	45.0	144.9	39.6	9.1
Queue Length 50th (m)	38.8	57.0	6.3	171.3	28.5	45.2	~50.3	36.1	0.0
Queue Length 95th (m)	66.7	87.4	14.8	#292.2	42.6	66.6	#90.0	53.7	29.4
Internal Link Dist (m)		169.9		129.1		138.9		321.6	
Turn Bay Length (m)	30.0		40.0		30.0				40.0
Base Capacity (vph)	472	1811	368	1546	284	493	235	532	795
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.52	0.45	0.20	0.99	0.59	0.47	1.17	0.35	0.66

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	229	653	107	70	1241	204	157	157	63	259	173	492
Future Volume (vph)	229	653	107	70	1241	204	157	157	63	259	173	492
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99		1.00	1.00		1.00	0.99		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.98		1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1662	3398		1655	3387		1697	1762		1660	1776	1431
Flt Permitted	0.08	1.00		0.31	1.00		0.54	1.00		0.25	1.00	1.00
Satd. Flow (perm)	137	3398		547	3387		972	1762		444	1776	1431
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	244	695	114	74	1320	217	167	167	67	276	184	523
RTOR Reduction (vph)	0	10	0	0	9	0	0	14	0	0	0	405
Lane Group Flow (vph)	244	799	0	74	1528	0	167	220	0	276	184	118
Confl. Peds. (#/hr)	6		19	19		6	17		7	7		17
Heavy Vehicles (%)	5%	3%	3%	5%	4%	4%	2%	2%	4%	5%	7%	8%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		8
Actuated Green, G (s)	65.2	55.7		54.4	47.9		25.8	18.8		31.8	21.8	21.8
Effective Green, g (s)	64.2	57.7		52.4	49.9		23.8	21.8		29.8	24.8	24.8
Actuated g/C Ratio	0.58	0.52		0.48	0.45		0.22	0.20		0.27	0.23	0.23
Clearance Time (s)	3.0	6.0		3.0	6.0		3.0	7.0		3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	264	1782		315	1536		249	349		219	400	322
v/s Ratio Prot	c0.11	0.24		0.01	c0.45		0.04	0.12		c0.10	0.10	
v/s Ratio Perm	0.43			0.10			0.11			c0.24		0.08
v/c Ratio	0.92	0.45		0.23	0.99		0.67	0.63		1.26	0.46	0.37
Uniform Delay, d1	33.7	16.3		15.9	29.9		38.7	40.4		37.7	36.8	36.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	35.5	0.8		0.4	21.8		6.9	3.5		148.5	0.8	0.7
Delay (s)	69.2	17.1		16.3	51.7		45.6	43.9		186.2	37.7	36.7
Level of Service	E	B		B	D		D	D		F	D	D
Approach Delay (s)		29.1			50.1			44.6			78.8	
Approach LOS		C			D			D			E	

Intersection Summary

HCM 2000 Control Delay	51.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	95.7%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBT	SBT
Lane Group Flow (vph)	55	991	46	1591	64	247
v/c Ratio	0.30	0.41	0.15	0.76	0.24	0.75
Control Delay	10.2	7.5	14.0	18.7	26.6	37.6
Queue Delay	0.0	0.4	0.0	0.0	0.0	0.0
Total Delay	10.2	7.9	14.0	18.7	26.6	37.6
Queue Length 50th (m)	3.2	39.9	4.2	120.2	8.4	32.5
Queue Length 95th (m)	8.2	61.4	12.4	180.2	18.9	59.0
Internal Link Dist (m)		129.1		115.2	28.9	320.6
Turn Bay Length (m)	40.0		15.0			
Base Capacity (vph)	267	2441	307	2104	344	399
Starvation Cap Reductn	0	826	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.21	0.61	0.15	0.76	0.19	0.62

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	52	889	51	42	1385	126	44	3	12	119	0	116
Future Volume (vph)	52	889	51	42	1385	126	44	3	12	119	0	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)	4.0	4.0		7.0	4.0			4.0			4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.99			0.97			0.93	
Flt Protected	0.95	1.00		0.95	1.00			0.96			0.98	
Satd. Flow (prot)	1728	3478		1711	3378			1746			1457	
Flt Permitted	0.07	1.00		0.29	1.00			0.66			0.82	
Satd. Flow (perm)	132	3478		521	3378			1196			1232	
Peak-hour factor, PHF	0.95	0.95	0.92	0.92	0.95	0.95	0.92	0.92	0.92	0.95	0.92	0.95
Adj. Flow (vph)	55	936	55	46	1458	133	48	3	13	125	0	122
RTOR Reduction (vph)	0	4	0	0	5	0	0	10	0	0	59	0
Lane Group Flow (vph)	55	987	0	46	1586	0	0	54	0	0	188	0
Confl. Peds. (#/hr)	4					4				2		3
Heavy Vehicles (%)	1%	3%	2%	2%	5%	8%	2%	2%	2%	17%	2%	18%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	5	2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	67.1	67.1		58.6	58.6			18.9			18.9	
Effective Green, g (s)	66.1	70.1		58.6	61.6			21.9			21.9	
Actuated g/C Ratio	0.66	0.70		0.59	0.62			0.22			0.22	
Clearance Time (s)	3.0	7.0		7.0	7.0			7.0			7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	159	2438		305	2080			261			269	
v/s Ratio Prot	0.02	c0.28			c0.47							
v/s Ratio Perm	0.21			0.09				0.05			c0.15	
v/c Ratio	0.35	0.41		0.15	0.76			0.21			0.70	
Uniform Delay, d1	12.8	6.2		9.4	13.9			31.9			36.0	
Progression Factor	1.00	1.00		1.00	1.00			1.00			0.95	
Incremental Delay, d2	1.3	0.5		1.0	2.7			0.4			7.7	
Delay (s)	14.1	6.7		10.4	16.6			32.3			41.9	
Level of Service	B	A		B	B			C			D	
Approach Delay (s)		7.1			16.4			32.3			41.9	
Approach LOS		A			B			C			D	

Intersection Summary				
HCM 2000 Control Delay	15.6	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.73			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	64.1%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	947	6	33	1583	56	1	0	13	6	0	16
Future Volume (Veh/h)	11	947	6	33	1583	56	1	0	13	6	0	16
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	12	997	6	35	1666	59	1	0	14	6	0	17
Pedestrians								9				
Lane Width (m)								3.6				
Walking Speed (m/s)								1.2				
Percent Blockage								1				
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh)		2			2							
Upstream signal (m)		139										
pX, platoon unblocked				0.89			0.89	0.89	0.89	0.89	0.89	
vC, conflicting volume	1725			1012			1953	2828	510	2302	2802	862
vC1, stage 1 conf vol							1033	1033		1766	1766	
vC2, stage 2 conf vol							920	1795		536	1036	
vCu, unblocked vol	1725			767			1824	2807	204	2216	2777	862
tC, single (s)	4.1			4.4			7.5	6.5	7.0	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.3			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	97			95			99	100	98	93	100	94
cM capacity (veh/h)	371			679			190	106	701	82	117	284

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	510	504	868	892	15	23
Volume Left	12	0	35	0	1	6
Volume Right	0	6	0	59	14	17
cSH	371	1700	679	1700	595	172
Volume to Capacity	0.03	0.30	0.05	0.52	0.03	0.13
Queue Length 95th (m)	0.8	0.0	1.3	0.0	0.6	3.6
Control Delay (s)	1.0	0.0	1.5	0.0	11.2	29.1
Lane LOS	A		A		B	D
Approach Delay (s)	0.5		0.7		11.2	29.1
Approach LOS					B	D

Intersection Summary					
Average Delay	0.9				
Intersection Capacity Utilization	79.2%	ICU Level of Service		D	
Analysis Period (min)	15				



Lane Group	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	29	93	692	12	633	183	897
v/c Ratio	0.16	0.22	0.90	0.06	0.40	0.40	0.45
Control Delay	2.6	24.6	29.0	19.9	19.7	12.8	12.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	2.6	24.6	29.0	19.9	19.7	12.8	12.5
Queue Length 50th (m)	0.0	12.9	55.2	1.4	46.3	17.3	54.3
Queue Length 95th (m)	1.2	24.9	#133.6	5.6	65.9	28.8	70.2
Internal Link Dist (m)	18.4		117.2		321.6		103.1
Turn Bay Length (m)		15.0		20.0		15.0	
Base Capacity (vph)	196	487	812	190	1602	505	2009
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.19	0.85	0.06	0.40	0.36	0.45

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	21	0	7	88	0	657	11	568	33	174	833	19
Future Volume (vph)	21	0	7	88	0	657	11	568	33	174	833	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5	3.3	3.6	3.5
Total Lost time (s)		4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt		0.97		1.00	0.85		1.00	0.99		1.00	1.00	
Flt Protected		0.96		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1166		1745	1518		1220	3412		1744	3329	
Flt Permitted		0.36		0.74	1.00		0.32	1.00		0.31	1.00	
Satd. Flow (perm)		430		1356	1518		408	3412		565	3329	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	22	0	7	93	0	692	12	598	35	183	877	20
RTOR Reduction (vph)	0	20	0	0	284	0	0	4	0	0	2	0
Lane Group Flow (vph)	0	9	0	93	408	0	12	629	0	183	895	0
Confl. Peds. (#/hr)	1					1	1		2	2		1
Heavy Vehicles (%)	54%	100%	45%	0%	0%	5%	43%	5%	1%	0%	7%	53%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		28.7		28.7	28.7		44.8	44.8		58.3	58.3	
Effective Green, g (s)		31.7		31.7	31.7		46.8	46.8		57.3	60.3	
Actuated g/C Ratio		0.32		0.32	0.32		0.47	0.47		0.57	0.60	
Clearance Time (s)		7.0		7.0	7.0		6.0	6.0		3.0	6.0	
Vehicle Extension (s)		5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		136		429	481		190	1596		435	2007	
v/s Ratio Prot					c0.27			0.18		0.04	c0.27	
v/s Ratio Perm		0.02		0.07			0.03			0.20		
v/c Ratio		0.07		0.22	0.85		0.06	0.39		0.42	0.45	
Uniform Delay, d1		23.8		25.0	31.9		14.6	17.4		11.1	10.8	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.4		0.5	14.3		0.6	0.7		0.7	0.7	
Delay (s)		24.3		25.6	46.2		15.2	18.1		11.8	11.5	
Level of Service		C		C	D		B	B		B	B	
Approach Delay (s)		24.3			43.8			18.0			11.6	
Approach LOS		C			D			B			B	

Intersection Summary				
HCM 2000 Control Delay	23.3	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.61			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	84.6%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	21	162	39	164	605	1	157	12	58	1	9	17
Future Volume (Veh/h)	21	162	39	164	605	1	157	12	58	1	9	17
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	26	200	48	202	747	1	194	15	72	1	11	21
Pedestrians		1			7						5	
Lane Width (m)		3.6			3.6						3.6	
Walking Speed (m/s)		1.2			1.2						1.2	
Percent Blockage		0			1						0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)		141										
pX, platoon unblocked				0.97			0.97	0.97	0.97	0.97	0.97	
vC, conflicting volume	753			248			1455	1433	231	1519	1456	754
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	753			205			1453	1431	187	1520	1455	754
tC, single (s)	4.1			4.1			7.2	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			85			0	86	91	98	89	95
cM capacity (veh/h)	862			1333			77	108	826	66	104	411

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	274	950	281	33
Volume Left	26	202	194	1
Volume Right	48	1	72	21
cSH	862	1333	102	192
Volume to Capacity	0.03	0.15	2.74	0.17
Queue Length 95th (m)	0.7	4.3	210.6	4.8
Control Delay (s)	1.2	3.5	876.8	27.6
Lane LOS	A	A	F	D
Approach Delay (s)	1.2	3.5	876.8	27.6
Approach LOS			F	D

Intersection Summary				
Average Delay	163.1			
Intersection Capacity Utilization	82.8%	ICU Level of Service	E	
Analysis Period (min)	15			

Appendix J

OTM Traffic Control Signal Warrants

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

Horizon Year: Existign Traffic
Region/City/Township: City of Burlington

Major Street: Masonry Court
Minor Street: Cooke Boulevard
North/South: N

Number of Approach Lanes: 1
Tee Intersection? N
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
	Masonry Court						Cooke Boulevard						
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
AM Peak Hour	6	336	28	13	41	1	37	1	118	2	0	3	0
PM Peak Hour	2	33	8	47	180	1	116	0	9	1	1	7	0
verage Hourly Volur	**2**	**92**	**9**	**15**	**55**	**1**	**38**	**0**	**32**	**1**	**0**	**3**	**0**

Warrant 1 - Minimum Vehicular Volume

Warrant	AHV
1A - All	248
1B - Mino	74
2A - Majo	174
2B - Cros	39

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
	All Approaches	480	720	600	900	248
					% Fulfilled	**34.4%**

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
	Minor Street Approaches	120	170	120	170	74
					% Fulfilled	**43.4%**

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
	Major Street Approaches	480	720	600	900	174
					% Fulfilled	**24.2%**

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
	Traffic Crossing Major Street	50	75	50	75	39
					% Fulfilled	**52.3%**

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

Horizon Year: Background Traffic
Region/City/Township: City of Burlington

Major Street: Masonry Court
North/South: N
Minor Street: Cooke Boulevard

Number of Approach Lanes: 1
Tee Intersection? N
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
	Masonry Court						Cooke Boulevard						
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
AM Peak Hour	11	1076	41	78	199	1	98	3	377	2	13	21	0
PM Peak Hour	21	162	39	163	603	1	153	12	58	1	9	17	0
verage Hourly Volur	**8**	**310**	**20**	**60**	**201**	**1**	**63**	**4**	**109**	**1**	**6**	**10**	**0**

Warrant 1 - Minimum Vehicular Volume

Warrant	AHV
1A - All	790
1B - Mino	191
2A - Majo	599
2B - Cros	69

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
1A	All Approaches	480	720	600	900	790
					% Fulfilled	109.7%

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
1B	Minor Street Approaches	120	170	120	170	191
					% Fulfilled	112.4%

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
2A	Major Street Approaches	480	720	600	900	599
					% Fulfilled	83.2%

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
2B	Traffic Crossing Major Street	50	75	50	75	69
					% Fulfilled	92.0%

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

Horizon Year: Background Traffic
Region/City/Township: City of Burlington

Major Street: Masonry Court
North/South: N
Minor Street: Cooke Boulevard

Number of Approach Lanes: 1
Tee Intersection? N
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
	Masonry Court						Cooke Boulevard						
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
AM Peak Hour	11	1080	41	78	199	1	99	3	378	2	13	21	0
PM Peak Hour	21	162	39	164	605	1	154	12	58	1	9	17	0
verage Hourly Volur	**8**	**311**	**20**	**61**	**201**	**1**	**63**	**4**	**109**	**1**	**6**	**10**	**0**

Warrant 1 - Minimum Vehicular Volume

Warrant	AHV
1A - All	792
1B - Mino	192
2A - Majo	601
2B - Cros	70

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
1A	All Approaches	480	720	600	900	792
					% Fulfilled	**110.0%**

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
1B	Minor Street Approaches	120	170	120	170	192
					% Fulfilled	**112.8%**

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
2A	Major Street Approaches	480	720	600	900	601
					% Fulfilled	**83.4%**

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
2B	Traffic Crossing Major Street	50	75	50	75	70
					% Fulfilled	**92.7%**

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

Horizon Year: Total Traffic
Region/City/Township: City of Burlington

Major Street: Masonry Court
Minor Street: Cooke Boulevard
North/South: N

Number of Approach Lanes: 1
Tee Intersection? N
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
	Masonry Court						Cooke Boulevard						
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
AM Peak Hour	11	1076	41	78	199	1	100	3	377	2	13	21	
PM Peak Hour	21	162	39	163	603	1	154	12	58	1	9	17	
verage Hourly Volur	**8**	**310**	**20**	**60**	**201**	**1**	**64**	**4**	**109**	**1**	**6**	**10**	**0**

Warrant 1 - Minimum Vehicular Volume

Warrant	AHV
1A - All	791
1B - Mino	192
2A - Majo	599
2B - Cros	70

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
1A	All Approaches	480	720	600	900	791
					% Fulfilled	**109.8%**

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
1B	Minor Street Approaches	120	170	120	170	192
					% Fulfilled	**112.8%**

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
2A	Major Street Approaches	480	720	600	900	599
					% Fulfilled	**83.2%**

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
2B	Traffic Crossing Major Street	50	75	50	75	70
					% Fulfilled	**93.0%**

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

Horizon Year: Total Traffic
Region/City/Township: City of Burlington

Major Street: Masonry Court
Minor Street: Cooke Boulevard
North/South: N

Number of Approach Lanes: 1
Tee Intersection? N
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
	Masonry Court						Cooke Boulevard						
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
AM Peak Hour	11	1080	41	78	199	1	103	3	378	2	13	21	
PM Peak Hour	21	162	39	164	605	1	157	12	58	1	9	17	
verage Hourly Volur	**8**	**311**	**20**	**61**	**201**	**1**	**65**	**4**	**109**	**1**	**6**	**10**	**0**

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
1A	All Approaches	480	720	600	900	794
					% Fulfilled	**110.3%**

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
1B	Minor Street Approaches	120	170	120	170	194
					% Fulfilled	**113.8%**

Warrant	AHV
1A - All	794
1B - Mino	194
2A - Majo	601
2B - Cros	71

Warrant 2 - Delay To Cross Traffic

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
2A	Major Street Approaches	480	720	600	900	601
					% Fulfilled	**83.4%**

	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted X	Free	Restricted	
2B	Traffic Crossing Major Street	50	75	50	75	71
					% Fulfilled	**95.0%**

Appendix K

Region of Waterloo TDM Worksheet

Region of Waterloo

Travel Demand Management (TDM) Implementation Checklist

Version 9/18/2013

Appendix K

Case Study:	40-70 Plains Rd E	**Site Context:**	Aldershot Mobility Hub
TDM Checklist No:		**ZBL Parking Requirement:**	
Date:		**Applicable Parking Reduction:**	

The Transportation Demand Management (TDM) Checklist and Parking Management Worksheet are not designed for residential properties, but can be used to inform mixed-use developments.

TABLE A		**Site Access**					
In creating an environment that supports pedestrian and cycling activity, the public realm must be accessible, safe, and comfortable to encourage movement on the street and in the surrounding area(s). These facilities and features should encourage walking and cycling.							
Points		**Features**				**Yes**	**N/A**
A1	**2**	Development incorporates functional building entrances that are oriented to public space or to locations where pedestrians and transit users arrive from such as a street, square, park or plaza.				**X**	
A2	**1**	External to site: Continuous sidewalks (consistent with AODA Accessible Built Environment Standard) are provided along both sides of all adjacent public streets (over and above requirement) AND Internal to site: Pedestrian walkways (consistent with AODA Accessible Built Environment Standard e.g.1.8m min width) are provided through large parking areas to link the building with the public street sidewalk system				**X**	
A3	**3**	Non-residential: development provides secure bike storage for 5% of the building occupants. Consistent with LEED requirements.				**X**	
A4	**4**	Shower and change facilities for employees provided on-site consistent with LEED requirements.					
A5	**2**	Provision of active uses at-grade along street frontages (e.g. retail).					
	Category Max =	10	**Total Points Applicable =**	10	**Score =**	6	

TABLE B		**Public Transportation Access**					
The availability and proximity of convenient public transit service with direct pedestrian linkages to the building will provide viable travel options for employees, visitors and residents.							
Points		**Features**				**Yes**	**N/A**
B1	**1**	Bus shelters with seating are provided at the transit stop immediately adjacent to the development in consultation with Transportation Planning at the Region of Waterloo					
B2	**1**	Information regarding public transit routes, schedules and fares are provided in an accessible and visible location on site and in adjacent bus stops				**X**	
B3a	**5**	Located within 800m of a Rapid Transit Station					
B3b	**3**	Located within 600 m of a bus service with headways of 15 min or less or is located in a designated mixed use corridor or node. **Note: Points are awarded for either B3a, B3b or B3c only. Please choose whichever represents the highest order of transit.**					
B3c	**1**	Located within 400 m of a bus service with headways of 16 min to 30 min. **Note: Points are awarded for either B3a, B3b or B3c only. Please choose whichever represents the highest order of transit.**				**X**	
	Category Max =	5	**Total Points Applicable =**	5	**Score =**	2	

TABLE C		**Parking**		
Vehicle parking facilities can affect the character, travel mode and cost of a development. Reducing parking supply to match expected demand can a have a positive influence on the selection of alternative travel modes.				
Points		**Features**	**Yes**	**N/A**
C1	**24**	Utilizes reduced parking supply consistent with the TDM Parking Management Worksheet. Contact your Area Municipal planning authority to determine whether the Worksheet is applicable to your development. **Note: Points are awarded for either C1, C2, or C3 only. Please choose whichever applies with the highest value.**		
C2	**24**	Includes allowances for shared parking in mixed-use zones. **Note: Points are awarded for C1, C2, or C3 only. Please choose whichever applies after consulting with the Area Municipal planning authority.**		
C3	**15**	Provides no more than the minimum number of parking spaces, as required by applicable Zoning By-Law. **Note: Points are awarded for either C1, C2, or C3 only. Please choose whichever applies.**	**X**	
C4	**10**	Implements paid parking on part or all of the site (e.g. parking permits, paid parking zones near main entrances)		**X**
C5	**3**	Provides priority parking for carpooling/vanpooling participants equivalent to 5% of employee spaces		**X**
C6	**5**	Commercial Uses: Provide car-share spaces equivalent to 2% of building occupants		**X**
C7	**3**	Parking is not located on major street frontage or between a road right of way and the building facade.	**X**	
C8	**5**	25% to 50% of parking is located underground or in a structure		

C9	**10**	50% to 75% of parking is located underground or in a structure					
C10	**15**	75% of parking or more is located underground or in a structure				**X**	
C11	**3**	Parking spaces provided off-site on a lot within 300 metres of the lot containing such use.					
Category Max =		25	**Total Points Applicable =**		22	**Score =**	25

Region of Waterloo TDM Checklist v2.0 **FORM-1**

Case Study: 40-70 Plains Rd E **Checklist No:** 0
Date: ########### **Site Context:** Aldershot Mobility Hub

TABLE D		**Trip Reduction Incentives**		
A formal TDM plan will identify specific initiatives that will be initiated in order to encourage reduced single occupant vehicle travel.				
Points		**Features**		**N/A**
D1	**2**	The building owner/occupant will make available a ride matching service for car/vanpooling		**X**
D2	**2**	The building owner/occupant will make available emergency ride home options		**X**
D3	**5**	The building owner/occupant will make available subsidized transit passes for all occupants for a period of two years	**X**	
D4	**5**	The building owner/occupant agrees to charge for parking as an unbundled cost to occupants	**X**	
D5	**2**	The building owner/occupant agrees to provide reduced cost parking for users of car/van pool, bicycle, moped/motorcycle spaces		**X**
D6	**10**	The building owner/occupant has prepared a TDM plan to the satisfaction of the Region of Waterloo and the Area Municipality that targets a 10% reduction in peak hour trips using forecast trip generation with status quo travel characteristics		**X**
D7	**5**	The employer has provided flexible working hours, telework or shift work arrangements.		**X**
D8	**14**	The development agrees to join Travelwise (TMA) that provides the same services outlined under items D1, D2, D6		**X**
D9	**5**	The building owner/occupant will make available car sharing services	**X**	
D10	**2**	The development includes mixed uses (i.e. retail, commercial or food services, daycares, or other complementary uses) on-site or located within 400 metres.		**X**
Category Max =		25	**Total Points Applicable =** -12	**Score =** 15

TABLE E	**Checklist Summary**			
For each item, a "Yes" answer is equivalent to the points as indicated in the section. N/A sections should be explained in an attachment to this table. The score for each section is reflected as a percentage and calculated by dividing the points by the "Total Applicable".				
Category	**Minimum Requirement**	**Total Applicable**	**Points Scored**	**Comments**
Pedestrian & Cyclist Orientation	24	10	6	
Public Transit Access		5	2	
Parking		22	25	
SUB-TOTAL		**37**	**33**	
Trip Reduction Incentives		*-12*	15	
OVERALL TOTAL		***25***	**48**	

TABLE F	**Scoring Summary**		
FINAL SCORE	**RATING (check one)**		
50 - 65	********		**TDM SUPPORTIVE DEVELOPMENT**
40 -49	*******	**X**	
30 - 39	******		
24 - 29	*****		
0 - 23			Non-TDM Supportive Development (Review and upgrade TDM elements to pass)

Comments:

Region of Waterloo

Parking Management Worksheet

Version 9/18/2013

Appendix K

Case Study: 40-70 Plains Rd E **Site Context:** Aldershot Mobility Hub

Date: **Reduction Worksheet No:**

"**Urban Growth Centres -** (UGC) area classification includes the Downtown / Uptown and RT Station Areas of Kitchener, Waterloo and Cambridge.

"**Intensification Corridor**" (IC) classification is applied to sites within 800 metres of the future CTC line

"**Other**" classification applies to all other sites

Please highlight the cell percentages applicable to your development under the appropriate classification. Please note that the Parking Management Worksheet and the Transportation Demand Management (TDM) Checklist are not designed for residential properties, but can be used for mixed-use developments. Local municipalities are the decision-making bodies with respect to consideration of parking reductions below Zoning By-law requirements.

TABLE A	Pedestrian and Cyclist Orientation			
In creating an environment that supports pedestrian and cycling activity, the public realm must be accessible, safe, and comfortable to encourage movement on the street and in the surrounding area(s). These facilities and features should encourage walking and cycling.				
	Features	**UGC**	**IC**	**Other**
A1	Development incorporates functional building entrances that are oriented to public space or to locations where pedestrians and transit users arrive from such as a street, square, park or plaza.	1%	1%	1%
A2	Continuous sidewalks (1.5m min. width) are provided along both sides of all adjacent public streets and pedestrian walkways (1.5m min width) are provided through large parking areas to link the building with the public street sidewalk system	0%	0%	1%
A3	Non-Residential: Development provides secure bike storage for 4% of the building occupants	2%	2%	1%
A4	Shower and change facilities provided on-site consistent with LEED requirements.	1%	1%	1%
A5	Provision of active uses at-grade along street frontages.	1%	1%	1%
	Category Maximum	**4%**	**4%**	**4%**
	Available Parking Reduction		**1%**	

TABLE B	Public Transportation Access			
The availability and proximity of convenient public transit service with direct pedestrian linkages to the building will provide viable travel options for employees, visitors and residents.				
	Features	**UGC**	**IC**	**Other**
B1	Bus shelters with seating are provided at the transit stop immediately adjacent to the development, in consultation with Transportation Planning at the Region of Waterloo	0%	0%	1%
B2	Information regarding public transit routes, schedules and fares are provided in an accessible and visible location on site and in adjacent bus stops	0%	0%	1%
B3a	Located in an UGC or within 800 m of a future Rapid Transit Station	24%	12%	0%
B3b	Located within 600m a transit route with 15 minute headways (or less) or is located in a designated mixed use corridor or node. **Note: Points are awarded for either B3a, B3b or B3c only. Please choose whichever represents the highest order of transit.**	-	-	3%
B3c	Located within 400 metres of a bus service with headways of 15 min to 30 min. **Note: Points are awarded for either B3a, B3b or B3c only. Please choose whichever represents the highest order of transit.**	-	-	1%
	Category Maximum	**24%**	**12%**	**5%**
	Available Parking Reduction		**0%**	

TABLE C	Parking			
Vehicle parking facilities can affect the character, travel mode and cost of a development. Reducing parking supply to match expected demand can have a positive influence on the selection of alternative travel modes.				
	Features	**UGC**	**IC**	**Other**
C1	Provides priority parking for carpooling/vanpooling participants equivalent to 5% of employee spaces	0%	0%	5%
C2	Commercial Uses: Provide car-share spaces equivalent to 2% of building occupants	2%	2%	0%
C3	Implements paid parking system on all or part of the site (e.g. parking permits, paid parking zones near main entrances)	2%	2%	1%
C4	Parking is not located on major street frontage.	0%	0%	1%
C5	25% to 50% of parking is located underground or in a structure	2%	1%	0%

C6	50% to 75% of parking is located underground or in a structure	4%	2%	0%
C7	75% of parking or more is located underground or in a structure	5%	3%	0%
	Category Maximum	**6%**	**4%**	**6%**
	Available Parking Reduction		**3%**	

Sample Parking Reduction Worksheet **FORM-2**

Case Study: 40-70 Plains Rd E **Site Context:** Aldershot Mobility Hub
Date: 1900-01-00 **Worksheet No:** 0

TABLE D	Trip Reduction Incentives			
A formal TDM plan will identify specific initiatives that will be initiated in order to encourage reduced single occupant vehicle travel.				
	Features	**UGC**	**IC**	**Other**
D1	The building owner/occupant will provide a ride matching service for car/vanpooling	0%	0%	1%
D2	The building owner/occupant will provide emergency ride home options	3%	2%	1%
D3	The building owner/occupant will provide subsidized transit passes for all occupants for a period of two years	10%	4%	2%
D4	The building owner/occupant agrees to charge for parking as a separate cost to occupants	10%	5%	2%
D5	The building owner/occupant agrees to provide reduced cost for users of car/van pool, bicycle, moped/motorcycle spaces	0%	0%	1%
D6	The development agrees to join Travelwise (TMA) that provides the same services outlined under items D1 and D2	9%	6%	4%
	Category Maximum	**23%**	**11%**	**7%**
	Available Parking Reduction		5%	

TABLE E	Parking Reduction Summary				
Please indicate the total reduction available based upon Tables A through D above.					
		Maximum Achievable Reduction			
Category	**Reduction Achieved**	**UGC**	**IC**	**Other**	**Comments**
Pedestrian & Cyclist Orientation	**1%**	4%	4%	4%	
Public Transit Access	**0%**	24%	12%	5%	
Parking	**3%**	6%	4%	6%	
Trip Reduction Incentives	**5%**	23%	11%	7%	
TOTAL	**9%**	**57%**	**31%**	**22%**	

TABLE F	TOTAL REDUCTION ACHIEVED	**9%**

Comments: