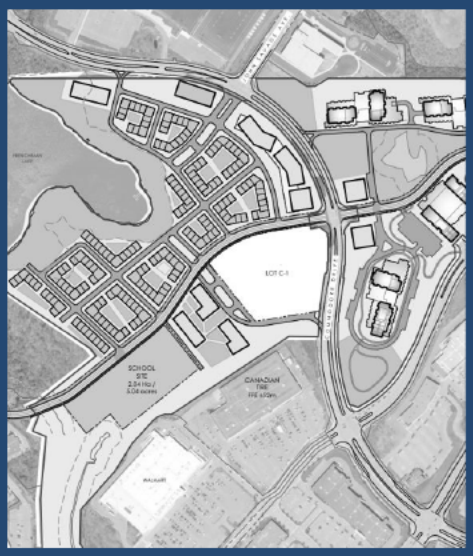


Report

September 5, 2024

Dartmouth Crossing Residential Development Mobility Analysis

DP Project #22-596





SUBMITTED BY:

DesignPoint Engineering & Surveying Ltd.

90 Western Parkway, Suite 500
Bedford, NS B4B 2J3

SUBMITTED TO:

North American Development Group

c/o 1 Westmount Square #300
Westmount, QC H3Z 2P9

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Paul Burgess, P.Eng. M.Eng.
Transportation Engineer



Ellen Dalton, P.Eng.
Transportation Engineer



This report was prepared by DesignPoint Engineering & Surveying Ltd. for North American Development Group using the care and skill ordinarily exercised by members of the engineering profession currently practicing under similar circumstances on similar projects in Nova Scotia.

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1.0 INTRODUCTION

1.1 Project Overview

DesignPoint Engineering & Surveying Ltd has been engaged to complete a mobility analysis study for a mixed-use development in Dartmouth Crossing. The proposed development includes approximately 4,200 residential units, a hotel, a grocery store, and a school.

Dartmouth Crossing and the neighboring area of Burnside includes commercial areas and a central shopping district surrounded by employment areas in office spaces and the adjacent business/industrial park. The area has no existing residential development until the opposite side of Highway 111 towards Highfield Park and North Dartmouth or the residential development along the Bedford Basin on the southwest side of Windmill Road.



Figure 1 - Dartmouth Crossing aerial (proposed project area shown in blue on the left) ***Image from nadg.com***

This proposed project adds dense residential development close to employment and amenities. It provides a valuable addition to the municipality's housing with a community where residents can live, shop, and work in the area. The intent of the development is to leverage its location along a BRT line and adjacent to many desirable destinations to create a complete community that shifts dependency away from single occupancy vehicles. A full site plan for the proposed development is included in Appendix A.

The original intent for this area was to construct additional office space. This project seeks to shift much of that to residential development. This shift comes at a benefit to Halifax as the development creates an opportunity to generate much needed housing, and shifting the land use away from office and promoting alternate mode choices mitigates the development's impact on the road network. The original plan for office space would add

peak hour trips in the peak direction (into Dartmouth Crossing in the morning, leaving the area in the evening. The shift to residential means that for those residents who are driving, many of the new trips being generated are instead travelling in the opposite direction or are staying within the area.

1.2 Project Location

The project is located in Dartmouth Crossing, between the areas of Burnside and North Dartmouth. From a transportation perspective, the project area is bound by four primary roadways- Highway 118, Highway 111, Wright Avenue, and Burnside Drive.

Towards the east of the site, Highway 118 runs north-south, connecting to Highway 102 in the north. Towards the south of the site, Highway 111 (the Circumferential Highway) links to the MacKay Bridge and to Woodside. Along the north of the project area, Wright Avenue connects Highway 118 to Burnside Drive and from there down to Windmill Road.

Burnside Drive (west of the project site) runs approximately parallel to Highway 118 and currently connects Highway 111 to Akerley Boulevard. Construction is underway for Burnside Drive to be extended beyond Akerley Boulevard to connect to the Highway 107 Extension (the Sackville-Bedford-Burnside Connector). This connection is anticipated to be completed by the end of 2024.

The development is proposed for the greenfield site to the west of the existing Dartmouth Crossing area.

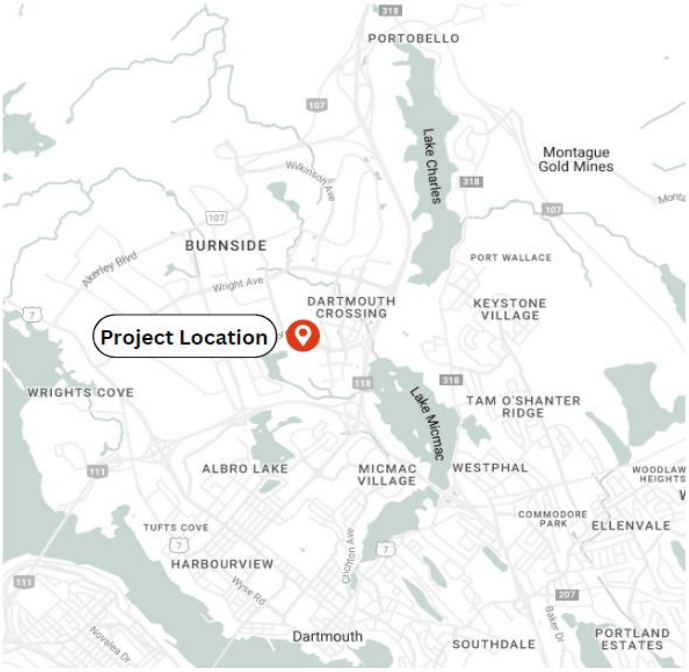


Figure 2 – Approximate Project Location



Figure 3 – Development Area in context of surrounding area

2.0 EXISTING CONDITIONS

Dartmouth Crossing is a commercial development located in northern Dartmouth. Construction began in the mid-2000's and is the largest retail development in eastern Canada. Dartmouth Crossing and Burnside have continued to expand over the past 20 years. The streets have been designed and constructed to Halifax's street design standards, which at the time of design and up to HRM's adoption of the Integrated Mobility Plan in 2017, prioritized vehicle infrastructure and operations compared to active transportation and transit.

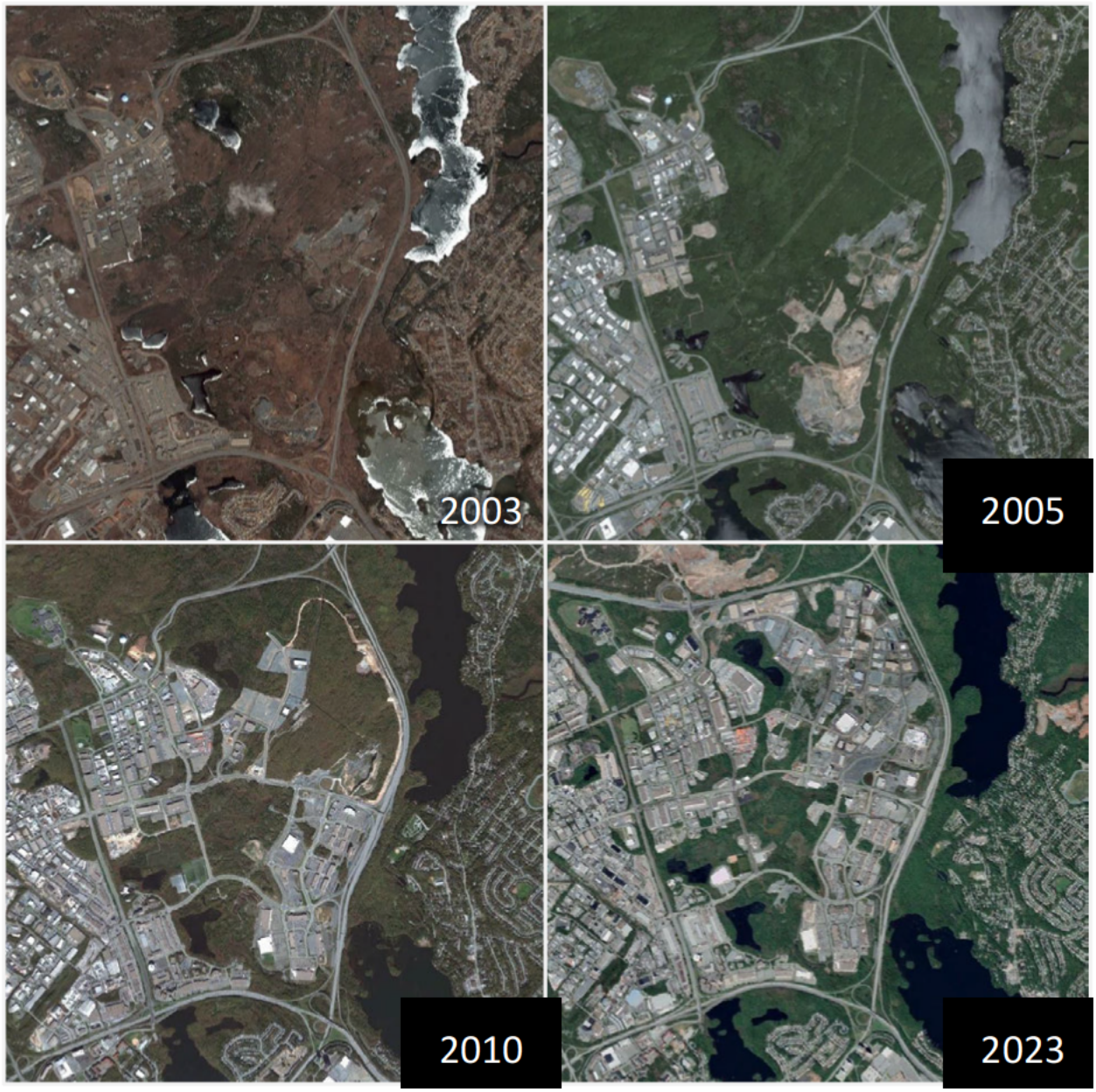


Figure 4 - Aerial images showing past 20 years of development of project area

2.1 Active Transportation

For pedestrians, there are existing sidewalk facilities providing a complete network throughout Burnside. The following figure shows the presence of sidewalks (in yellow) and multi-use pathways (in purple) throughout the area surrounding the development. While there are sidewalks on both sides of the street in most cases, buildings are setback far from the street, increasing pedestrian walking distances and having a negative impact on the pedestrian environment.

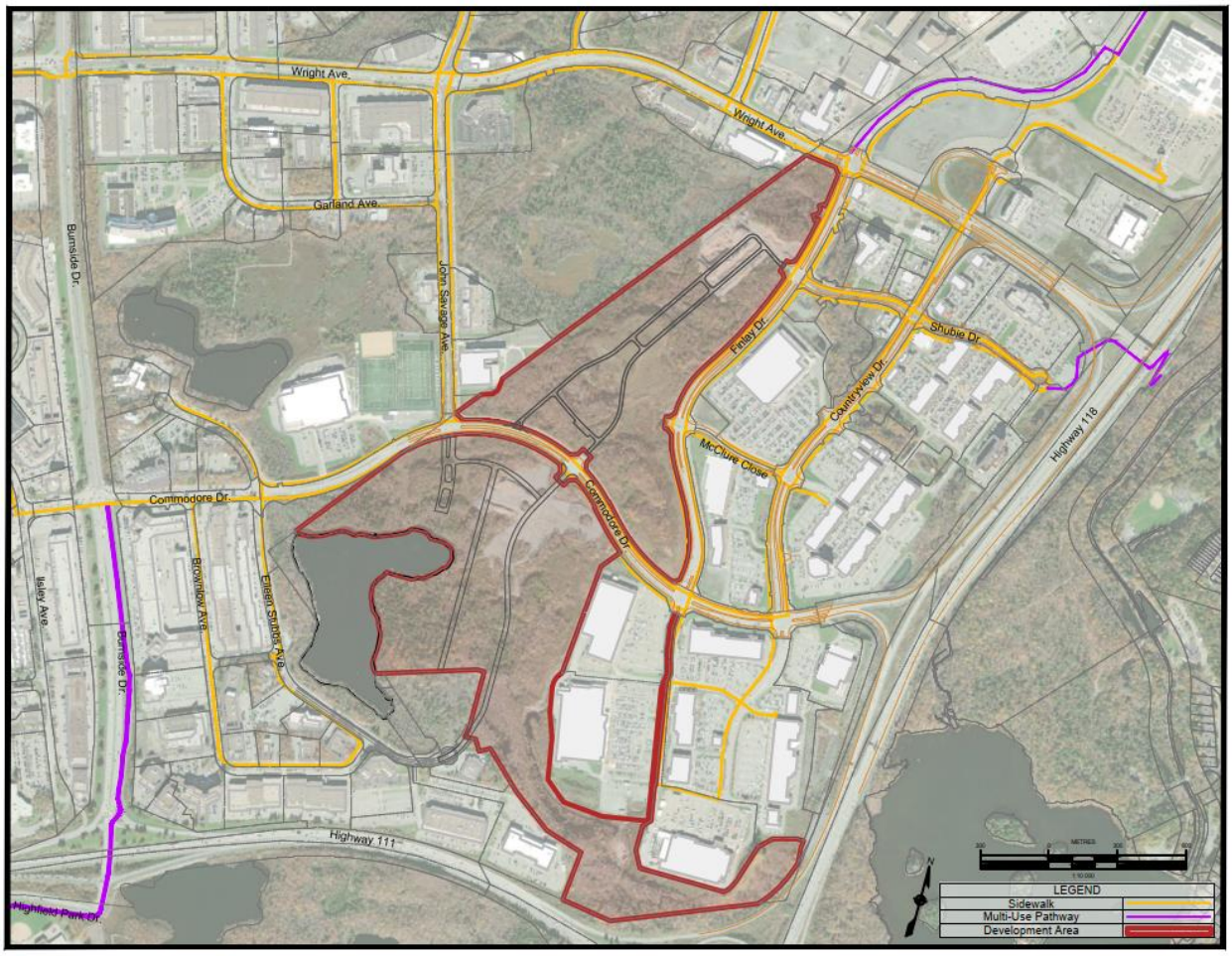


Figure 5 - Existing pedestrian infrastructure surrounding development

For cyclists, there are painted bike lanes (shown in blue in the following figure) on some of the surrounding streets and multi-use pathways (shown in purple) that provide facilities for cyclists on Burnside Drive, Cutler Avenue, and a dedicated bridge providing access from the Dartmouth Crossing commercial area to Shubie Park and the Trans Canada Trail on the eastern side of Highway 118.

While painted bike lanes may be beneficial compared to shared lanes, the volume and speed of vehicles on streets within Dartmouth Crossing are both high enough that protected or off-street infrastructure is more appropriate.

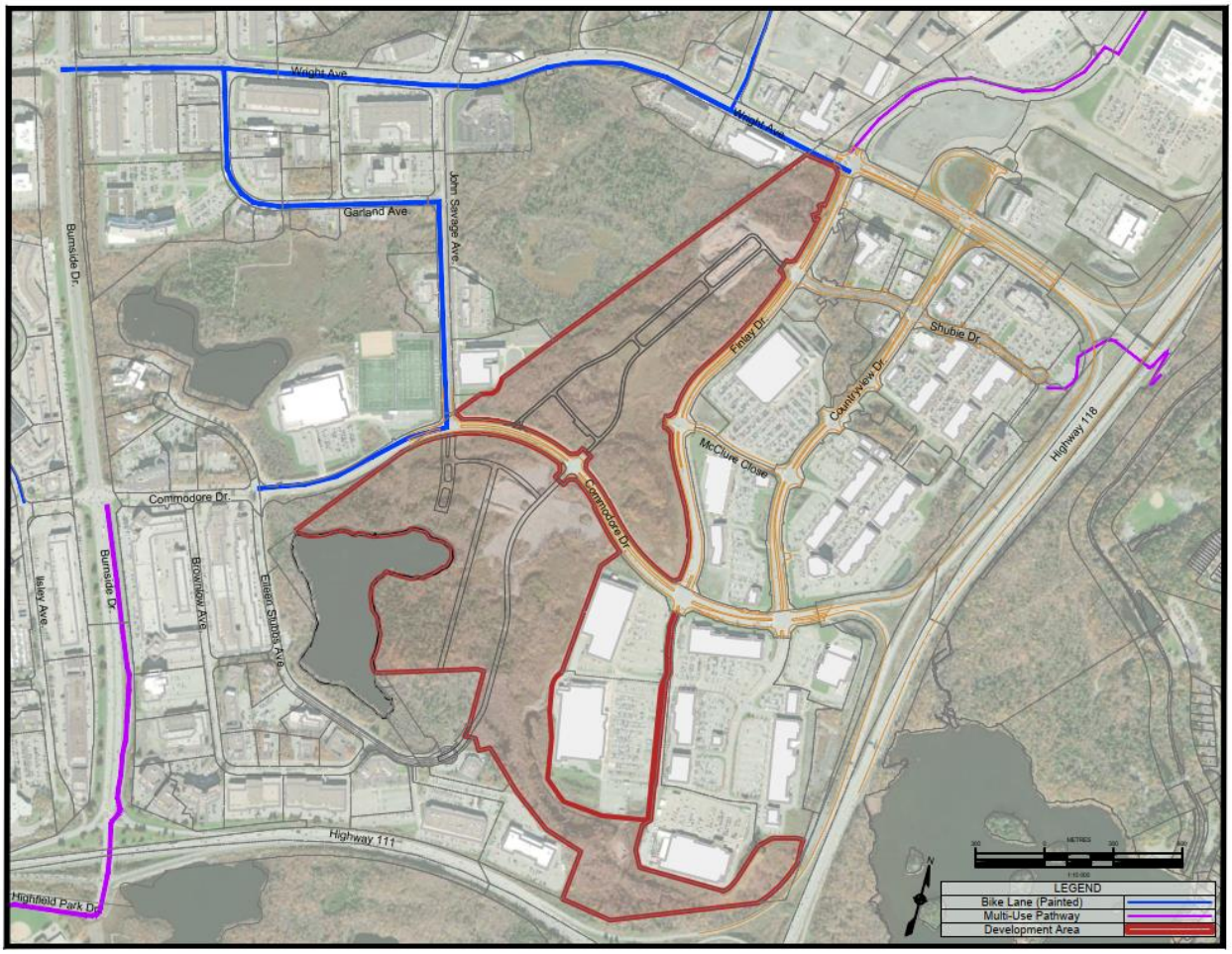


Figure 6 - Existing cycling infrastructure surrounding development

HRM's Active Transportation Plan indicates a proposed greenway that will extend the existing Burnside Drive Greenway further along Burnside Drive and along Commodore Avenue to connect to Eileen Stubbs Avenue (where the painted bike lanes begins).

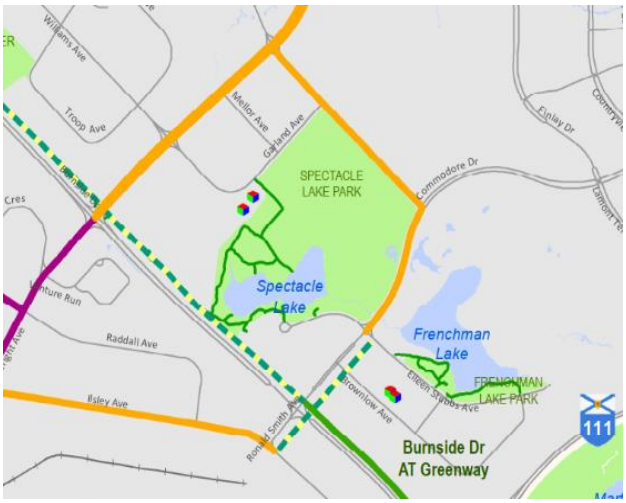


Figure 7 - Clip from HRM's AT Plan showing proposed greenway extension in dashed green and yellow along Burnside Dr and Commodore Ave

Data collected for this project illustrates a limited volume of existing active transportation users in the area.

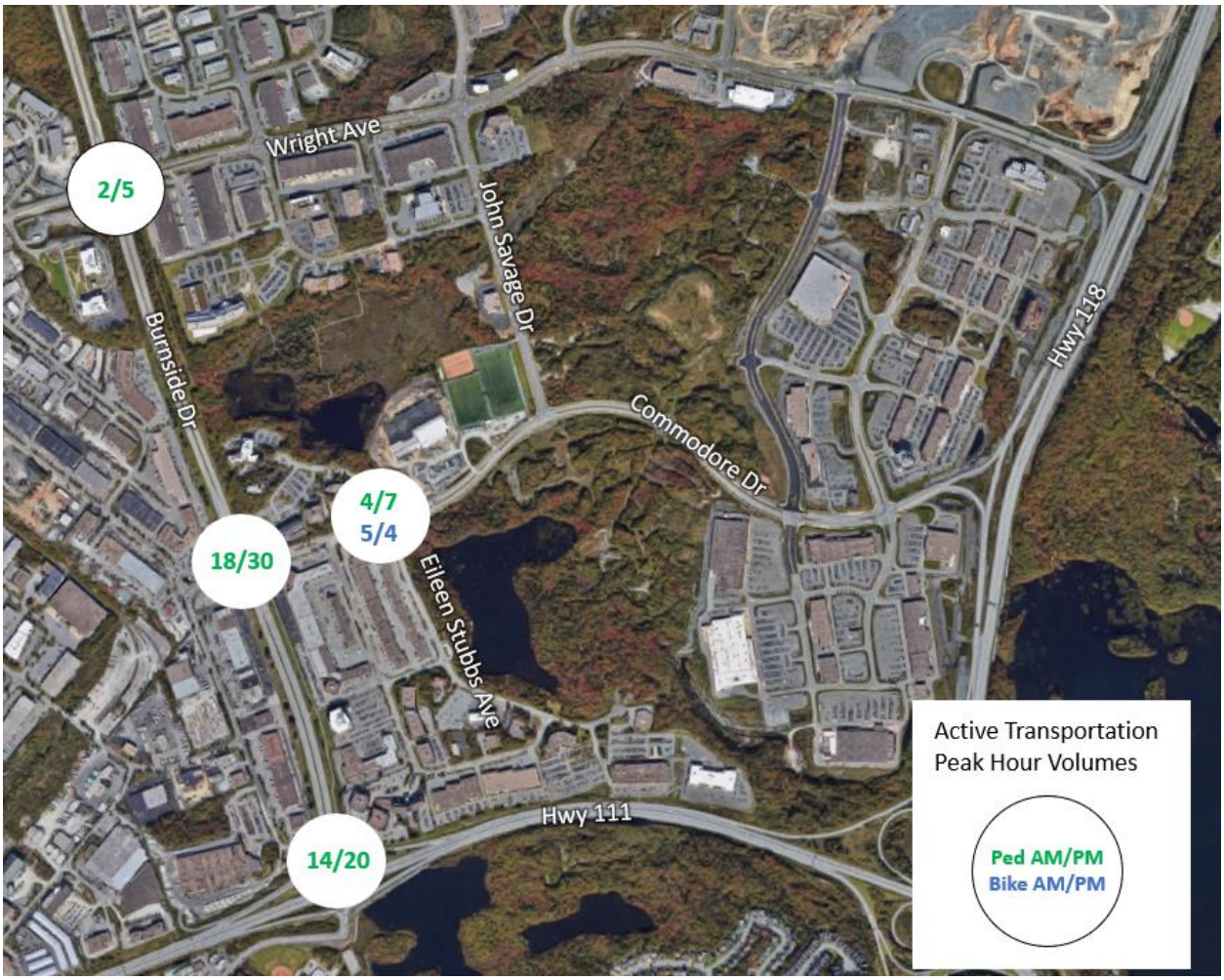


Figure 8 - Existing Active Transportation Peak Hour Volumes

2.2 Transit

Halifax Transit services the area with routes that run along the perimeter of the proposed development area. The following figure illustrates these routes with existing transit stops shown as blue dots.

Route 56 “Dartmouth Crossing” (shown in cyan) travels through the primary commercial/retail area of Dartmouth Crossing and provides a connection to Micmac Terminal and the Bridge Terminal with buses running every 30 minutes.

Route 64 “Burnside” (shown in yellow) travels through the central area of Burnside Industrial Park, travelling from Wrights Cove to Akerley Boulevard and then making its way through the industrial park before crossing over Highway 111 to Highfield Terminal. Buses run every 15 minutes in the morning and evening, and every hour during midday.

Route 72 “Portland Hills” (shown in pink) includes a loop through a portion of the Dartmouth Crossing commercial area and provides a connection to Highfield Terminal. Micmac Terminal, and Portland Hills Terminal. Buses run every 30 minutes until approximately 7pm when service is reduced to every 60 minutes.

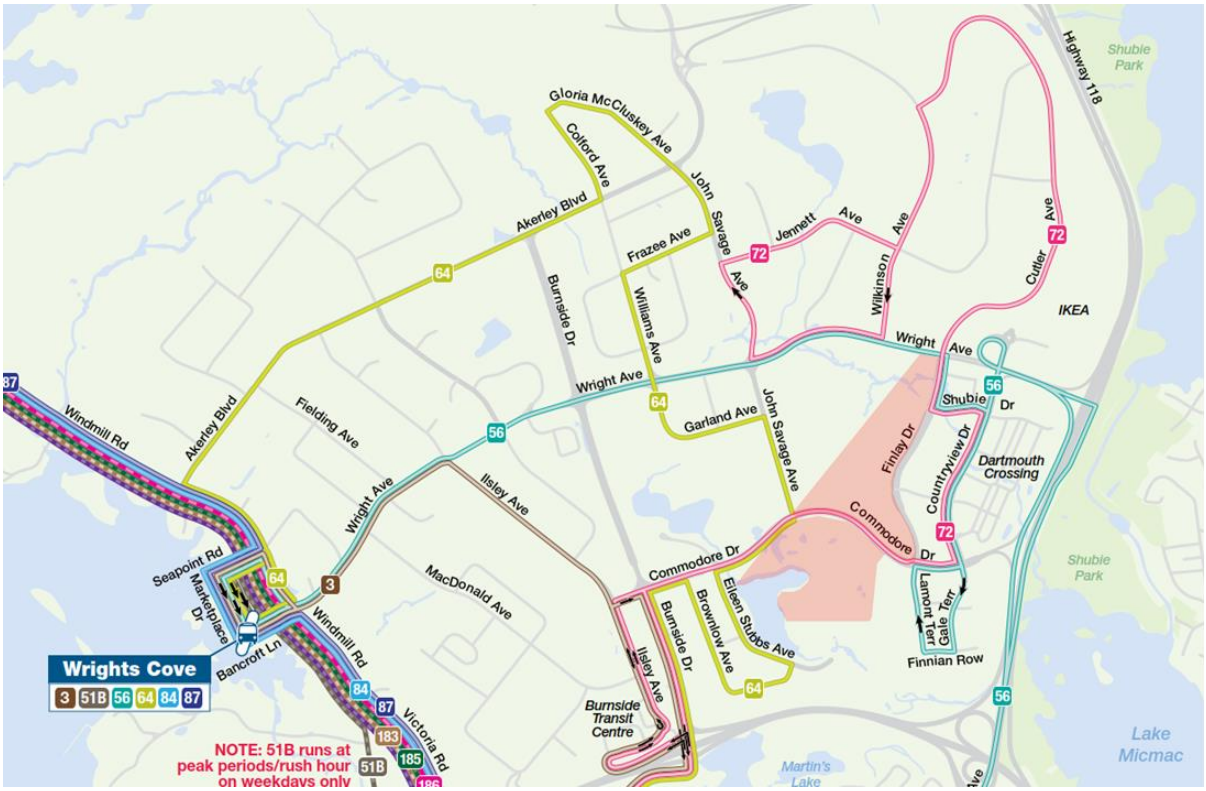


Figure 9 - Existing transit service surrounding the proposed development area

HRM's Rapid Transit Strategy from 2020 includes policy direction to plan for higher-density mixed use development around Rapid Transit. Figure 37 of the Rapid Transit Strategy (see below) identifies Dartmouth Crossing as a potential transit-oriented community.

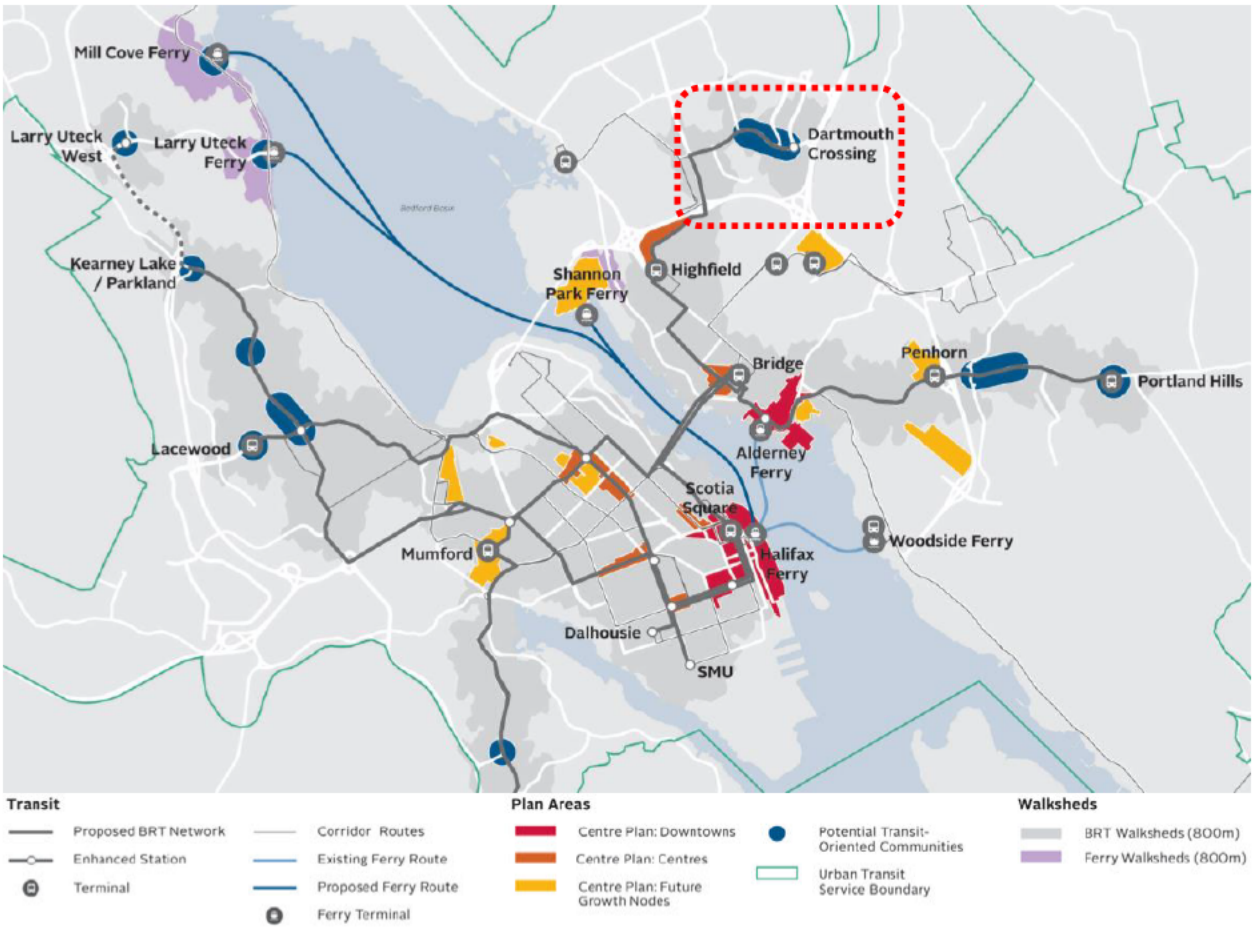


Figure 10 – Map (Figure 37 from HRM's Rapid Transit Strategy)

The Rapid Transit Strategy has the "Purple Line" extending into Dartmouth Crossing via Commodore Drive. This route connects Dartmouth Crossing and North Dartmouth across the MacKay Bridge to Clayton Park and Bedford West as depicted in the following figures from the 2020 plan.



Figure 11 - Estimated BRT Travel Times (HRM Rapid Transit Strategy, 2020)

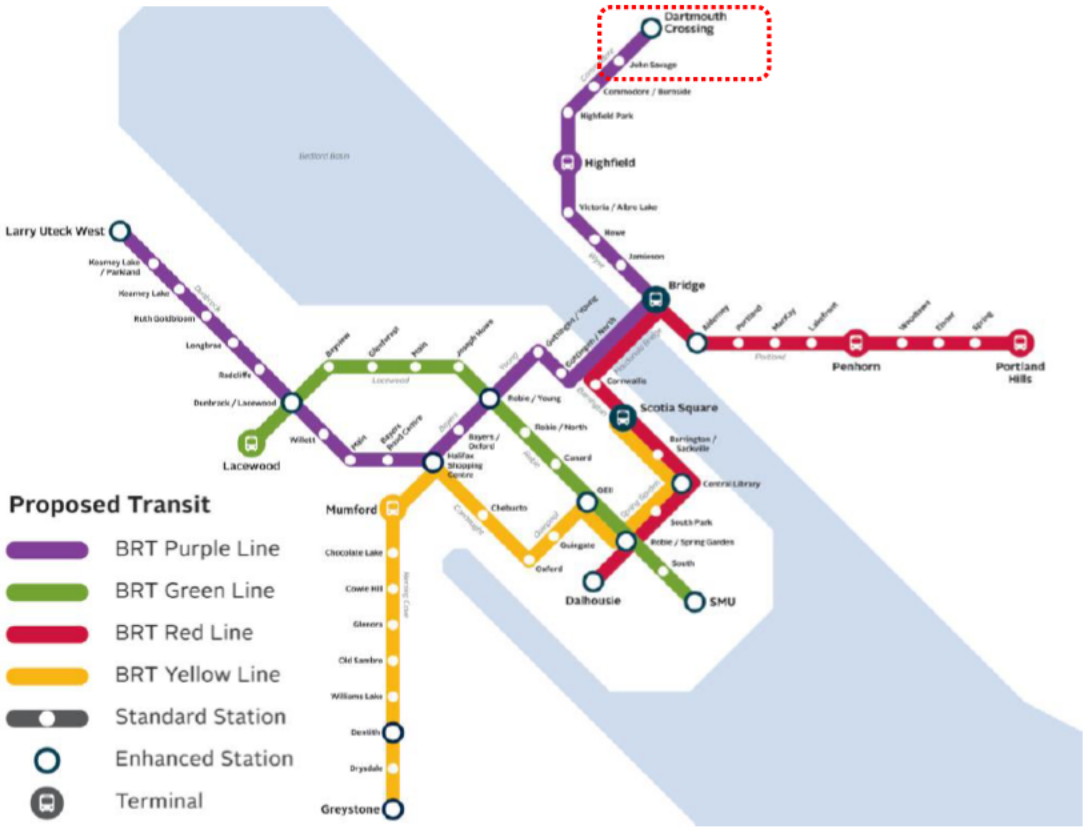


Figure 12 - Planned BRT Network, with study area highlighted in red (from HRM Bus Rapid Transit Plan)

2.3 Auto

2.3.1 Study Area Streets

The study area streets for the mobility analysis include Burnside Drive, Commodore Drive, Wright Avenue, and Finlay Drive. The Highway 111 / Burnside Drive, Highway 118 / Wright Avenue and Highway 118 Collector-Distributor road are also included in the study. The Highway 118 Collector-Distributor road will be analysed in a separate analysis.

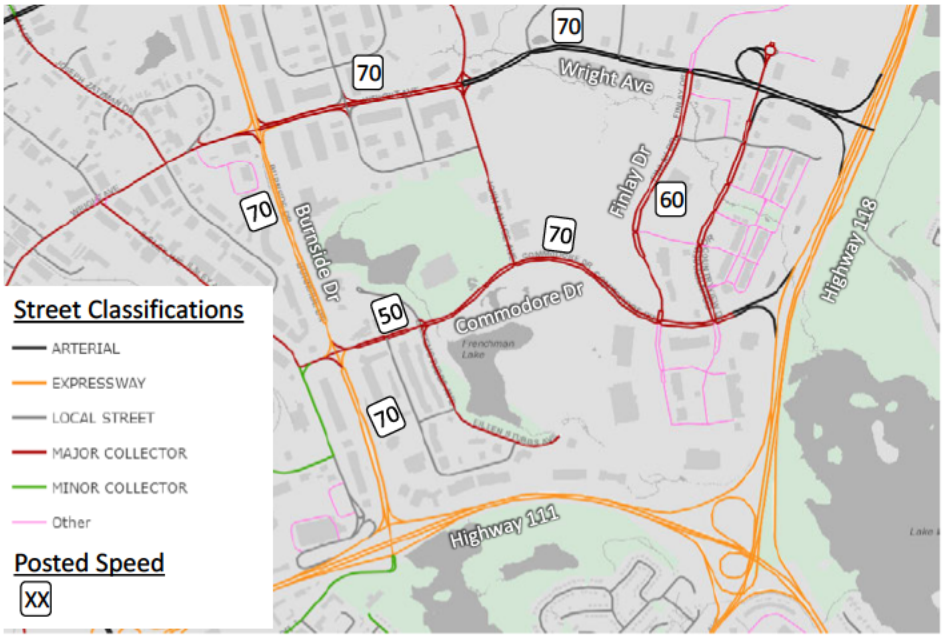


Figure 13 - Study Area Streets

HRM owns all streets internal to the boundary streets, and NSDPW owns the Highway 111 and Highway 118 interchanges. NSDPW road ownership is shown in the figure below.

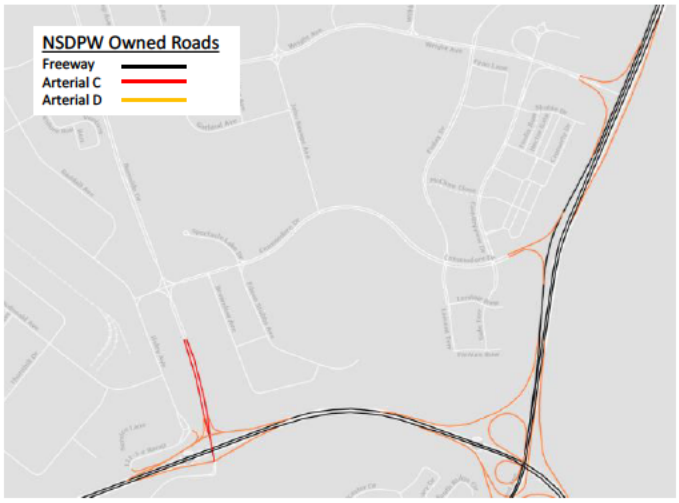


Figure 14 - NSDPW Owned Roads

2.3.2 Study Area Intersections

The study area for the intersection traffic analysis is bound by Burnside Drive, Wright Avenue, Highway 118 and Highway 111 and includes 14 key intersections (13 existing, one proposed) within Dartmouth Crossing and Burnside. The lane configuration and traffic control conditions are shown in the following figure. A separate analysis has been completed for the Highway 118 Collector-Distributor Road and the Highway 118 / Highway 111 interchange and is addressed in Section 10 of this report.

Lane Configuration and Traffic Control



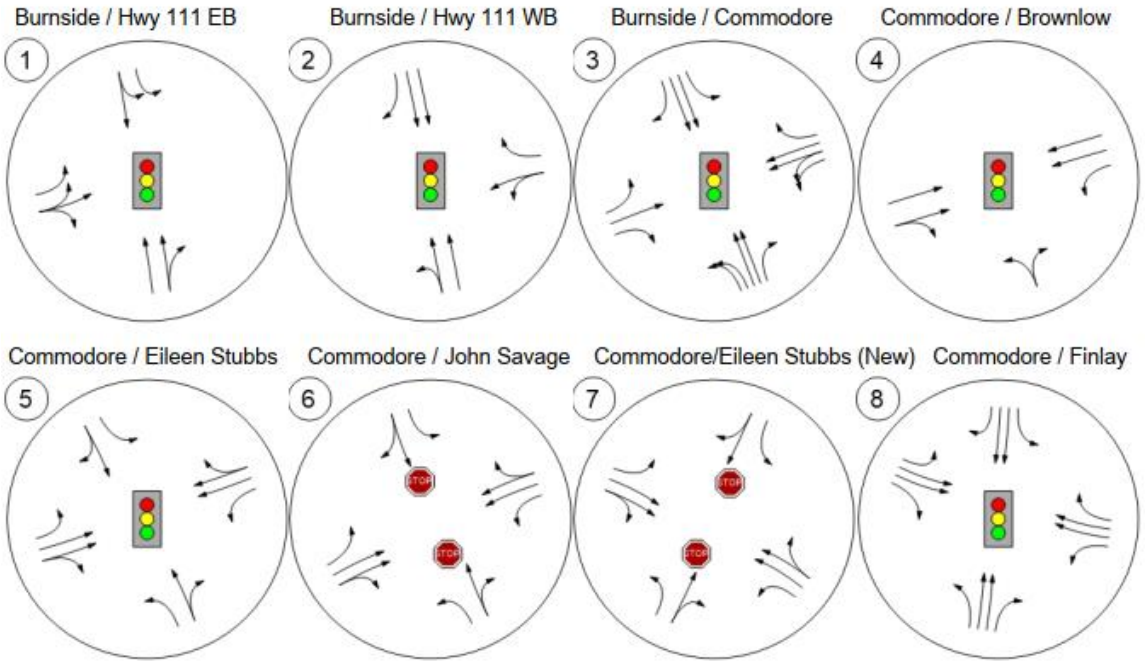
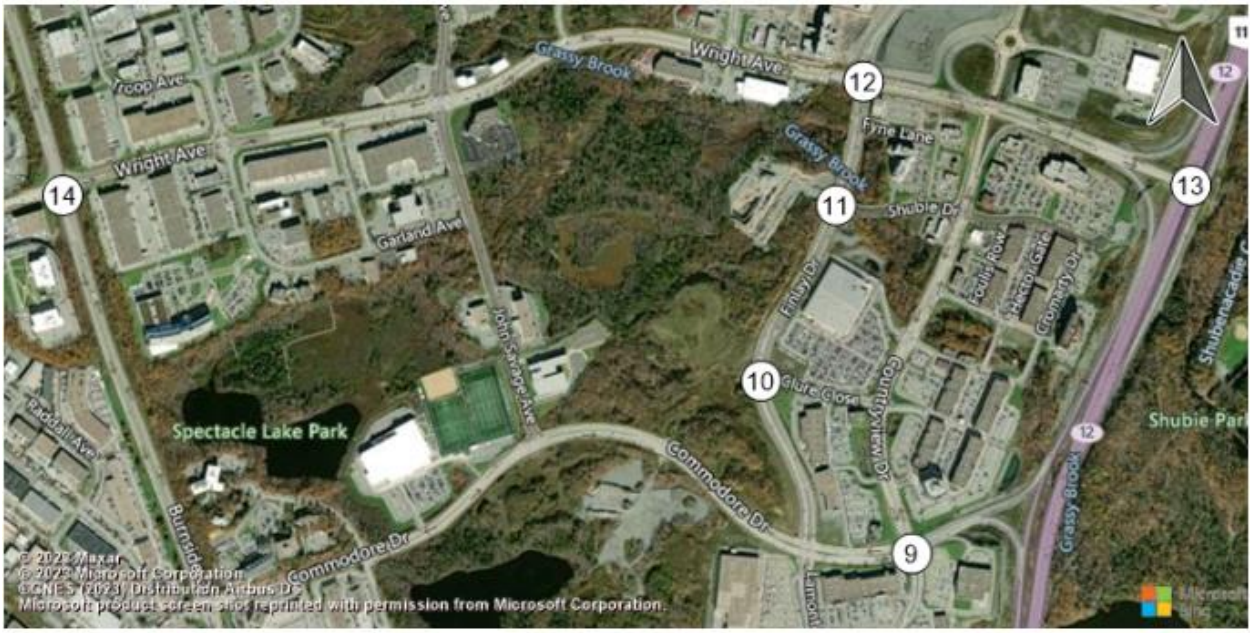


Figure 15 - Study Intersections & Existing Intersection Configurations (Part A)

Lane Configuration and Traffic Control



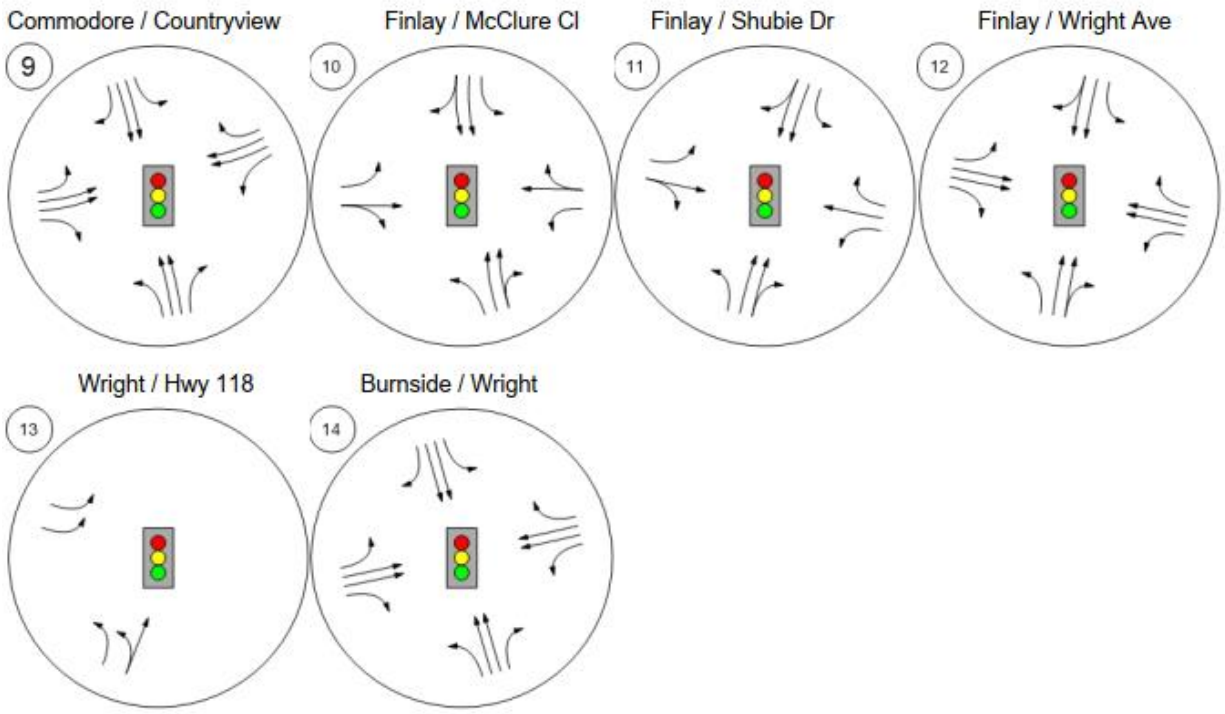


Figure 16 - Study Intersections & Existing Intersection Configurations (Part B)

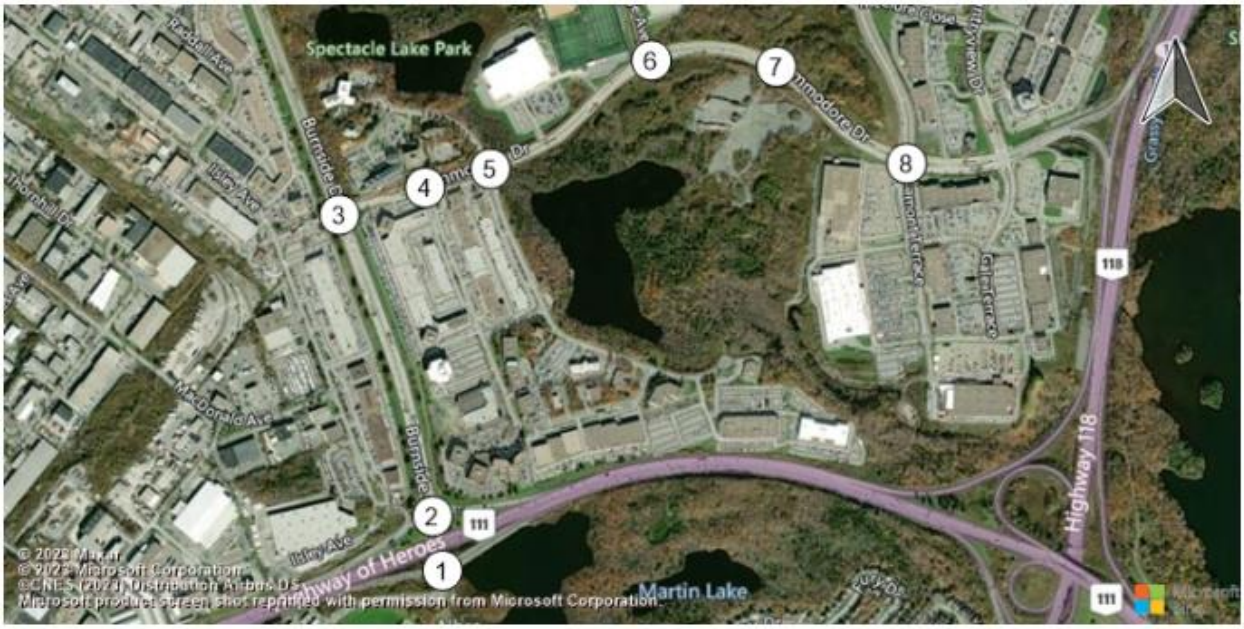
2.3.3 Existing Traffic Volumes

Weekday peak hour traffic data for the 12 study area intersections was collected by DesignPoint using MioVision video data collection. Table 1 provides a summary of the traffic data collection program, and a summary of the AM and PM peak volumes are provided in Figures 17 to 20. For the Existing Traffic scenario, intersection counts have been adjusted to balance volumes between intersection as appropriate. The full data set is provided in Appendix B.

Table 1 – Traffic Data Collection Summary

Intersection	Data Collected	Date Collected
Burnside Drive at Highway 111 EB / Highfield Park	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	April 27th, 2023
Burnside Drive at Highway 111 WB	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	April 26th, 2023
Burnside Drive at Commodore Drive	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	April 25th, 2023
Commodore Drive at Brownlow Avenue	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	May 25th, 2023
Commodore Drive at Eileen Stubbs Avenue / Spectacle Lake Drive	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	May 24th, 2023
Commodore Drive at John Savage Avenue	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	January 10th, 2023
Commodore Drive at Finlay Drive / Lamont Terrace	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	January 11th, 2023
Commodore Drive at Countryview Drive	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	May 31st, 2023
Finlay Drive at McClure Close	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	January 12th, 2023
Finlay Drive at Shubie Drive	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	January 18th, 2023
Wright Avenue at Finlay Drive / Cutler Avenue	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	January 25th, 2023
Wright Avenue at Highway 118	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	May 30th, 2023
Wright Avenue at Burnside Drive	7 – 9 AM, 11 AM – 1 PM, 4 – 6 PM	October 19th, 2023

AM Peak - Existing Traffic Volumes (2023)



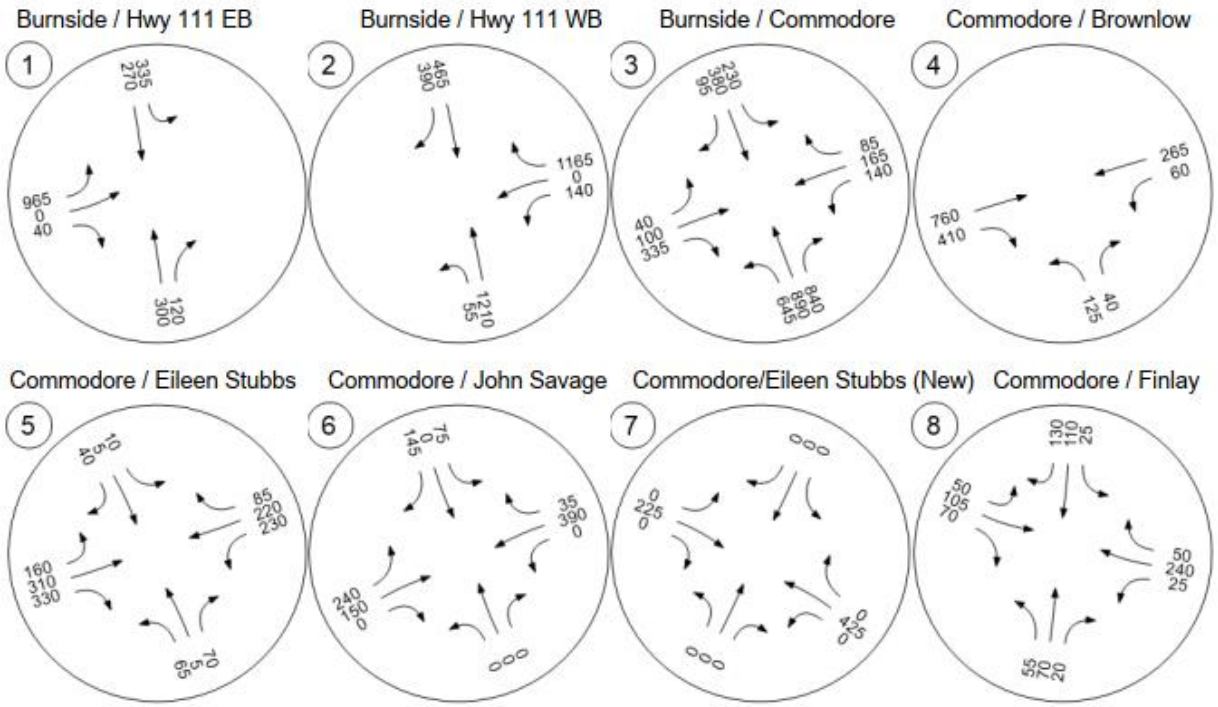


Figure 17 - AM Existing Traffic Volumes (Part A)

AM Peak - Existing Traffic Volumes (2023)



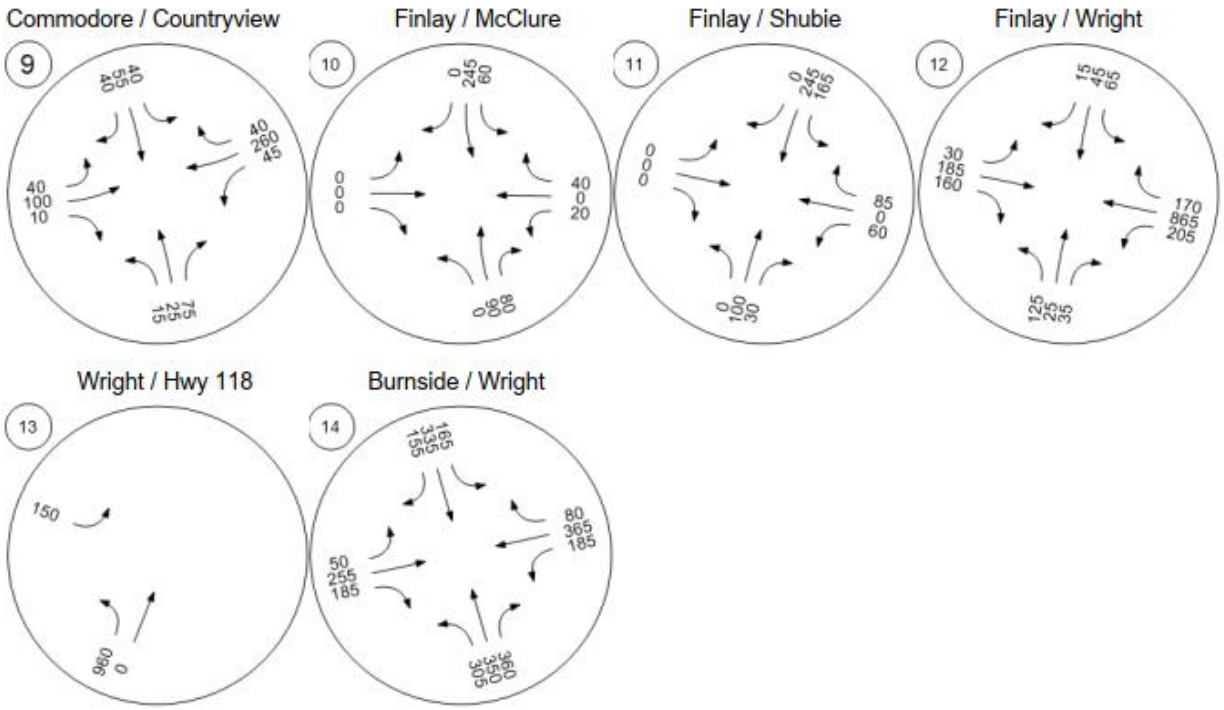
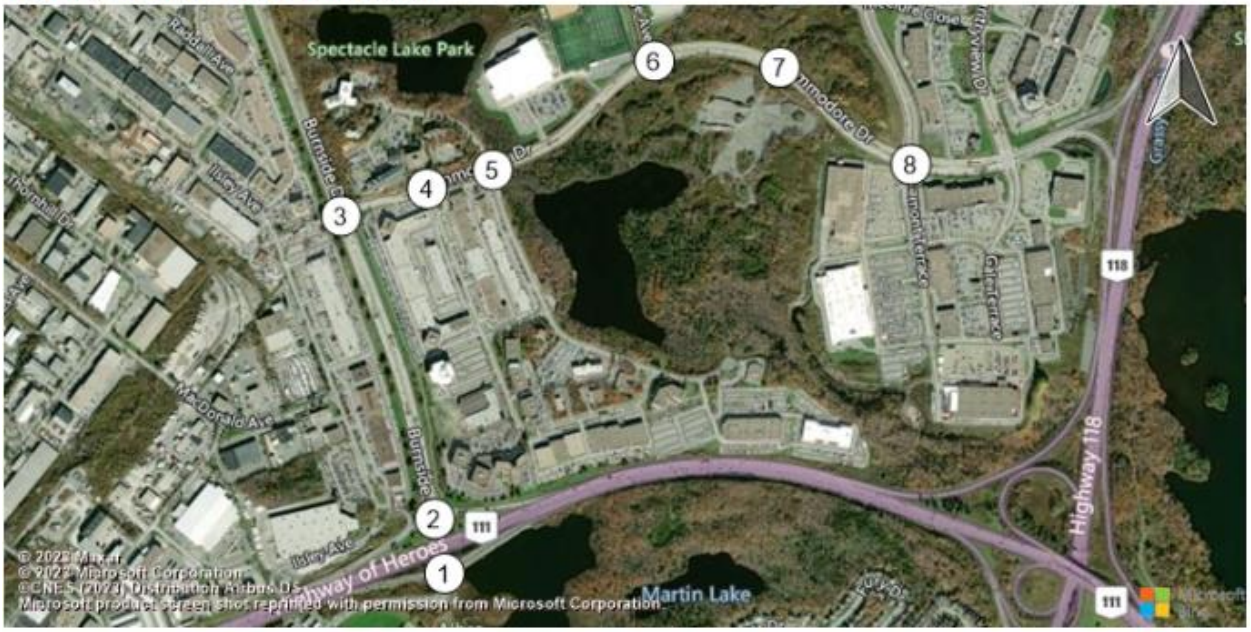


Figure 18 - AM Existing Traffic Volumes (Part B)

PM Peak - Existing Traffic Volumes (2023)



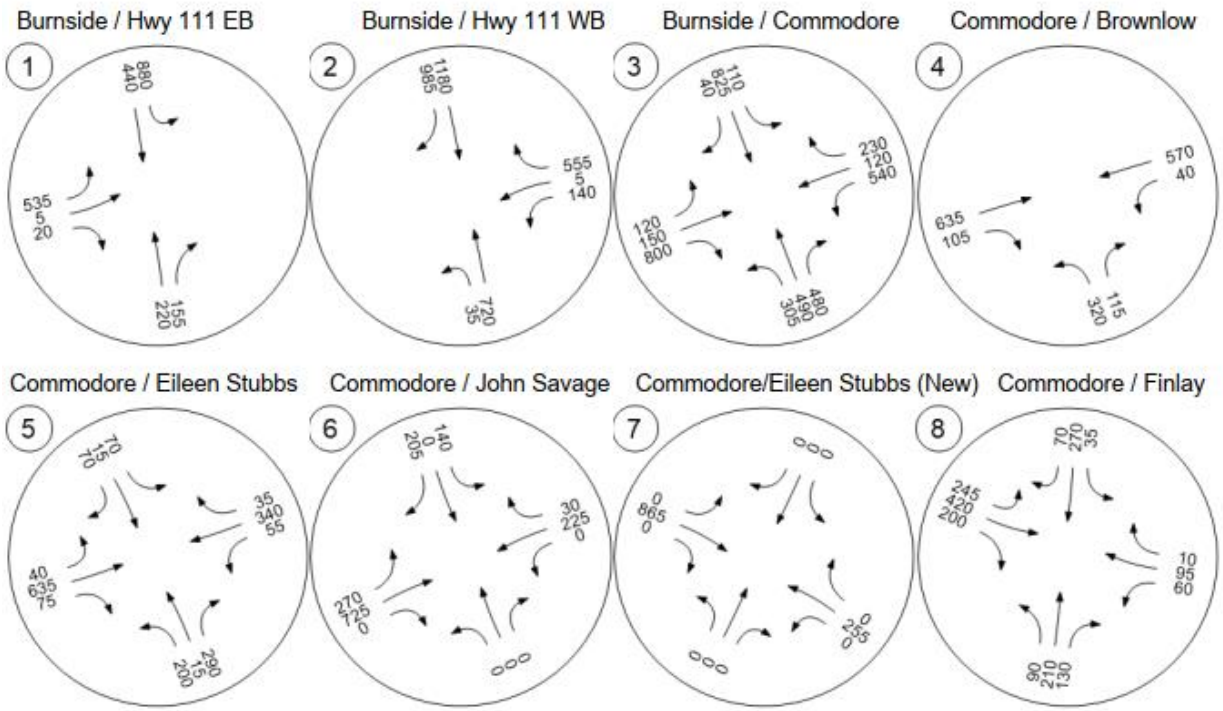


Figure 19 - PM Existing Traffic Volumes (Part A)

PM Peak - Existing Traffic Volumes (2023)



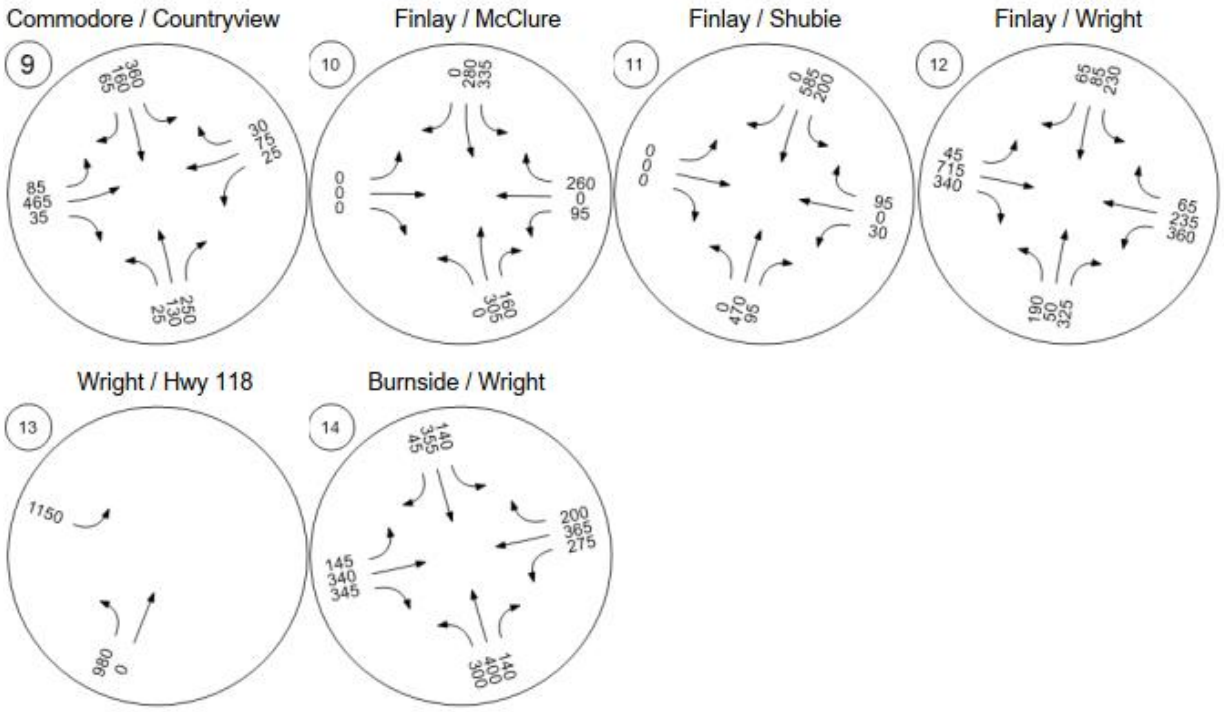


Figure 20 - PM Existing Traffic Volumes (Part B)

2.3.4 Existing Traffic Analysis

A level of service (LOS) analysis is a method to determine how well a transportation facility, typically an intersection, performs from a driver's perspective during a specified period (usually peak hours). The LOS is a measure of the average delay of each vehicle travelling through an intersection with grades ranging from 'A' to 'F'. 'A' is associated with minimal delay, and 'F' is associated with heavily congested conditions with unacceptable delays for drivers. The desired or acceptable level of service can vary depending on the location and context of individual streets. For this study, the LOS limit for an intersection is 'E' and individual movements 'F' for HRM streets. HRM's Traffic Impact Study Guidelines limits the volume-to-capacity ratio for a shared lane to 0.85 and a dedicated lane to 1.0. For unsignalized intersections, if any of the approaches have a LOS 'F', the intersection LOS is 'F' as well.

The tables below provide the LOS criteria defined by the *Highway Capacity Manual* for signalized and unsignalized intersections.

Table 2 - Highway Capacity Manual level of service criteria for signalized intersections

Level of Service	Average Control Delay (seconds per vehicle)	General Description
A	≤ 10	Free flow
B	> 10 – 20	Stable flow (slight delays)
C	> 20 – 35	Stable flow (acceptable delays)
D	> 35 – 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	> 55 – 80	Unstable flow (intolerable delay)
F[1]	> 80	Forced flow (congested and queues fail to clear)

Source: Highway Capacity Manual 2010

1. If the volume-to-capacity ratio for a lane group exceeds 1.0, LOS 'F' is assigned to the individual lane group. LOS for an overall approach or an intersection is determined solely by the control delay

Table 3 - Highway Capacity Manual level of service criteria for unsignalized intersections

Level of Service	Average Control Delay (seconds per vehicle)
A	≤ 10
B	> 10 - 15
C	> 15 - 25
D	> 25 - 35
E	> 35 - 50
F[1]	> 50

Source: Highway Capacity Manual 2010

1. If the volume-to-capacity ratio for a lane group exceeds 1.0, LOS 'F' is assigned to the individual lane group. LOS for an overall approach or an intersection is determined solely by the control delay

The traffic analysis was completed using PTV Vistro traffic modelling software. The traffic signals in Dartmouth Crossing all operate on fully-actuated and non-coordinated cycles. Signals phases have been optimized in each analysis scenario using a 120 second maximum cycle length, other than the intersection of Burnside Drive and Commodore Drive, which has a maximum cycle length of 130 seconds. A summary of the AM and PM peak hour level of service measures for each intersection is provided in Tables 4 and 5. The complete Vistro intersection reports are provided in Appendix C.

AM Peak Hour

Burnside Drive / Highway 111 Eastbound

During the AM peak hour, the southbound approach at the Burnside Drive / Highway 111 Eastbound intersection operates within acceptable level of service measures, but queue lengths extend to the Burnside Drive / Highway 111 Westbound intersection.

Commodore at John Savage

The southbound approach to the Commodore at John Savage intersection operates at a LOS F with average delay of 66 seconds. This is not uncommon for the stop-controlled approach at an unsignalized intersection.

All other intersections and individual movements meet the level of service standards.

PM Peak Hour

Highway 111 / Burnside Interchange

During the PM peak hour, the Highway 111 eastbound intersection with Burnside Drive is the poorest performing intersection and has a level of service 'F'. The southbound approach is over capacity with a v/c ratio of 1.28 for the left turn movement. Queues extend well beyond the adjacent intersection.

The Highway 111 eastbound intersection has two high volume movements, the eastbound left turn from Highway 111 towards Burnside Drive and the southbound left turn from Burnside Drive to Highway 111. The eastbound and southbound approaches both have dual left turn lanes that require split signal phasing, which has an impact on capacity.

The eastbound through (EBR) movement also has a v/c ratio of 0.90 which exceeds the HRM threshold for through and shared movements.

Commodore Drive / John Savage Avenue

The southbound left turn movement from John Savage Avenue to Commodore Drive has a level of service 'F' with over 300 seconds of delay during the PM peak hour. The high volume of through traffic does not allow for sufficient gaps for left turning traffic departing the stop-controlled leg of John Savage Avenue. High side street delays can be mitigated by adding traffic signals.

Table 4 - AM Peak Hour LOS summary for 2023 Existing Traffic

Intersection	LOS Criteria	Intersection Control	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Intersection
Burnside at Hwy 111 EB/Highfield Park	Vehicle Count			300	120	335	270		965	0	40				
	v/c			0.58	0.63	0.90	0.90		0.91	0.91					
	Delay (s)			36.0	37.7	58.9	57.6		38.2	38.7					43.9
	LOS			D	D	E	E		D	D					D
	95th% Queue (m)			59.0	61.1	100.2	101.9		124.0	125.7					
Burnside at Hwy 111 WB	Vehicle Count		55	1210			465	390				140	0	1165	
	v/c		0.56	0.59			0.27	0.37				0.64		-	
	Delay (s)		7.8	8.1			8.7	10.3				31.4		-	10.0
	LOS		A	A			A	B				C		-	B
	95th% Queue (m)		53.1	52.1			22.6	32.9				32.9		-	
Burnside at Commodore	Vehicle Count		645	890	840	230	380	95	40	100	335	140	165	85	
	v/c		0.94	0.53	0.67	0.74	0.29	0.14	0.32	0.77	0.00	0.70	0.76	0.57	
	Delay (s)		55.9	21.0	26.5	61.8	26.0	24.3	58.2	67.6	0.0	63.2	64.6	60.5	39.2
	LOS		E	C	C	E	C	C	E	E	A	E	E	E	D
	95th% Queue (m)		130.4	108.9	138.3	81.0	58.2	23.8	19.1	53.0	0.0	51.7	53.8	35.7	
Commodore at Brownlow	Vehicle Count		125		40					760	410	60	265		
	v/c			0.79						0.48	0.53	0.21	0.12		
	Delay (s)			35.8						6.7	7.3	13.4	3.9		9.5
	LOS			D						A	A	B	A		A
	95th% Queue (m)			42.2						45.5	49.3	9.6	7.3		
Commodore at Eileen Stubbs	Vehicle Count		65	5	70	10	5	40	160	310	330	230	220	85	
	v/c		0.14	0.12		0.02	0.07		0.34	0.38	0.40	0.72	0.18	0.19	
	Delay (s)		22.4	19.4		21.7	18.9		18.5	14.6	14.9	32.3	12.9	13.0	18.3
	LOS		C	B		C	B		B	B	B	C	B	B	B
	95th% Queue (m)		15.5	13.7		2.3	8.2		33.9	56.6	51.9	69.6	24.6	23.0	
Commodore at John Savage	Vehicle Count					75	0	145	240	150	0	0	390	35	
	v/c	STOP					0.61	0.21	0.24	-	-	-	-	-	
	Delay (s)						66.1	11.0	9.4	-	-	-	-	-	8.5
	LOS						F	B	A	-	-	-	-	-	F
	95th% Queue (m)						24.0	5.9	7.3	-	-	-	-	-	
Commodore at New Access	Vehicle Count														
	v/c	STOP													
	Delay (s)														
	LOS														
	95th% Queue (m)														
Commodore at Finlay	Vehicle Count		55	70	20	25	110	130	50	105	70	25	240	50	
	v/c		0.07	0.03	0.02	0.03	0.05	0.11	0.33	0.19	0.24	0.12	0.43	0.17	
	Delay (s)		5.9	4.7	4.6	5.5	4.8	5.2	41.4	31.9	32.5	36.0	33.7	32.0	21.6
	LOS		A	A	A	A	A	A	D	C	C	D	C	C	C
	95th% Queue (m)		5.5	2.8	1.4	2.2	4.2	9.3	16.0	14.1	16.2	7.2	33.8	11.5	
Commodore at Countryview	Vehicle Count		15	25	75	40	55	40	40	100	10	45	260	40	
	v/c		0.02	0.01	0.07	0.05	0.03	0.03	0.30	0.19	0.04	0.22	0.49	0.14	
	Delay (s)		5.1	4.4	4.6	5.2	4.4	4.5	42.3	32.5	31.6	37.5	34.8	32.4	25.2
	LOS		A	A	A	A	A	A	D	C	C	D	C	C	C
	95th% Queue (m)		1.3	0.9	5.3	3.6	2.1	2.8	12.9	13.6	2.2	13.5	37.4	9.3	
Finlay at McClure	Vehicle Count			90	80	60	245	0				20	0	40	
	v/c			0.06	0.07	0.07	0.10					0.12	0.26		
	Delay (s)			2.8	2.9	4.0	3.0					35.4	34.7		6.4
	LOS			A	A	A	A					D	C		A
	95th% Queue (m)			3.6	3.5	3.8	5.54					5.6	9.5		
Finlay at Shubie	Vehicle Count			100	30	165	245	0				60	0	85	
	v/c			0.05	0.06	0.20	0.10					0.29	0.42		
	Delay (s)			3.4	3.4	5.4	3.6					34.8	34.0		10.1
	LOS			A	A	A	A					C	C		B
	95th% Queue (m)			3.4	3.4	13.2	6.8					16.6	19.8		
Wright at Finlay	Vehicle Count		125	25	35	65	45	15	30	185	160	205	865	170	
	v/c		0.18	0.04	0.05	0.09	0.04	0.05	0.14	0.20	0.33	0.45	0.89	0.33	
	Delay (s)		16.1	21.2	21.4	15.6	22.4	22.5	27.7	32.6	34.3	27.0	42.7	32.8	34.4
	LOS		B	C	C	B	C	C	C	C	C	C	D	C	C
	95th% Queue (m)		27.2	6.4	7.9	14.5	8.0	7.8	8.1	29.9	46.3	60.0	145.1	48.0	
Wright at Hwy 118	Vehicle Count		960						150						
	v/c		0.43						0.59						
	Delay (s)		4.9						28.5						8.1
	LOS		A						C						A
	95th% Queue (m)		26.5						14.9						
Burnside at Wright	Vehicle Count		305	350	360	165	335	155	50	255	185	185	365	80	
	v/c		0.52	0.21	0.41	0.32	0.20	0.18	0.19	0.42	0.58	0.61	0.57	0.24	
	Delay (s)		15.0	14.1	17.2	11.1	14.0	14.1	31.1	39.6	42.3	38.3	40.6	37.4	24.6
	LOS		B	B	B	B	B	B	C	D	D	D	D	D	C
	95th% Queue (m)		54.8	33.0	65.9	26.3	31.4	25.1	15.1	45.5	59.1	60.0	63.7	22.8	

Table 5 - PM Peak Hour LOS summary for 2023 Existing Traffic

Intersection	LOS Criteria	Intersection Control	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Intersection
Burnside at Hwy 111 EB/Highfield Park	Vehicle Count			220	155	880	440		535	5	20				
	v/c			0.33	0.37	1.28	1.24		0.90	0.90					
	Delay (s)			32.5	33.3	177.3	164.3		61.1	61.1					122.9
	LOS			C	C	F	F		E	E					F
	95th% Queue (m)			60.1	61.3	421.0	399.0		144.5	114.0					
Burnside at Hwy 111 WB	Vehicle Count		35	720			1180	985				140	5	555	
	v/c		0.39	0.34			0.57	0.80				0.81		-	
	Delay (s)		4.9	4.8			10.2	18.7				46.7		-	12.8
	LOS		A	A			B	B				D		-	B
	95th% Queue (m)		24.6	26.2			74.6	124.4				50.0		-	
Burnside at Commodore	Vehicle Count		305	490	480	110	825	40	120	150	800	240	120	230	
	v/c		0.84	0.35	0.46	0.39	0.72	0.07	0.68	0.81		0.85	0.40	0.69	
	Delay (s)		57.4	23.4	26.4	46.3	36.6	25.4	55.7	60.1		53.2	42.7	47.6	41.4
	LOS		E	C	C	D	D	C	E	E		D	D	D	D
	95th% Queue (m)		66.8	65.7	80.8	35.9	128.9	9.7	54.7	68.4		106.6	47.1	77.2	
Commodore at Brownlow	Vehicle Count		320		115					635	105	40	570		
	v/c			0.90						0.42	0.44	0.13	0.35		
	Delay (s)			31.3						12.0	12.2	17.3	10.6		16.3
	LOS			C						B	B	B	B		B
	95th% Queue (m)			94.0						49.6	50.5	7.3	35.4		
Commodore at Eileen Stubbs	Vehicle Count		200	15	290	70	15	70	41	635	75	55	340	35	
	v/c		0.33	0.38		0.16	0.10		0.14	0.63	0.63	0.32	0.33	0.34	
	Delay (s)		15.1	13.0		17.0	10.3		22.7	20.8	20.8	30.7	17.8	17.8	18.1
	LOS		B	B		B	B		C	C	C	C	B	B	B
	95th% Queue (m)		32.7	38.3		12.4	9.1		7.8	66.9	65.3	13.5	32.2	31.6	
Commodore at John Savage	Vehicle Count					140	0	205	270	725	0	0	225	30	
	v/c	STOP				1.55		0.26	0.23	-	-	-	-	-	
	Delay (s)					367.0		10.5	8.7	-	-	-	-	-	35.0
	LOS					F		B	A	-	-	-	-	-	F
	95th% Queue (m)					88.6		7.7	6.9	-	-	-	-	-	
Commodore at New Access	Vehicle Count														
	v/c	STOP													
	Delay (s)														
	LOS														
	95th% Queue (m)														
Commodore at Finlay	Vehicle Count		90	210	130	35	270	70	245	420	200	60	95	10	
	v/c		0.17	0.12	0.14	0.06	0.15	0.07	0.68	0.45	0.41	0.31	0.10	0.02	
	Delay (s)		13.2	9.3	9.6	11.5	9.5	9.1	34.2	26.3	26.2	35.1	23.3	22.7	20.4
	LOS		B	A	A	B	A	A	C	C	C	D	C	C	C
	95th% Queue (m)		15.7	13.8	15.3	5.4	17.5	7.6	70.0	51.9	42.0	17.6	10.4	1.8	
Commodore at Countryview	Vehicle Count		25	130	250	360	160	65	85	465	35	25	75	30	
	v/c		0.04	0.06	0.23	0.57	0.08	0.06	0.32	0.69	0.10	0.22	0.11	0.08	
	Delay (s)		7.2	6.0	7.2	14.8	6.1	6.0	34.5	33.9	28.7	42.9	28.7	28.6	19.8
	LOS		A	A	A	B	A	A	C	C	C	D	C	C	B
	95th% Queue (m)		2.9	6.2	24.1	66.6	7.8	5.5	24.4	65.1	7.7	8.2	9.4	6.2	
Finlay at McClure	Vehicle Count			305	160	335	280	0				95	0	260	
	v/c			0.21	0.22	0.62	0.13					0.30	0.84		
	Delay (s)			6.0	6.1	18.0	5.5					30.7	37.7		15.7
	LOS			A	A	B	A					C	D		B
	95th% Queue (m)			19.7	18.4	64.4	11.25					24.6	64.1		
Finlay at Shubie	Vehicle Count			470	95	200	585	0				30	0	95	
	v/c			0.23	0.23	0.36	0.24					0.15	0.48		
	Delay (s)			4.2	4.2	9.2	4.3					33.8	35.0		7.2
	LOS			A	A	A	A					C	C		A
	95th% Queue (m)			17.2	16.6	24.2	18.0					8.2	22.7		
Wright at Finlay	Vehicle Count		190	50	325	230	85	65	45	715	340	360	235	65	
	v/c		0.31	0.09	0.58	0.54	0.13	0.14	0.09	0.90	0.81	0.97	0.21	0.11	
	Delay (s)		20.4	27.8	37.8	27.0	28.4	28.5	20.1	47.2	50.0	71.0	27.9	26.9	42.0
	LOS		C	C	D	C	C	C	C	D	D	E	C	C	D
	95th% Queue (m)		48.7	15.2	93.8	65.8	23.0	21.2	10.8	127.2	108.9	133.1	34.8	15.9	
Wright at Hwy 118	Vehicle Count		980						1150						
	v/c		0.85						0.88						
	Delay (s)		30.9						17.9						23.9
	LOS		C						B						C
	95th% Queue (m)		99.0						81.2						
Burnside at Wright	Vehicle Count		300	400	140	140	355	45	145	340	345	275	365	200	
	v/c		0.66	0.36	0.24	0.34	0.32	0.08	0.33	0.31	0.6	0.68	0.36	0.38	
	Delay (s)		0.6	25.1	24.2	19.8	24.6	22.1	18.6	24.4	28.4	30.6	26.6	27.1	26.0
	LOS		C	C	C	B	C	C	B	C	C	C	C	C	C
	95th% Queue (m)		3.5	51.8	30.4	31.1	45.1	9.0	31.4	43.9	79.4	68.2	48.1	45.6	

2.3.5 Traffic Collisions

HRM's Strategic Road Safety Strategy (2018) has the goal to reduce the frequency of injury and fatality collisions within the Municipality by 20% by the year 2023. HRM's Open Data Portal includes collision data on all streets within the Municipality since 2018. The available intersection collision data from HRM's portal has been reviewed with the intent of identifying common collision types and potential countermeasures. The available data indicates that there have been 249 collisions at study area intersections since 2018. Collision data is summarized in the following table and figure.

The format of the available collision data does not provide sufficient information to fully understand the details of each collision, including the location or the direction of travel of any vehicles involved in the collision. Using the available information, general trends have been noted in the order to review subject intersections.

Table 6 - Traffic Collision Summary

Intersection	# of Collisions	Collision Type					
		Rear End	One Crossing Path of Other	Same Direction Sideswipe	Left Turn Across Opposing Traffic	Right Angle	Other
Burnside Dr at Hwy 111 EB	25	13	4	4	1	2	1
Burnside Dr at Hwy 111 WB	7	5	0	1	0	0	1
Burnside Dr at Commodore Drive	66	15	18	11	8	3	11
Commodore Dr at Brownlow Ave	7	5	0	0	0	1	1
Commodore Dr at Eileen Stubbs Ave	6	2	0	0	1	1	2
Commodore Dr at John Savage Ave	7	2	1	0	2	2	0
Commodore Dr at Finlay Dr	13	4	3	4	0	0	2
Commodore Dr at Countryview Dr	11	1	5	3	0	1	1
Finlay Dr at McClure Cl	10	5	0	0	0	0	5
Finlay Dr at Shubie Dr	3	0	1	0	1	0	1
Finlay Dr at Wright Ave	36	7	9	9	4	2	5
Wright Ave at Hwy 118 NB	18	9	1	4	0	0	4
Burnside Dr at Wright Ave	40	14	14	2	2	2	6
Total	**249**	**82**	**56**	**38**	**19**	**14**	**40**

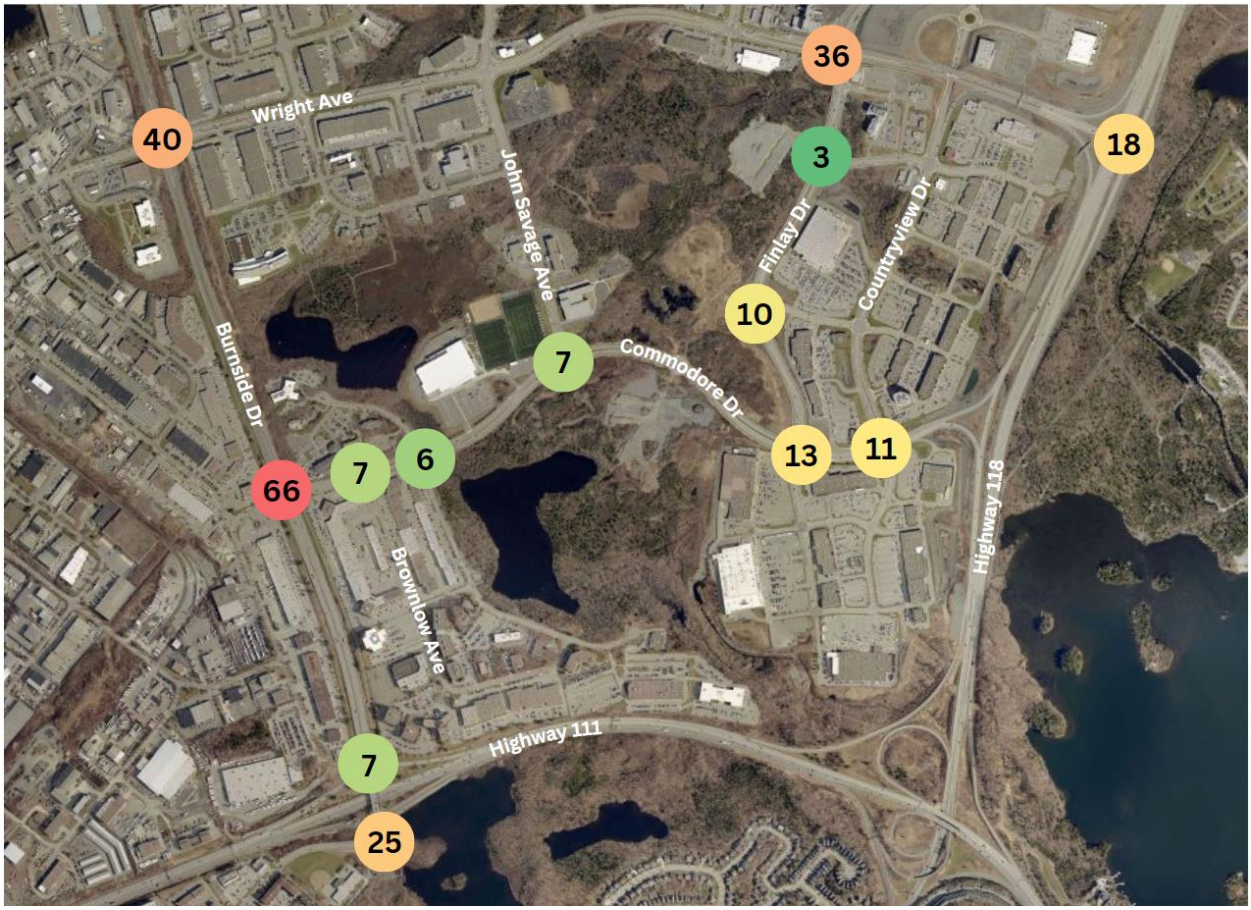


Figure 21 – Volume of collisions at study area intersections since 2018

Broadly, rear end collisions are the most prevalent throughout the study area. The probability of rear end collisions is increased with a lack of auxiliary turn lanes, and high and variable vehicle speeds. The majority of intersections within the study area have auxiliary turn lanes. It is expected that the frequency of rear end collisions is influenced by traffic speeds approaching intersections.

Burnside Drive at Commodore Drive

Burnside Drive at Commodore Drive has the highest volume of collisions within the study area. Of the 66 collisions recorded, none were fatal, and 11 resulted in injury.

Of the recorded collisions at this location, rear end and one vehicle crossing the path of other were the most prevalent. Throughout most of the time this data was collected, the posted speed limit on Burnside Drive was 80 kph. The high speeds at this location are likely a contributing factor to this collision volume. This past year, the posted speed limit on Burnside Drive was reduced to 70 kph which is likely to improve the safety of this intersection.

The second highest collision type at this location was one vehicle crossing the path of other. These generally represent collisions with one vehicle being cut off by another, either from the left or the right. Contributing factors may be similar to those for sideswipes. These often occur when a driver quickly changes lanes- such

lane changes may be a defensive movement in response to a driver trying to avoid hitting something ahead, such as another vehicle or debris on the roadway; or an abrupt or unplanned change in lane such as moving in and out of a turning lane. These conditions are all exacerbated by higher speeds and volumes.

This location has the highest volume of recorded collisions of left turn across opposing traffic. Some of these are likely attributed to the poor sight lines of southbound drivers turning left to Commodore Avenue. The northbound direction of travel has dual left turning lane, and so the southbound single left turn lane is not aligned with the opposite direction, making it difficult to see oncoming traffic, as shown in the illustration on the right. Safety improvements at this location are discussed further in Section 6.3.

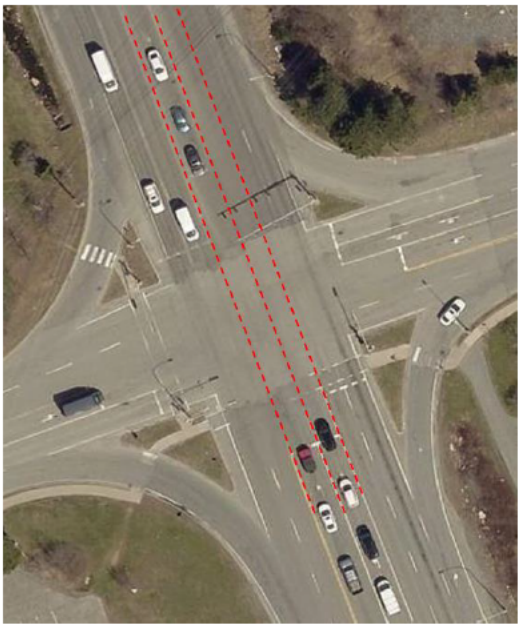


Figure 22 - Burnside at Commodore Lane Alignment

Burnside Drive at Wright Avenue

Burnside Drive at Wright Avenue also has a high volume of collisions. Of the 40 collisions recorded, none were fatal, and six (6) resulted in injury.

The most prominent collision types are rear end and one vehicle crossing path of other. Similar factors are likely to contribute to these collisions as those at the intersection of Burnside Drive and Commodore Avenue. Reducing the posted speed limit on Burnside Drive should help contribute towards mitigating these types of collisions in lowering the operating speeds of vehicles.

Finlay Drive at Wright Avenue

Burnside Drive at Wright Avenue also has a high volume of collisions. Of the 36 collisions recorded, none were fatal, and one (1) resulted in injury.

Wright Avenue has a posted speed of 70 kph. Similar to the other intersections discussed above, high speeds likely contribute to the collisions that are being observed at this location. The high volume of collisions caused by sideswipes and one vehicle crossing the path of another points towards a trend of abrupt lane changes. A contributing factor to this may be that as eastbound drivers approach the intersection, Finlay is the last opportunity to turn off before getting onto the highway. This decision-making point may come earlier than drivers are expecting, contributing towards some of these lane changes. This could be mitigated with improved wayfinding signage.

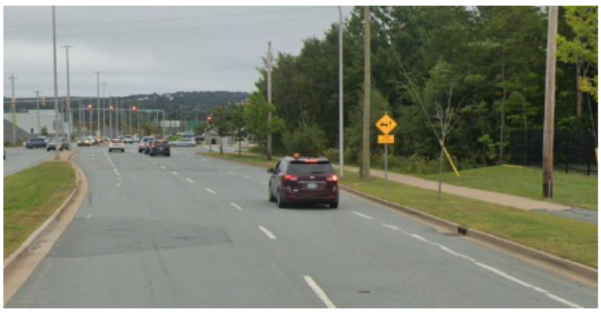


Figure 23 - End of bike lane on Wright Ave

The eastbound leg of Wright Avenue also has an on-street bike lane that ends approximately 50 m in advance of the intersection. Vehicles may also be moving out of the lane to make space for cyclists who are merging into a shared lane of traffic. It would improve safety for both cyclists and vehicles to have this cycling infrastructure continue through to connect to another facility.

3.0 PROPOSED DEVELOPMENT

The development lands cover an area of approximately 70 hectares. This undeveloped area is bisected by the existing Commodore Drive public roadway. To the east of the development is the existing Dartmouth Crossing commercial area. The development is enclosed towards the west and north by the commercial and industrial areas of Burnside and the City of Lakes Business Park.

3.1 Layout and Network Connections

The proposed development includes mixed-use buildings, low- and high-rise residential buildings, a proposed school site, and a grocery store commercial site. A larger scale plan of the proposed development has been included in Appendix A.

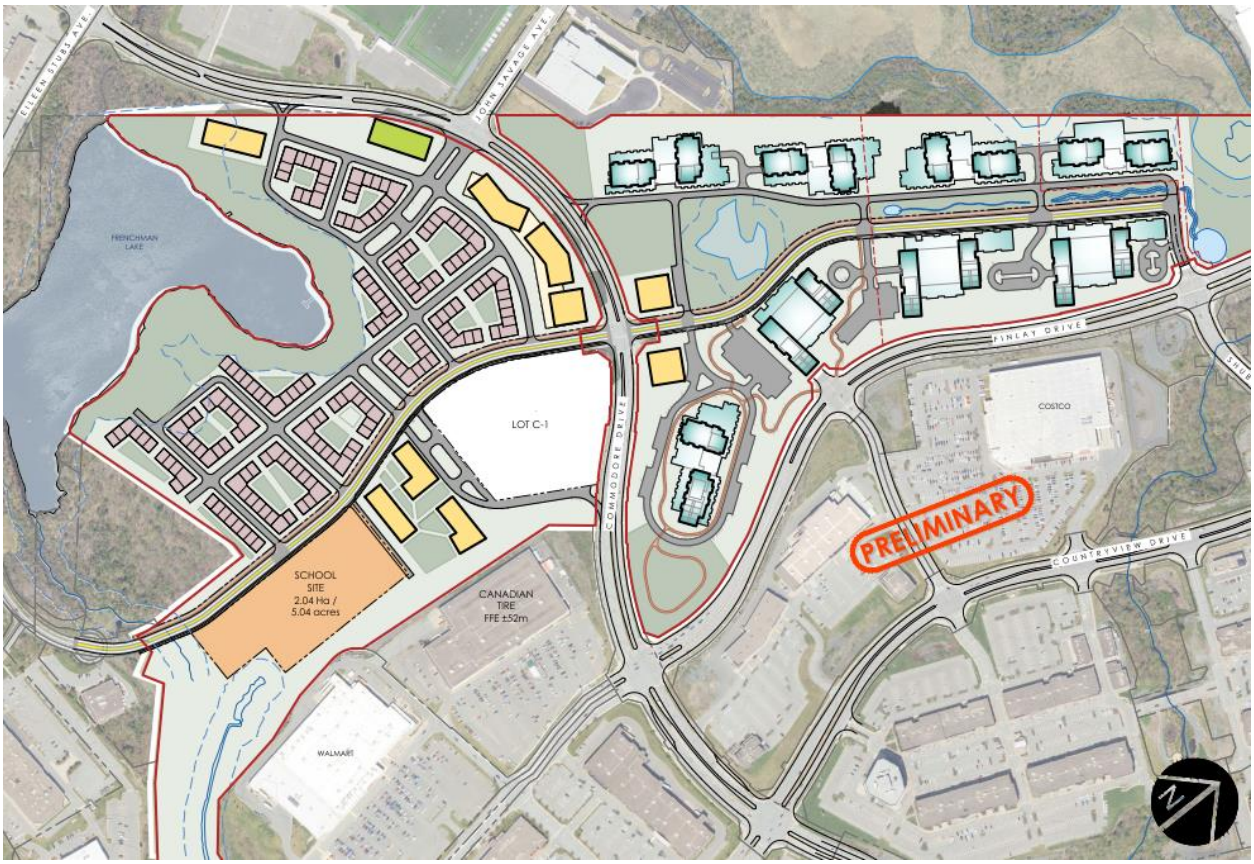


Figure 24 - Proposed Development Layout (Plan prepared by zzap)

A proposed public road runs through the development. This road connects to the existing signalized intersection on Finlay Drive at Shubie Drive towards the north of the site, crosses Commodore Drive at a new proposed signalized intersection, and connects to an extension of the existing Eileen Stubbs Avenue at the southern end of the development.

Private road and driveway connections are also proposed at the existing signalized intersection on Finlay Drive at McClue Close; on Commodore Drive at John Savage Avenue; and three (3) limited right-in/right-out connections to Commodore Drive.

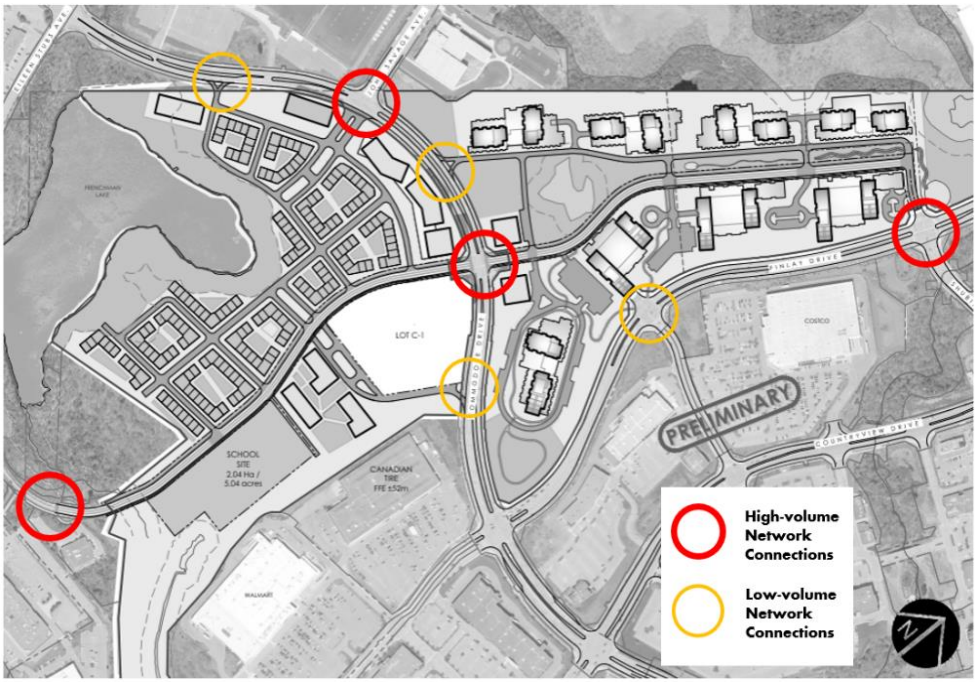


Figure 25 - Connections from existing street network to the proposed development

The proposed public road is planned to have pedestrian and cycling facilities, all private roads and driveways will have sidewalks on at least one side. Off-road trail facilities throughout the development will provide additional pedestrian and active transportation infrastructure.

As discussed in Section 2.2, transit facilities surround the proposed development. The planned Purple BRT line travels down Commodore Drive through the middle of the development. A BRT stop is proposed at the intersection of Commodore Drive and the extension of Eileen Stubbs Avenue and the new street access.

3.2 Local Context

This development presents a unique opportunity within HRM to capture an area of undeveloped land that is in close proximity to major existing employment and commercial areas, and leverage this location to build a dense residential area in the midst of it, then further augment this by building additional neighbourhood commercial needs, amenities and a school site. Through this approach, the development will create a complete community for residents moving to the area.

The following figure provides a high-level view of the destinations and land uses that can be reached within a 15-minute walkshed of the community. Amenities within this walking distance include two daycares (Adventures Child Care Centre on Eileen Stubbs and Willowbrae on Garland Avenue), a community recreation centre (RBC Centre), and school (École Secondaire Mosaïque). Land uses and destinations that are planned as part of this proposed development (including a new school site, grocery store, and park access) are shown on the figure as dashed lines.

In addition to the specific destinations highlighted, it is noted that the entire area comprises numerous employment hubs, with office space located throughout the business park, offices in Dartmouth Crossing, and numerous commercial businesses operating in the area.



Figure 26 - Walkshed showing Nearby Land Uses

Based solely on travel time, a similar map has been prepared showing the approximate area that can be reached within 15 minutes of cycling from the development. Note that this map does not include any consideration for what cycling facilities may be available on streets or if cyclists may opt to take an alternate less-direct route in preference for a more comfortable ride.

Individual land uses are not shown on the cycling figure, but the extent of the area notably includes most of Burnside as well as a much of North Dartmouth.

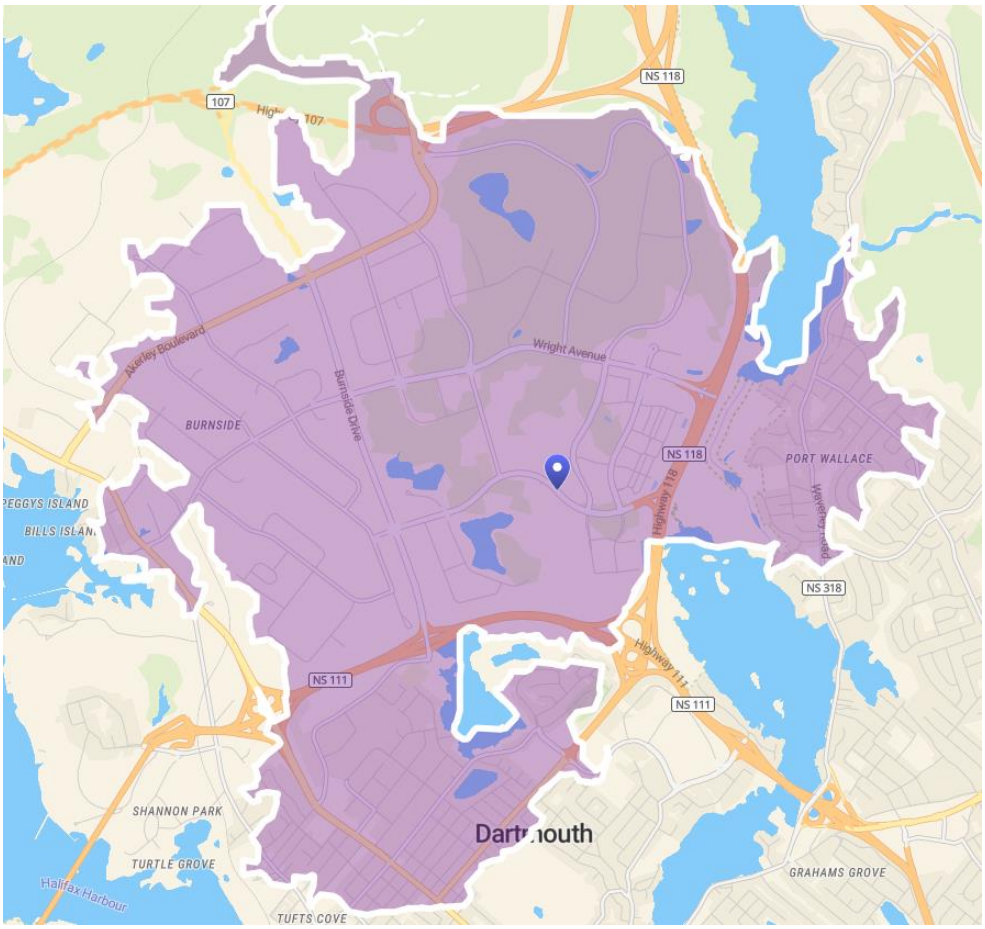


Figure 27 - Approximate 15-minute cycling area (smappen.com)

3.3 Internal Network

The internal network within the proposed development is built off the main public road that runs through the entire development. This will be a two-lane roadway designed to HRM's standard municipal guidelines for a local roadway. A multi-use path is proposed along the western side of the roadway, as shown in the following figure along with preferred locations for midblock crossings. Outside this main spine through the development, sidewalks are planned for all streets and driveways which will combine with some off-street trails to create a porous network of pedestrian facilities within the community.

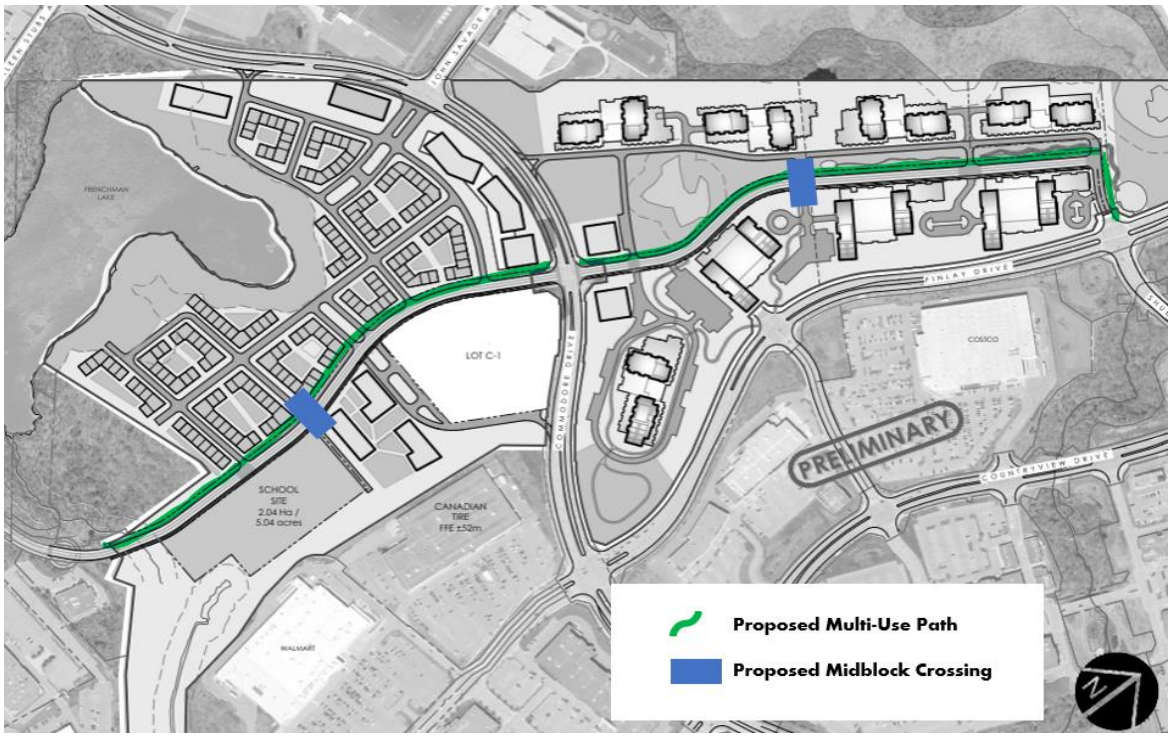


Figure 28 - Internal Active Transportation Route

The main transit stop within the development will be the planned BRT stop located at the intersection of Commodore Drive and the extension of Eileen Stubbs Avenue. Two new transit stops have also been proposed along Eileen Stubbs Avenue for Route 64. In an effort to serve the greatest number of transit riders, it is proposed that the existing Route 64 "Burnside" be rerouted to travel from Brownlow Avenue and along the extension of Eileen Stubbs Avenue, removing the existing portion of Eileen Stubbs Avenue from the route.



Figure 29 - Proposed Reroute of Route 64

This revised route along the new road would have a limited impact on the actual travel distance for buses (mitigating overall impacts on the route run times) and provide service to a high volume of residents in the southern portion of the development. Losing service on Eileen Stubbs Avenue would have the greatest impact on users travelling to/from the business centre at 50 Eileen Stubbs Avenue, as well as the offices located at civic 80 and 100 Eileen Stubbs Avenue. These locations however are all within a 400 m walk of Brownlow Avenue.

This rerouting allows the southern portion of the proposed development to be directly on this bus route. This will serve the residents of the area, improve access to the grocery store and events happening at the school and also create a transfer location for the Purple BRT line. Proposed transit stop locations within the development are shown on the following figure.

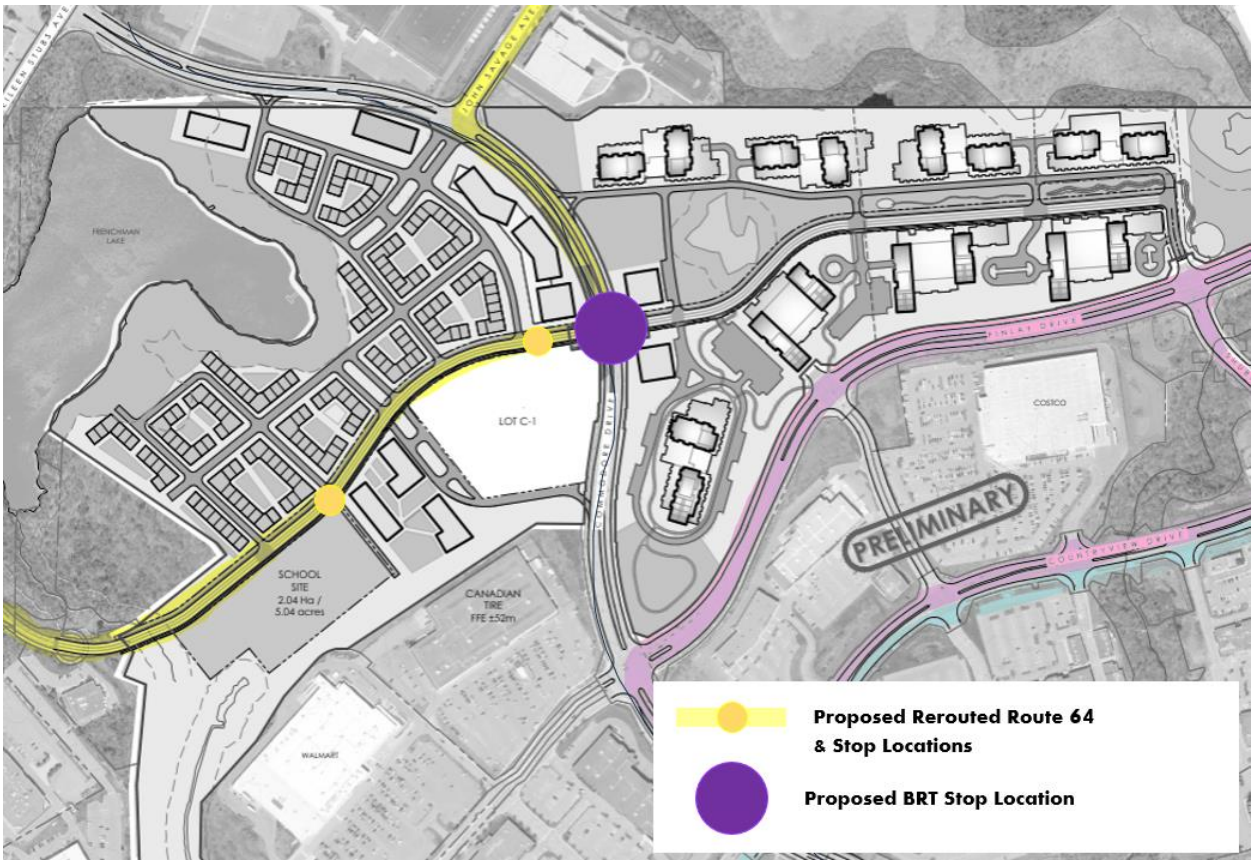


Figure 30 - Proposed Internal Transit Stop Locations

This development offers a valuable opportunity for HRM's Planned BRT route to add users in the off-peak direction. Dartmouth Crossing is a major employment hub with no existing residential areas. Existing transit routes allow residents to be connected to all areas of Burnside and have direct access to several nearby transit terminals. As transit facilities are improved along the BRT line (particularly further down the line where road users experience congestion and delays), the appeal of transit will increase and should result in a greater shift to this mode.

3.4 Transportation Demand Management

Broadly, Transportation Demand Management (TDM) includes a range of strategies that seek to reduce the reliance on single occupancy vehicles during peak hour travel times. The cumulative impact of numerous policies, programs, and tools contribute to the overall reduction of demand on roadway infrastructure, which in turn improves the efficiency of all modes of transportation using the road network, while also reducing the environmental impact of transportation within the Municipality.

Mixed-use development is an intrinsic TDM strategy, as the variety of land uses can meet the needs of residents for daily activities and offer the convenience of doing so without having to travel off-site to do so.

To encourage the choice of cycling as an alternate mode of transportation, consideration should be given to end-of-trip facilities at all buildings within the development. This includes providing bicycle parking in accordance with the Dartmouth Land-Use Bylaw and that the site be designed so that these bicycle parking spaces are located in convenient and highly visible locations.

Transit ridership in the area is promoted by the development's close proximity to transit facilities, especially the BRT stop. The lobby of all residential buildings should have transit information, including routing and timetables, posted in a visible location to assist residents in making the decision to use transit.

The use of e-scooters would be a viable TDM measure in this area. This could be achieved by partnering with a local company to expand and establish a new riding zone within Dartmouth Crossing.

3.5 Alignment with HRM's Priorities

In HRM's Strategic Priorities Plan for 2021-25, it is indicated that the "Municipality's vision for the future is to enhance our quality of life by fostering the growth of healthy and vibrant communities, a strong and diverse economy, and a sustainable environment." This includes fostering a prosperous economy, inclusive communities, a dedication to integrated mobility, and prioritization of environmental objectives.

The proposed development creates much needed housing to assist with the Municipality's current housing crisis, and it situates this housing both close to an array of employment and also directly on a BRT transit corridor. This allows residents in the area to access employment without needing to rely on single occupancy vehicles, reducing both the financial burden on individuals of vehicle ownership and operation and also reducing the societal burden of this behaviour. The design and location of the community promotes the choice of alternate modes of transportation and encourages a shift in the way that resident access employment and go about their day. This reduces the number of vehicles on the roads, mitigating the congestion and emissions created by each potential vehicle.

The shift towards getting people out of single occupancy vehicles as well as the inclusion of green spaces within and surrounding the development create spaces for residents to enjoy and also increases the frequency of resident interactions. These repeat interactions combine with the chance encounters that take place at neighbourhood commercial spaces like those being proposed within the development- the grocery store or ground floor commercial that becomes a coffee shop, along with school drop-off/pick-up lines all contribute towards fostering the relationships that build a vibrant community.

4.0 DEVELOPMENT TRAVEL DEMAND

4.1 Multimodal Site Generated Trips

4.1.1 Mode Share

HRM's IMP mode share targets for active transportation and transit for the inner suburban area are 6% and 24%, respectively. HRM's Mode Share app includes mode share data from the 2016 census for census tracts within the Municipality. Data for census tracts with similar characteristics of the proposed development (i.e. inner suburban area, some active transportation infrastructure, high frequency transit and transit stations, residential and commercial land uses). The census tracts surrounding the Lacewood Transit Terminal were estimated to have a similar representation as the proposed Dartmouth Crossing development, but with less density. Mode share data (2016) for four similar census tracts is provided in the following table. Based on the data below, it has been assumed that the proposed Dartmouth Crossing development would have a 6% active transportation mode share and a 27% transit mode share, which is in line with HRM's inner suburban mode share targets.

Table 7 - Existing mode share for select census tracts

Location	Census Tract	Active Transportation Mode Share	Transit Mode Share
Lacewood	2050025.03	7	23
Clayton Park	2050025.01	6	27
Seton / Bayview	2050025.02	8	22
Burnside / Highfield Park	2050114.00	8	29

4.1.2 Site Generated Traffic – Proposed Development

Multimodal site generated trips have been calculated using the Institute of Transportation Engineers (ITE) *Trip Generations Manual*, 11th Edition. Trip generation calculations have been completed using 'person' trip rates, where possible, and applied to each mode using modal share estimates.

Multimodal peak hour trip calculations for the proposed development are shown in the following table. Pass-by trips are trips by vehicles already travelling along the route and will enter/exit the site and continue along the route. ITE provides a 24% pass-by trip rate for Supermarket trips during the PM peak hour, which has been applied in the trip calculations. A 30% internal trip capture rate has also been applied to Supermarket trips, to account for trips originating within the development. The proposed development is estimated to generate 1,271 two-way vehicle trips during the AM peak hour and 1,206 two-way vehicles during the PM peak hour. Site generated traffic is mostly outbound during the AM peak (31% inbound / 69% outbound) and more inbound during the PM peak (59% inbound / 41% outbound).

The lack of data and development size makes it difficult to estimate the number of residential person trips. Take for example land use code (LUC) 222, High Rise Apartment. For the AM peak hour, there were only 15 studies, and the largest sample size was 1020 dwelling units.

Using persons as the trip type and LUC 221, a dwelling unit size of 2032 units would generate 1758 and 1607 person trips in the AM and PM peak hour respectively. There appears to be an anomaly or a typo in the data.

For this land use, the trip generation rate for LUC 221 during the AM peak is 0.48 person trips per hour. This is much higher than LUC 220 (Low Rise) which should be higher.

To check this, the database for vehicle trips per dwelling unit was used as the trip type. For the AM peak hour, there were 30 studies and the largest sample size was just under 500 units. The average vehicle trip rate was 0.37 vehicles per hour which was lower than LUC 220. Based on this review, the person trip generation rate for LUC 220 was increased, and LUC 221 was decreased so that the person trip rate was approximately 20% higher than the vehicle rate. These rates are highlighted in the table below:

Table 8 - Multimodal site generated trips

Land Use	Land Use Code	Variable	Units	Trip Generation Rates[1]						Trips Generated			
				AM Peak			PM Peak			AM Peak		PM Peak	
				Rate	In	Out	Rate	In	Out	In	Out	In	Out
Residential Trips (Person Trips)													
Multifamily (Low-Rise)	220	Dwellings	510	0.51	0.22	0.78	0.51	0.63	0.37	57	203	164	96
Multifamily (Mid-Rise)	221	Dwellings	2032	0.44	0.23	0.77	0.39	0.61	0.39	206	688	483	309
Multifamily (High-Rise)	222	Dwellings	1732	0.34	0.25	0.75	0.32	0.66	0.34	147	442	366	188
Total Person Trips										410	1333	1013	594
Active Transportation Trips[2]										25	80	61	36
Transit Trips[3]										111	360	274	160
Residential Vehicle Trips (1.2 occupancy)										229	744	566	332
Institutional and Commerical Trips (Vehicle Trips)													
School	522	Students	500	0.67	0.54	0.46	0.15	0.48	0.52	181	154	36	39
Supermarket	850	kGFA (sq.ft)	40	2.86	0.59	0.41	8.95	0.5	0.5	67	47	179	179
Hotel	310	Rooms	200	0.46	0.56	0.44	0.59	0.51	0.49	52	40	60	58
Institutional and Commerical Trips										300	241	275	276
School Active Transportation/Internal Trip Reduction (65%)[4]										118	100	23	25
Pass-by Trip Reduction[5]												43	43
Internal Trip Capture[6]										20	14	54	54
Adjusted Institutional and Commercial Trips										162	127	155	154
Total Site Generated Vehicle Trips										**391**	**871**	**721**	**485**

Notes:
1. Trip generation rates from ITE *Trip Generation Manual* , 11th Edition.
2. AT mode share equals 6%, as per IMP Inner Suburban target.
3. Transit mode share equals 27% based on mode share data from comparable census tracts.The IMP Inner Suburban target for transit is 24%.
4. A 65% reduction has been applied to school trips as most trips are expected to be completed by active transportation or internal vehicle trips.
5. Pass by-trip rates from ITE *Trip Generation Manual,* 11th Edition (24%) for Supermarket only.
6. Internal Trip Capture estimated at 30% of supermarket trips.

4.1.3 Site Generated Traffic – Previous Development Plan

For comparison, the previous development plan for this area had included 2,500 residential units and 2,000,000 square feet of office space to be developed[1]. Site generated traffic calculations are provided in Table 9. The development enabled under the current zoning would add approximately 2,400 two-way vehicle trips during both the AM and PM peak hours. Site generated traffic is mostly inbound during the AM peak (72% inbound / 28% outbound) and outbound during the PM peak (27% inbound / 73% outbound). Site generated traffic has been completed for the development of these lands based on this previous plan in order to compare to the proposed development. A 33% reduction in auto trips (other than hotel trips) has been applied for non-auto mode share associated with active transportation and transit travel.

Table 9 - Site generated trip estimate for current zoning

Land Use	Land Use Code	Variable	Units	Trip Generation Rates[1]						Trips Generated			
				AM Peak			PM Peak			AM Peak		PM Peak	
				Rate	In	Out	Rate	In	Out	In	Out	In	Out
Office Park	750	kGFA (sq.ft)	2000	1.33	0.89	0.11	1.3	0.14	0.86	2367	293	364	2236
Multifamily (Mid-Rise)	221	Dwellings	2500	0.37	0.23	0.77	0.39	0.61	0.39	213	712	595	380
Total Trips										**2580**	**1005**	**959**	**2616**
Mode Share Reduction[2]										851	332	316	863
Estimated Site Generated Trips										**1729**	**673**	**642**	**1753**
Notes:	1. Trip generation rates from ITE *Trip Generation Manual*, 11th Edition. 2. A 33% non-auto mode share has been used for consistency and comparison to the proposed development, although this is likely high.												

The proposed development generates 1,131 fewer two-way vehicle trips during the AM peak hour and 1,189 fewer two-way vehicle trips during the PM peak hour compared to the office focused development that had been previously considered. Traffic added by the proposed development has a higher directional split (inbound versus outbound) in the non-peak direction and will add significantly less stress on traffic operations for the area.

[1] It should be noted that current zoning permits only commercial/industrial uses as-of-right. Residential uses may only be considered by development agreement

4.1.4 Site Trips Distribution

The site generated trips have been divided into five zones based on the conceptual internal street layout and connectivity to the existing street network. HRM provided origin-destination data from HRM's regional traffic model and Streetlight Data (2019). These data sources were used as a reference for developing the site generated traffic distribution and are provided in **Appendix D**. Adjustments to site traffic distribution were conducted by zone and considered each individual location, routes to destinations and traffic congestion.

The zones are shown in the figure on the right and the generated trips for each zone is provided in the following table.



Figure 31 - Site trip distribution zones

Table 10 - Multimodal trips for each zone

Zone	Trips Generated											
	Active Transportation				Transit				Vehicle			
	AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
1	6	19	14	9	27	86	63	40	56	178	131	82
2	1	4	3	2	6	18	14	9	13	38	29	18
3	6	20	15	9	29	90	68	42	60	186	140	87
4	7	23	17	11	31	105	77	48	175	305	253	195
5	4	13	10	6	18	61	46	28	88	166	155	116
Total	**25**	**80**	**59**	**37**	**111**	**360**	**268**	**166**	**391**	**871**	**708**	**498**

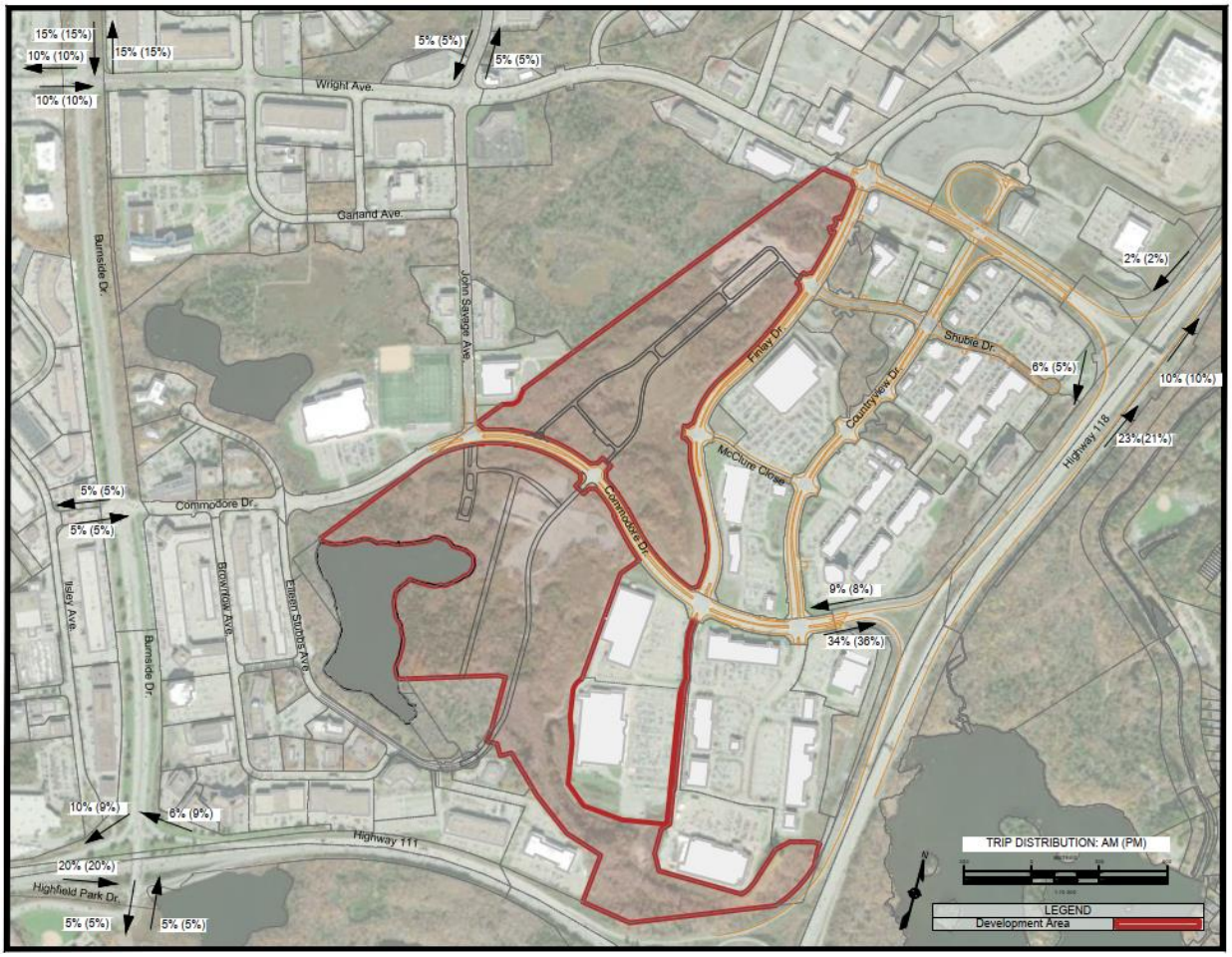


Figure 32 - Trip Distribution

The trip distribution above has been applied to each traffic zone. The distribution of site generated traffic for the AM peak hour is shown in Figures 33 and 34 and the PM peak hour in Figures 35 and 36.

These trips are based on the assumed distribution of external trips. Assignment to the network is based on a logical all-or-nothing assignment. For example, a trip from Zone 1 to Highway 118 North (Gate 9) would use the most direct and logical route to the interchange. It would not include intermediate trips, for example, a trip from Zone 1 to the Daycare and then to Highway 118 north. These trips do not include internal trips.

Figure 33 - AM Peak Site Trips (Part A)



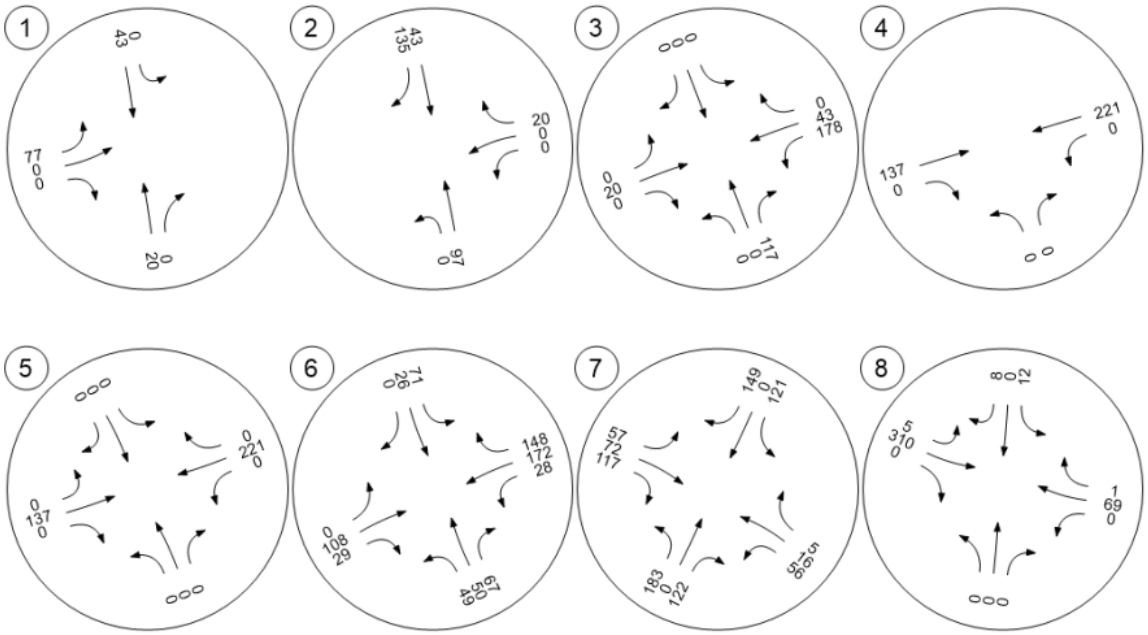


Figure 34 - AM Peak Site Trips (Part A)



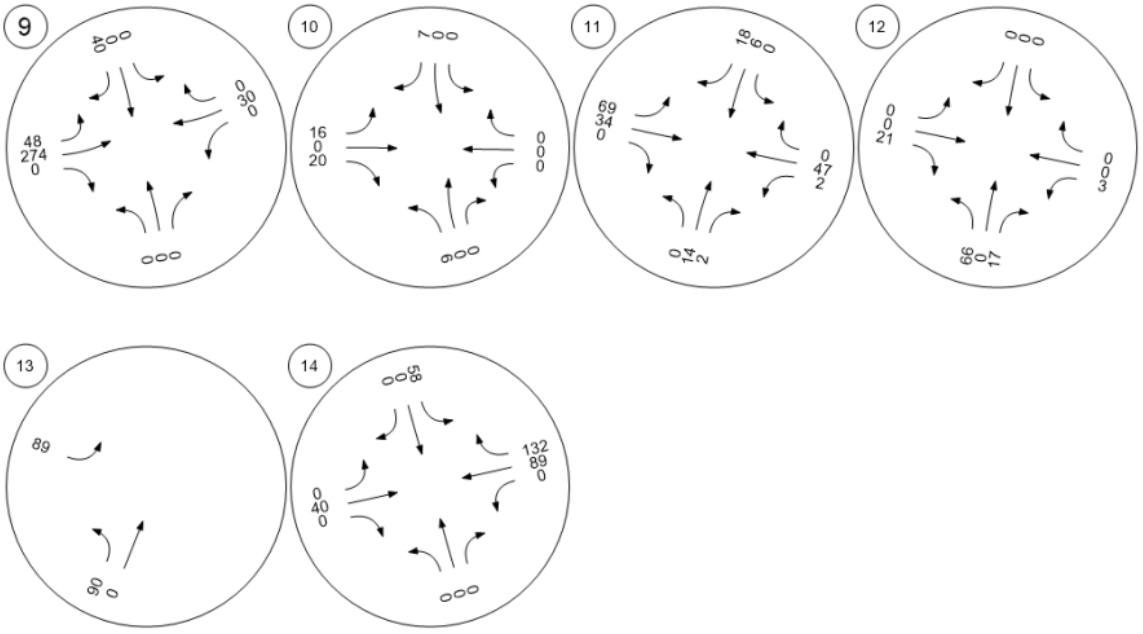


Figure 35 - PM Peak Site Trips (Part A)



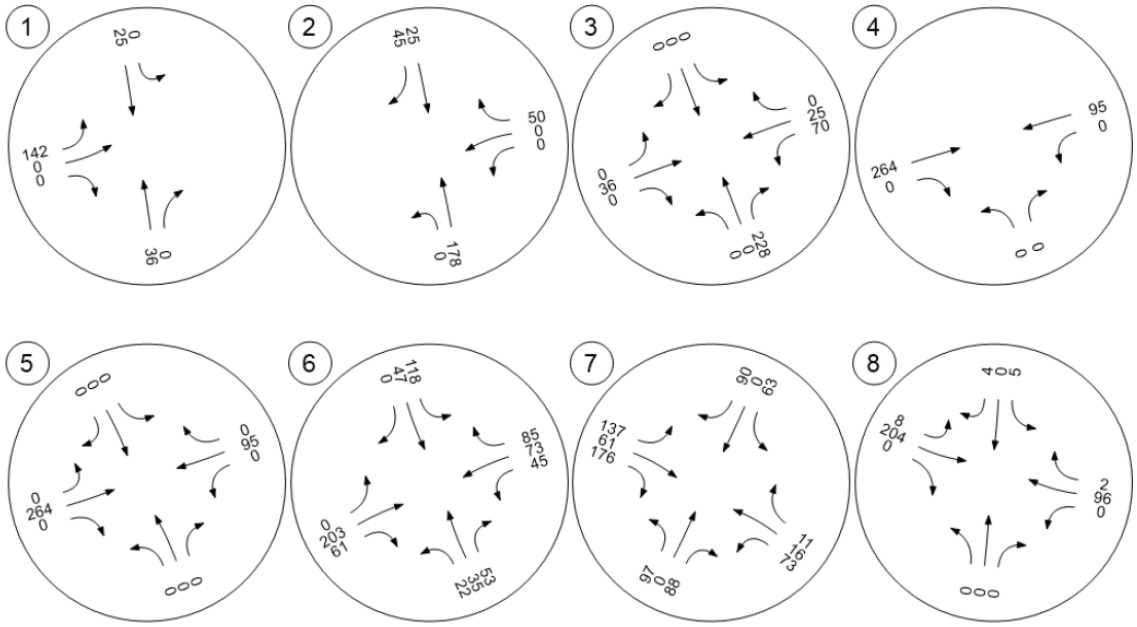
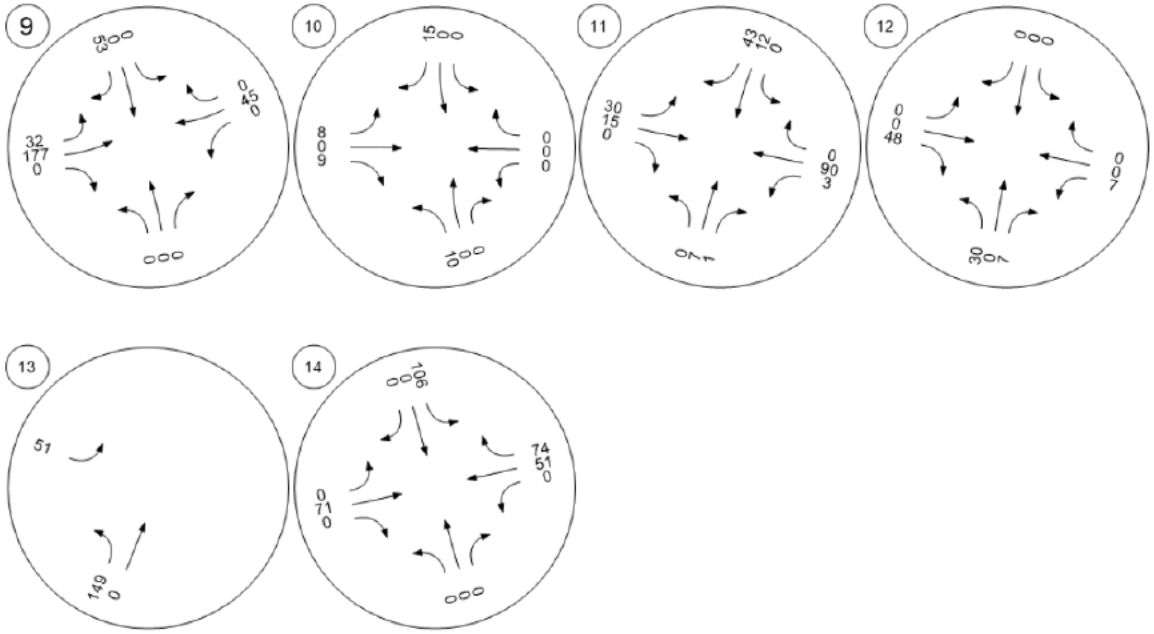


Figure 36 - PM Peak Site Trips (Part B)





4.2 Internal Trip Assignment

Within the site generated traffic calculations discussed in Section 4.1.2, are a number of assumptions that generate internal trips by various modes of transportation.

For the estimated transit trips, each of these trips also includes a leg of travel for a transit user travelling to/from the transit stop from/to their destination. Considering the significant volume of transit trips generated by this development, this creates a correspondingly significant volume of pedestrian trips, many of which will be crossing through the intersection of Commodore Drive and Eileen Stubbs/New Street Access, where the BRT transit stop is located. In order to estimate the volume of pedestrians crossing through this intersection, it was assumed that 80% of transit riders will be using the BRT system. Of this 80%, it was assumed that all of these trips are travelling in the peak direction (this oversimplification can be estimated to balance out through an over- and under-assumption of pedestrians crossing from the south and north sides of the development during both peak hours). Typical paths were generated based on assumed travel patterns and areas of density to calculate the estimated volume of pedestrians crossing each leg of the intersection during the peak hour. These routes are included in Appendix E.

A similar approach was taken to capture pedestrians from the northern portion of the development crossing to and from the school site.

4.3 Cycling Facility Assessment

Based on the internal pedestrian trip assignment discussed in the previous section, it is estimated that the peak hour pedestrian volumes on the proposed multi-use facility will be 133 in the AM peak and 118 in the PM peak. These estimates represent the segment of the path with the highest volume of pedestrians- immediately upstream of the intersection, where the volumes coming from all of the tributary access points are combined.

The TAC Geometric Design Guide for Canadian Roads indicates that for a scenario with “a high percentage of pedestrians (more than 20% of users)”, which is true of this the proposed new street, the width of a MUP should be at least 1 m wide for every 33 persons per hour. Based on this, it is recommended that the MUP facility have a width of at least 4 m.

5.0 INFRASTRUCTURE UPGRADES

5.1 Active Transportation

Active transportation facilities should be provided within the development. A 4.0 m wide MUP should be provided on one side of the roadway to accommodate active transportation users.

Active transportation facilities on the streets surrounding the development should be reviewed by the Municipality. The existing painted bike lanes in this area are inadequate facilities for the speeds, vehicular volumes, and heavy traffic on these streets, including Commodore Drive and Wright Avenue.

Considering the plans for a BRT, we recommend that HRM undertake a functional plan for Commodore Drive that considers both transit and active transportation facilities. One option that may be considered in such a plan would be to have a MUP along most of Commodore Drive. To accommodate the BRT stop the MUP could split off to have a bi-directional bikeway running behind the transit stop and sidewalk to connect pedestrians to the stop.

It would be ideal to have a protected facility to connect this new development to the Highway 118 crossing, providing a link to Shubie Park and The Trans Canada Trail. As recapitalization projects are untaken in the area, HRM should review the opportunity to improve active transportation facilities. It is likely that MUPs will continue to be adequate to accommodate the volumes of pedestrians and cyclists in the area.

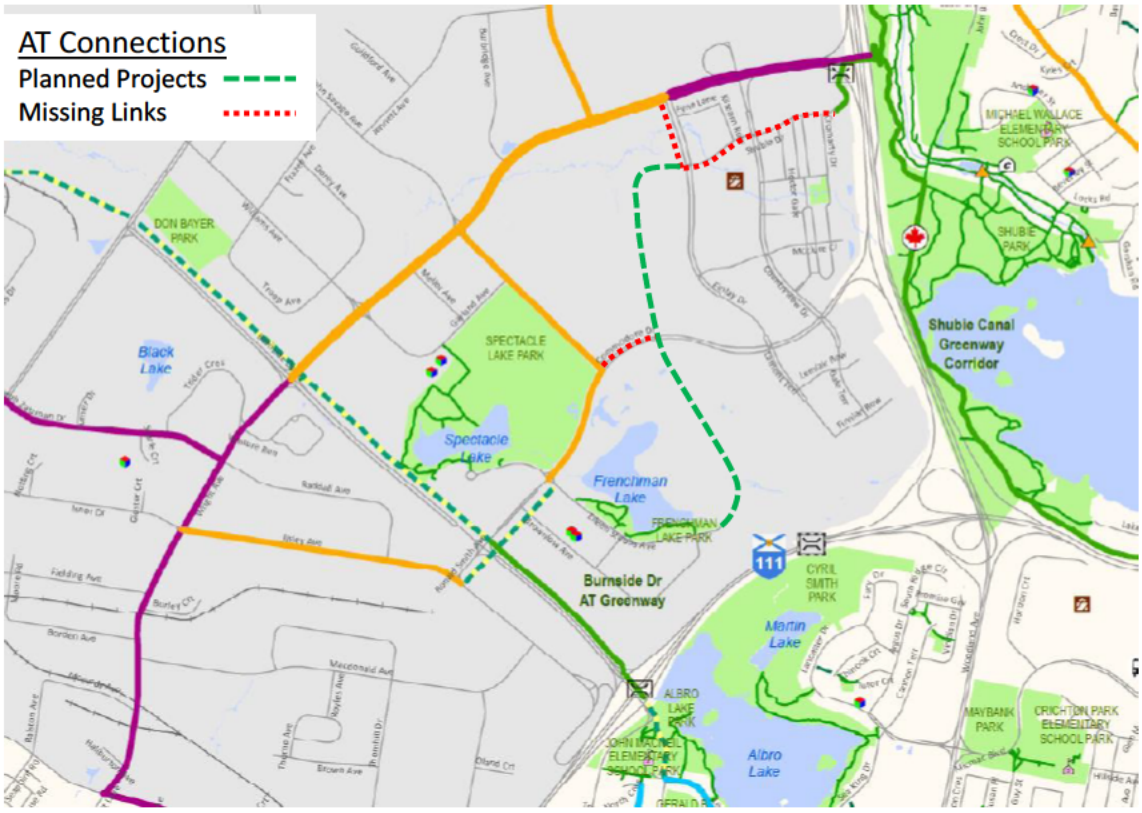


Figure 37 - Future AT Connections

5.2 Transit

5.2.1 Transit Priority Measures

HRM's Rapid Transit Strategy includes bus rapid transit on Commodore Drive and Burnside Drive. The Rapid Transit Strategy recommended transit only lanes on both Commodore Drive between Countryview Drive and John Savage Avenue and Burnside Drive between Commodore Drive and Highway 111 through the conversion of traffic lanes. The dark blue lines in the adjacent figure signify transit priority lanes.



Figure 38 - Proposed BRT Route through Dartmouth Crossing (HRM Rapid Transit Strategy, 2020)

Burnside Drive

Burnside Drive, between Highway 111 and Commodore Drive, has six lanes of traffic and a 70 km/h posted speed. In the northbound direction, the outside lane is added from the Highway 111 Off-Ramp, and in the southbound direction the outside lane is added from Ronald Smith Avenue. The added lanes allow for continuous traffic flow for both of these high volume right turn movements. Converting the outside lanes to transit only would require each of the right turn movements to yield to traffic on Burnside Drive and could cause a weaving issue both from Highway 111 and Ronald Smith Avenue. The outside lanes on Burnside Drive do not generally experience notable delays or queues, so full transit lanes are not expected to provide a notable benefit.

One option for transit priority would be to add a southbound queue jump at the Highway 111 Eastbound intersection. Transit could use the outside lane to by-pass southbound through traffic when there is a queue present.

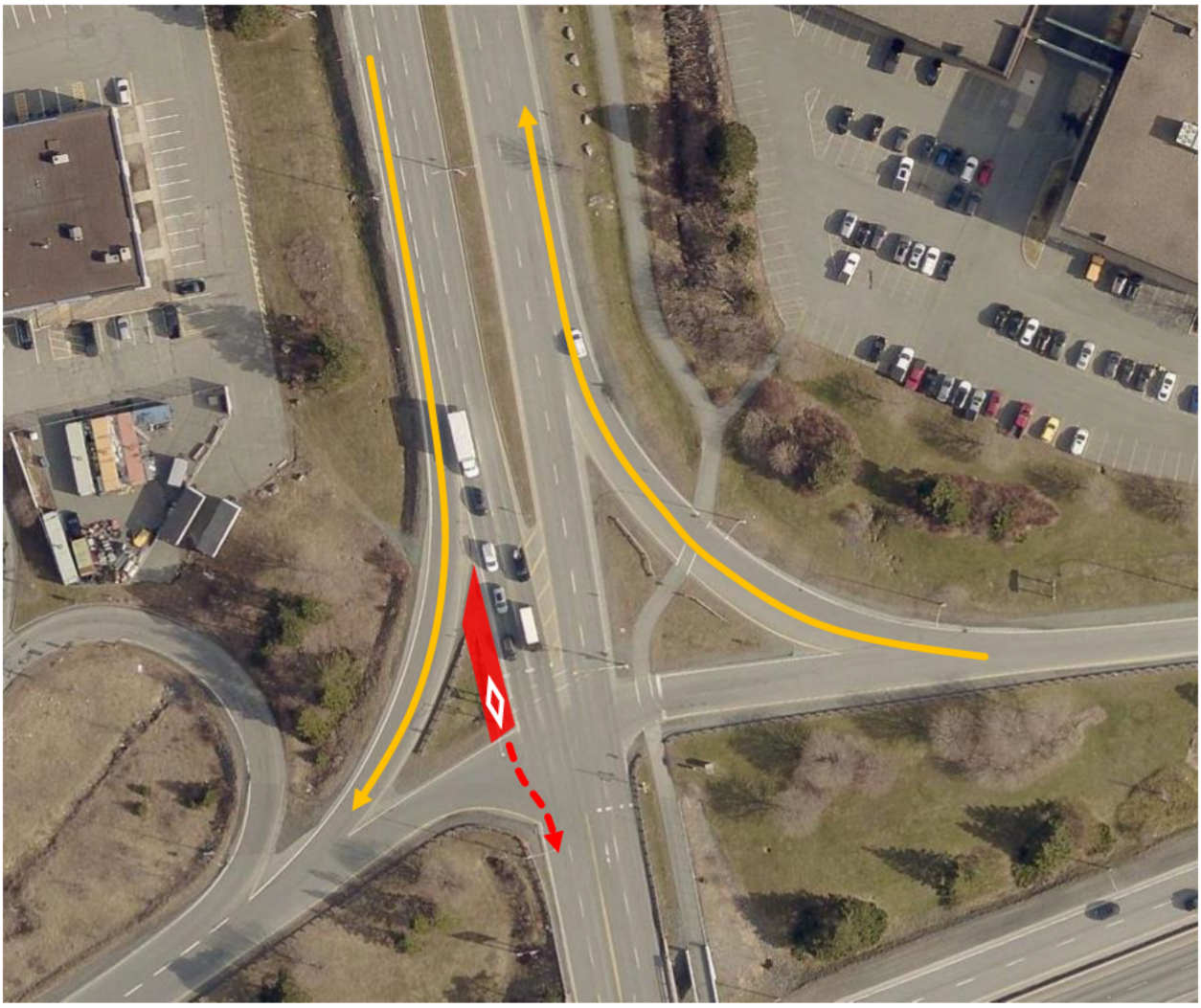


Figure 39 – Potential southbound transit queue jump lane at Hwy 111 interchange

Commodore Drive from John Savage Avenue to Countryview Drive

Commodore Drive has two through lanes of traffic in each direction. Transit lanes could be added by converting the curbside lanes to right turn lanes, except transit.

5.2.2 BRT Transit Hub

We recommend that the planned BRT Transit Hub be relocated from the proposed location on Commodore Drive near John Savage Avenue and instead placed at the main entrance to this proposed development. As previously discussed, this development offers an opportunity to add riders to this BRT line in the off-peak direction. Figure 40 shows that this relocation places the core of the residential area within 400 m of the hub and almost the entire development within an 800m radius.

5.2.3 Local Transit Service

We also recommend that Halifax Transit consider modifying the "Burnside" Route 64 so it loops through the new development to the new connection with Eileen Stubbs instead of the current route that goes through Brownlow to Eileen Stubbs. Should the transit route be modified Halifax Transit should also consider

modifications to the locations of the transit stops on Brownlow Avenue to be closer to MacLean Road in order to provide continued service to users at these buildings.

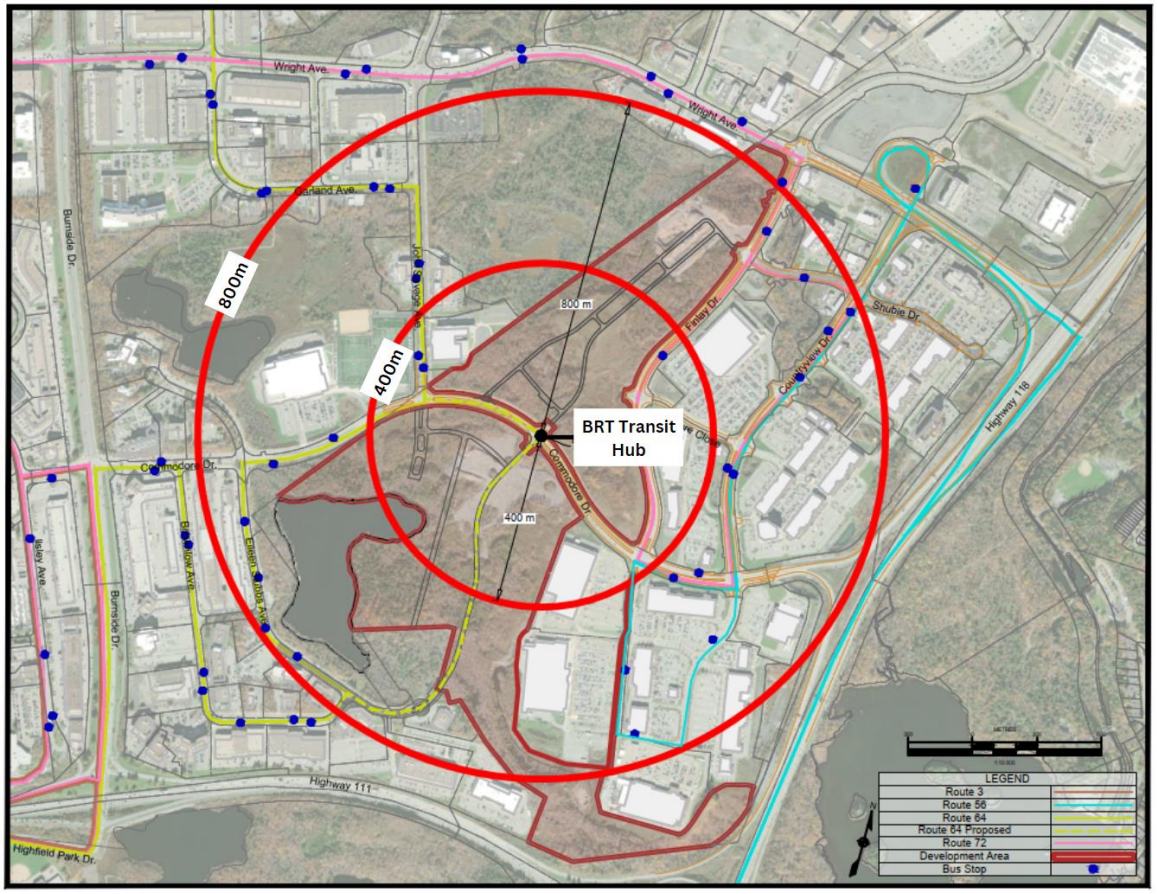


Figure 40 - Proposed BRT Transit Hub Relocation and Route 64 Revised Routing

5.3 Traffic Upgrades

HRM's planned transit lanes on Commodore Drive have been included as the future base case for analysis. In addition to these transit lanes, several intersection improvements have been identified, where there are existing capacity limitations.

5.3.1 Intersection of Commodore Drive and Burnside Drive

The intersection of Commodore Drive and Burnside Drive is a critical intersection in the network. The four-legged intersection has high demand in all directions and a history of collisions. There are dual left turn lanes on the northbound and westbound approaches to accommodate the heavy left turn movements, which are the critical movements at the intersection. There are several proposed changes to improve the intersections operations and safety.

The northbound Burnside Drive approach has a channelized right turn lane with yield control. While the eastern leg has two receiving lanes, it is fed by single lane approaches in the eastbound through and southbound left directions. It is proposed that the northbound channelized right turn lane is modified to become an added lane

on the eastern exit, removing the yield control. Improving the capacity of the northbound right turn benefits both traffic and transit movement.

The southbound Burnside Drive has a single left turn lane, opposite dual left turn lanes on the northbound approach. To improve sightlines and road safety, it is recommended that the southbound left turn is shifted to align with the opposing centre left turn lane.

The Ronald Smith Avenue approach will require slight realignment to conform with the proposed changes to the receiving lane on Commodore Drive.

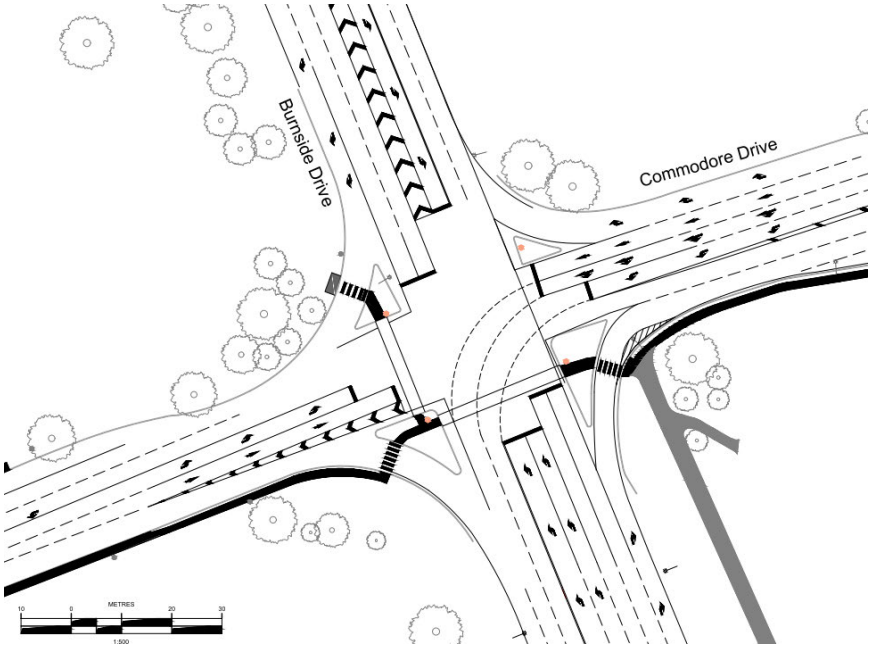


Figure 41 - Proposed configuration of Burnside Drive at Commodore Drive

5.3.2 Intersection of Commodore Drive and Brownlow Avenue

The westbound left turn movement, from Commodore Drive to Brownlow Avenue should be restricted as there is no left turn lane. Left turning traffic can use the Eileen Stubbs Avenue / Spectacle Lake Drive intersection. There is a single northbound shared lane on Brownlow Avenue. The curb to curb width is 11 m. The northbound approach should be repainted with left and right turn lanes to improve capacity.

5.3.3 Intersection of Commodore Drive and John Savage Avenue/New Street

The intersection of Commodore Drive and John Savage Avenue is a three-legged, stop-controlled intersection. The proposed development adds a fourth leg opposite John Savage Avenue. The Transportation Association of Canada (TAC) Traffic Signal Warrant has been used to evaluate the need for traffic signals. The warrant analysis uses a system that considers geometry, operating parameters, local demographics, pedestrian and vehicular volumes and conflict points to evaluate if traffic signals should be considered. The warrant procedure provides a score for vehicles and pedestrians. A combined score of 100-points or higher results in signals being recommended. The TAC Traffic Signal Warrant procedure has been completed based on 2023 Existing Traffic

volumes, 2043 Background Traffic volumes and 2043 Total Traffic volumes. The 2023 Existing Traffic scenario resulted in 54 points, 2043 Background Traffic resulted in 66 points, and the 2043 Total Traffic scenario resulted in 209 points. The results show that the intersection requires signalization with the addition of the proposed development. Traffic signal warrants are provided in Appendix F.

The eastbound approach on Commodore Drive can remain as-is. The westbound approach requires a left turn lane with 50 m of storage. The John Savage Avenue approach should become a left lane and a shared through/right lane. The new street, the northbound approach, should also have a dedicated left turn lane with at least 30 m of storage and a shared through/right lane.

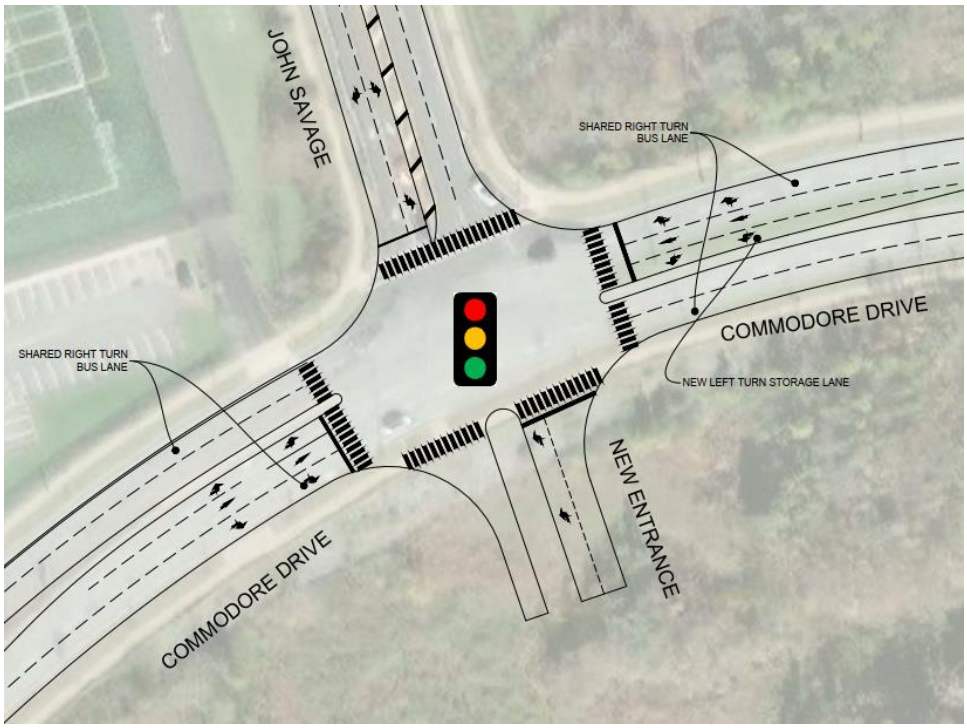


Figure 42 - Proposed signalized intersection of Commodore Drive at John Savage Avenue

5.3.4 Intersection of Commodore Drive and Eileen Stubbs Avenue / New Street

A new four-legged intersection will be created at Commodore Drive and the extension of Eileen Stubbs to the east, and a new street providing access to the north side of Commodore Drive. The signal warrant procedure was completed for the new intersection and resulted in a score of 406 (159 vehicle points and 247 pedestrian points), indicating that the intersection should include traffic signals. The planned bus rapid transit station at this intersection results in a high volume of pedestrian crossings to access the BRT station. A safe pedestrian crossing is required to provide access to transit on both sides of Commodore Drive.

The Commodore Drive approaches to the intersection can remain unchanged. Both the northbound and southbound approach should have a dedicated left turn lane with 50 m of storage and a shared through/right lane. Each approach should have a pedestrian crossing.. The median on both Commodore Drive approaches should be extended so that they can serve as a pedestrian refuge area.

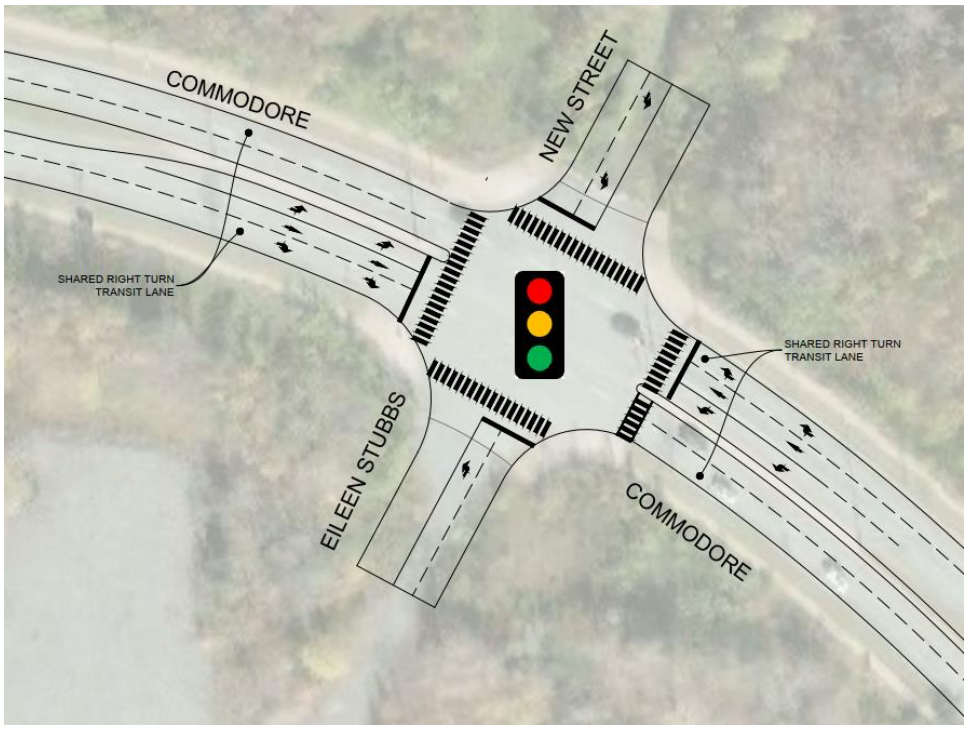


Figure 43 - Proposed signalized intersection of Commodore Drive at Eileen Stubbs Avenue (new intersection)

5.3.5 Intersection of Wright Avenue and Finlay Drive

The intersection of Wright Avenue and Finlay Drive / Cutler Avenue has several movements near capacity during the PM peak hour. The critical movement is the westbound left turn from Wright Avenue to Finlay Drive, but other high-volume movements include the eastbound through, eastbound right, and northbound right. The existing intersection configuration has an average delay of 47.7 seconds under 2043 PM Total Traffic volumes.

The northbound approach (Finlay Drive) lane configuration is a left lane, through lane and through/right lane. While the northbound right movement is a high-volume movement with 376 vehicles during the PM peak hour, the through movement is limited to 55 vehicles.

The intersection capacity can be improved by changing the northbound lane configuration to a left lane, through lane and right lane. This removes the potential for through vehicles to block the heavy right turn movement. A right turn signal can be added with a phase the overlaps with the westbound left turn. This provides more green signal time for the northbound right turn and allows signal timing to be reallocated to optimize the intersection. An overlapping phase for the eastbound right turn movement would also be beneficial. With the proposed modifications, the average intersection delay is reduced to 40 seconds. While the benefit is not substantial, this a low cost and low effort improvement that can improve the capacity to several high volume movements.

In addition to the proposed improvements, the Countryview Drive roundabout provides an alternative route to the westbound left turn to Finlay Drive. If drivers, especially residents as part of their daily commute, experience unacceptable delay at the westbound left turn, it is expected that they will reroute to the Countryview Drive roundabout.

5.4 Phasing of Traffic Upgrades

Development construction is planned to be completed in 8 phases. A phasing diagram is provided in the figure below.

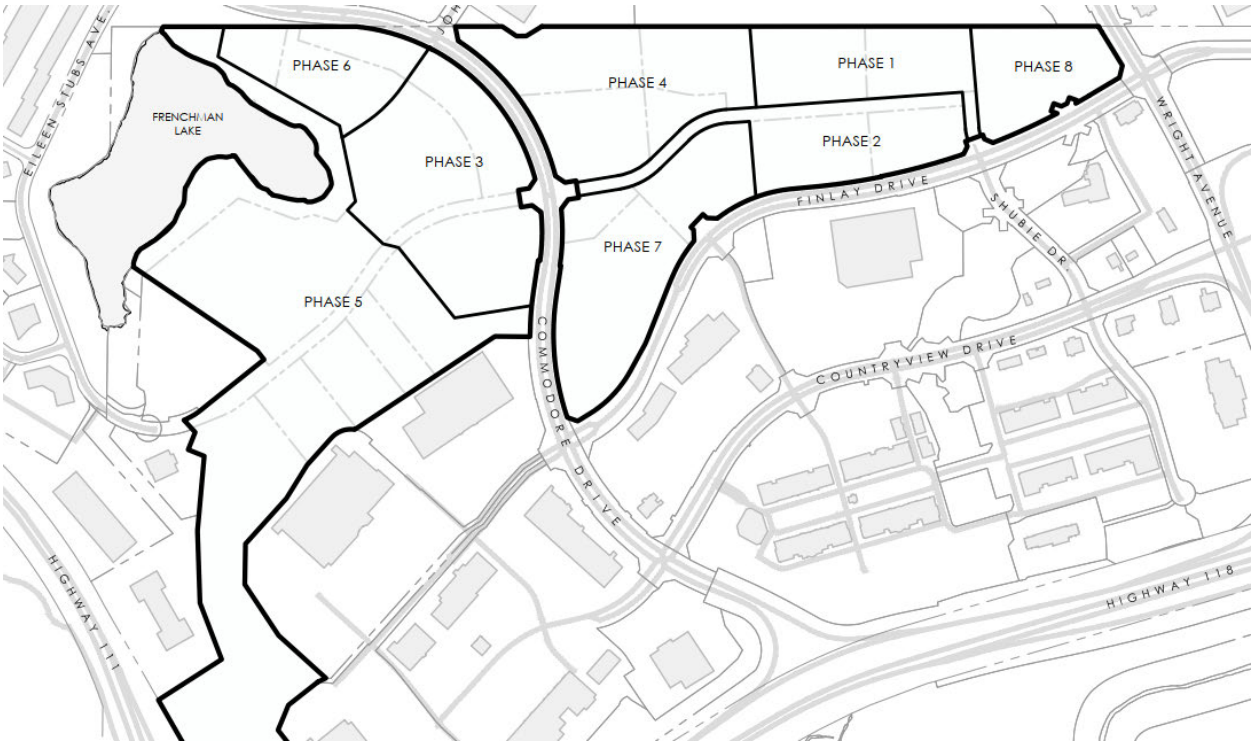


Figure 44 - Development phasing plan

There are five upgrades that have been identified through the traffic analysis, provided in the table on the following page.

Table 11 - Timing of traffic upgrades

Intersection	Upgrade	Responsibility	Reason for Upgrade	Timing
Burnside Dr / Hwy 111 Interchange	Reconstruct interchange with five lane cross-section	NSDPW	Issues under existing conditions. Identified in previous Hwy 107 studies that interchange requires upgrades.	Long-term planning required.
Burnside Dr / Commodore Dr	Realign intersection with free flow NB right turn lane Repaint SB offset LT lane to realign EB approach	HRM HRM	Issues under background conditions.	Should be planned for with BRT.
Commodore Dr / Brownlow Ave	Restrict westbound left turn and paint northbound left and right turn lanes	HRM	Left turning traffic blocks through lane. Traffic can use Eileen Stubbs instead. Northbound turn lanes reduce delay and only requires repainting within current curb to curb width.	Should be planned for with BRT.
Commodore Dr / John Savage Ave	New signalized intersection	Dartmouth Crossing	Signals are required because of development traffic.	Prior to the development of Phase 6.
Commodore Dr / Eileen Stubbs Ave	New signalized intersection	Dartmouth Crossing	Signals are required because of development traffic.	Prior to the development of Phase 3.
Wright Ave / Finlay Ave	Traffic signal phasing and repainting	HRM	Issues under background conditions.	Could be repainted following season and signal upgrades considered in the future.

6.0 FUTURE TRAFFIC CONDITIONS

Future traffic conditions have been analysed based on the future street network, with the planned bus lanes on Commodore Drive and traffic improvements described in section 5.3.

6.1 2043 Background Traffic

6.1.1 2043 Background Traffic Volumes

Future background traffic is the traffic added by general annual traffic growth, without traffic added by the proposed development. The proposed development is expected to be completed within 15 years. To ensure that traffic operations do not deteriorate shortly after the completion of the development it is typical to use a

horizon year for analysis that is five years after the expected completion date. This study uses a horizon year of 2043. The background growth rate has been provided by HRM based on the regional VISUM traffic model. The annual growth rate for background traffic is 0.5% resulting in a 10% total increase over the 20-year horizon period.

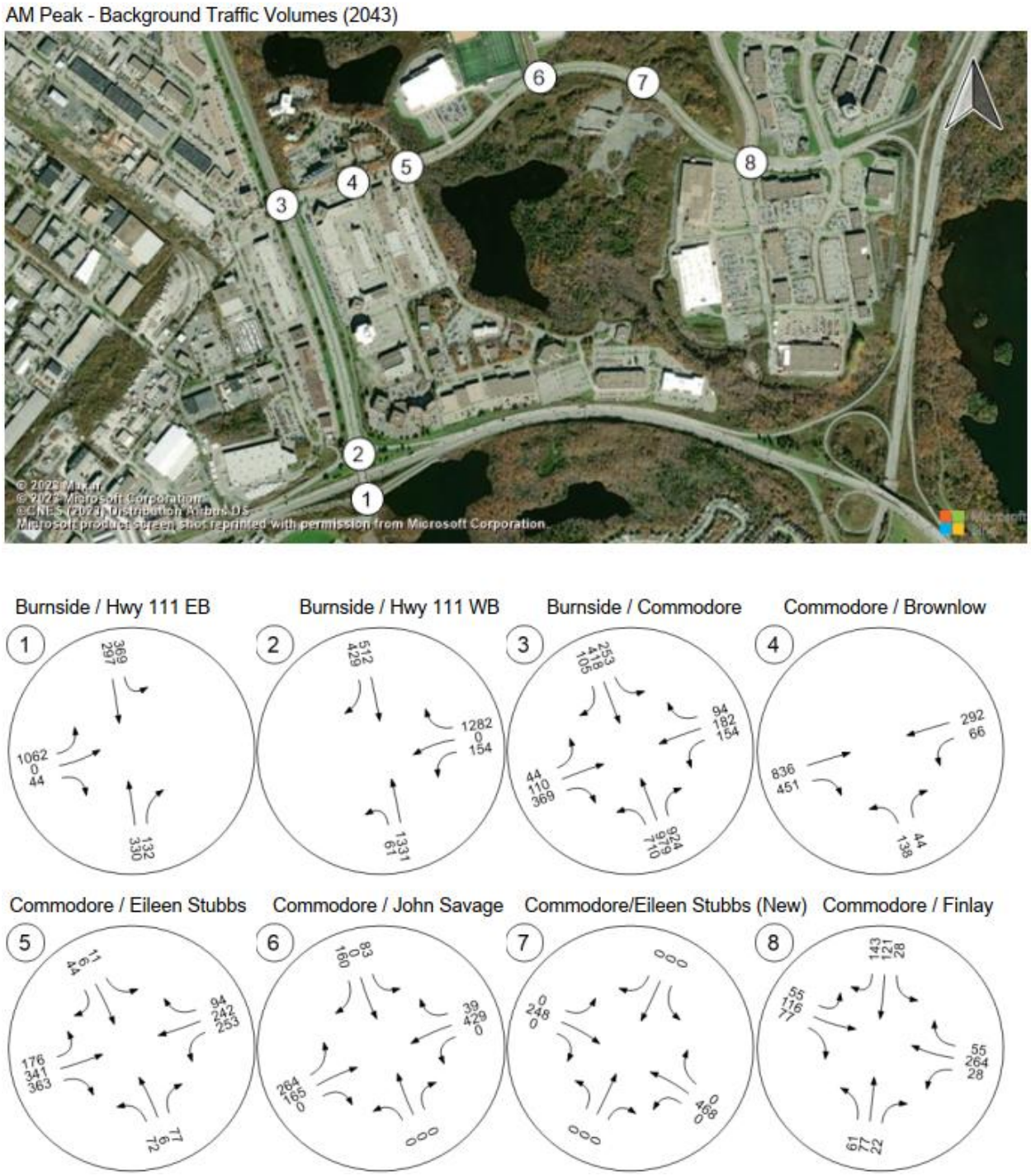


Figure 45 - AM Background Traffic Volumes (Part A)

AM Peak - Background Traffic Volumes (2043)



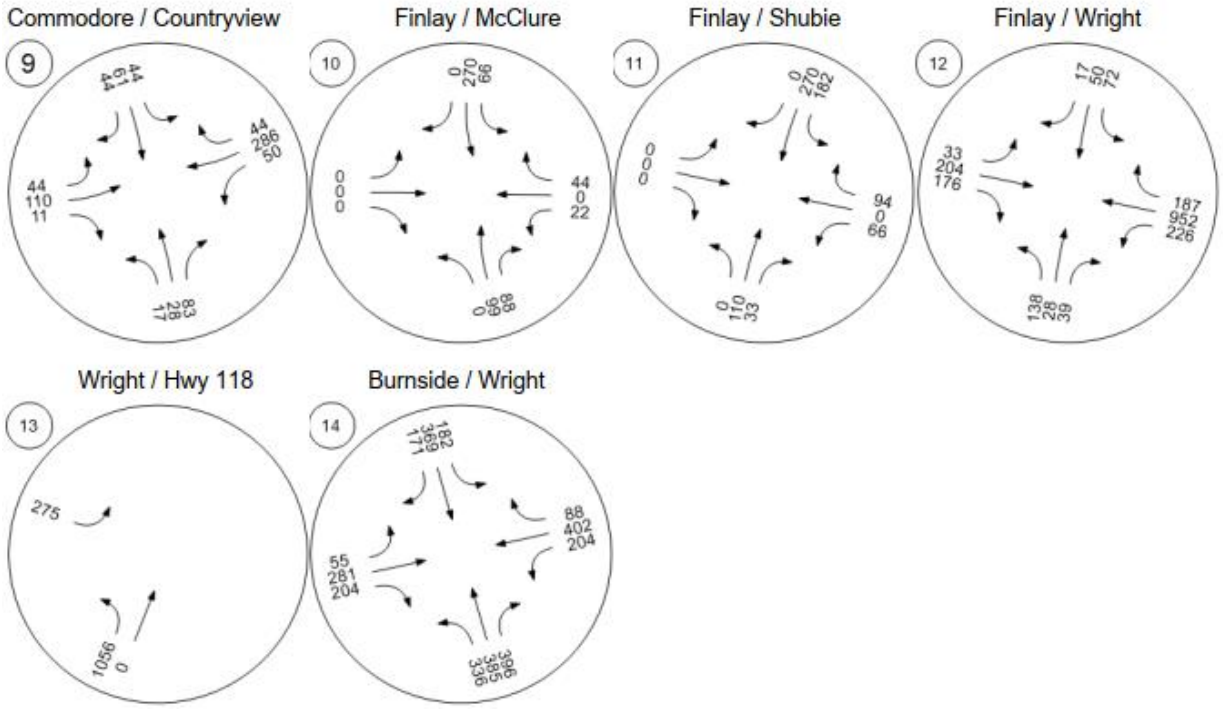


Figure 46 - AM Background Traffic Volumes (Part B)

PM Peak - Background Traffic Volumes (2043)



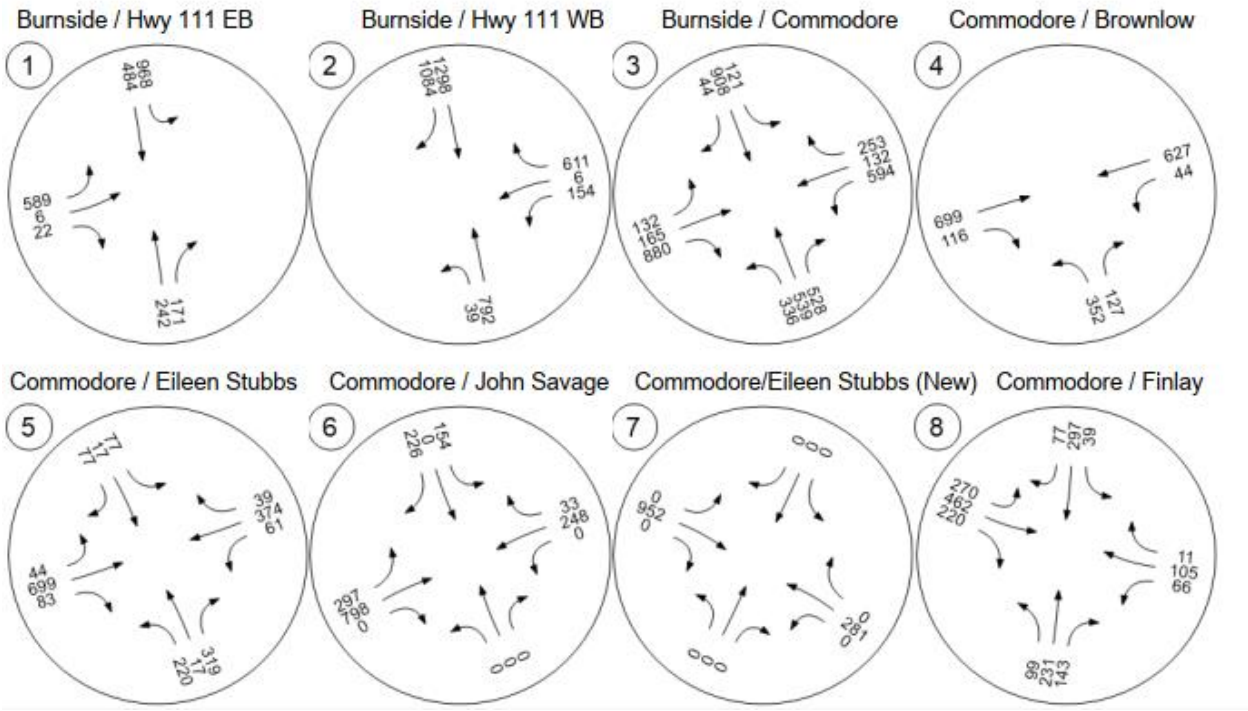


Figure 47 – PM Background Traffic Volumes (Part A)

PM Peak - Background Traffic Volumes (2043)



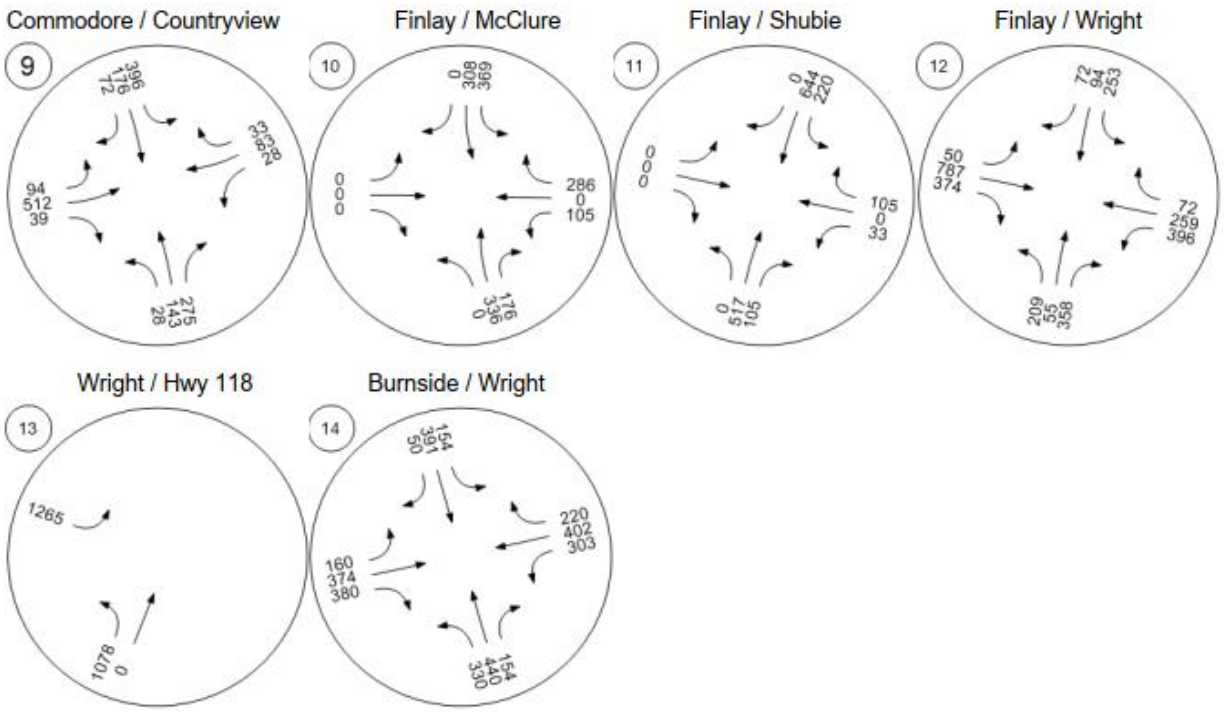


Figure 48 - PM Background Traffic Volumes (Part B)

6.1.2 2043 Background Traffic Operations

A level of service analysis has been completed for 2043 Background Traffic with bus lanes on Commodore Drive and other intersection improvements to determine how the existing street network would operate in the future, without the addition of development traffic.

AM Peak Hour

Highway 111 EB / Burnside Interchange

The eastbound approach to the intersection is over capacity under AM background volumes with a volume-to-capacity ratio of 1.04 and level of service 'E'.

Burnside Drive / Commodore Drive

The northbound left turn from Burnside Drive to Ronald Smith Avenue fails under AM background volumes. The volume-to-capacity ratio is 1.21 and a level of service 'F'.

PM Peak Hour

Burnside Drive / Commodore Drive

The northbound left turn from Burnside Drive to Ronald Smith Avenue fails under PM background volumes. The volume-to-capacity ratio is 1.04 and a level of service 'F'.

Wright Avenue / Finlay Drive

The westbound left turn lane from Wright Avenue to Finlay Drive is over capacity during the PM peak under background traffic volumes, with a v/c ratio of 1.01 and average delay of 86 seconds. There are approximately 400 left turning vehicles in the single left turn lane.

Table 12 - AM Peak Hour LOS summary for 2043 Background Traffic

Intersection	LOS Criteria	Intersection Control	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Intersection
Burnside at Hwy 111 EB/Highfield Park	Vehicle Count			330	132	369	297		1062	0	44				
	v/c			0.75	0.82	0.74	0.74		1.03	1.04					
	Delay (s)			38.8	41.3	39.9	39.1		72.9	75.7					56.9
	LOS			D	D	D	D		E	E					E
	95th% Queue (m)			68.3	70.4	95.3	96.9		197.1	201.0					
Burnside at Hwy 111 WB	Vehicle Count		61	1331			512	429				154	0	1282	
	v/c		0.63	0.65			0.29	0.41				0.69		-	
	Delay (s)		8.9	9.6			9.0	10.8				32.2		-	10.9
	LOS		A	A			A	B				C		-	B
	95th% Queue (m)		62.8	61.8			25.6	37.7				36.8		-	
Burnside at Commodore	Vehicle Count		710	979	924	253	418	105	44	110	369	154	182	94	
	v/c		1.21	0.57	0.72	0.71	0.30	0.15	0.33	0.79	-	0.70	0.76	0.57	
	Delay (s)		152.2	21.5	28.4	30.8	24.7	22.9	57.6	67.6	-	62.0	64.3	59.4	56.2
	LOS		F	C	C	C	C	C	E	E	-	E	E	E	E
	95th% Queue (m)		217.9	120.5	156.2	53.4	61.5	25.4	21.2	58.2	-	55.5	58.5	39.4	
Commodore at Brownlow	Vehicle Count		138		44					836	451		292		
	v/c		0.82		0.24					0.47	0.52		0.12		
	Delay (s)		56.8		45.9					5.4	6.1		3.1		10.4
	LOS		E		D					A	A		A		B
	95th% Queue (m)		60.2		14.2					60.7	64.7		9.8		
Commodore at Eileen Stubbs	Vehicle Count		72	6	77	11	6	44	176	341	363	253	242	94	
	v/c		0.47	0.40		0.09	0.24		0.24	0.27	0.29	0.63	0.13	0.13	
	Delay (s)		51.8	45.5		49.5	44.0		6.3	4.6	4.8	16.5	3.8	3.9	12.1
	LOS		D	D		D	D		A	A	A	B	A	A	B
	95th% Queue (m)		30.0	27.7		4.4	16.3		21.0	31.4	29.4	71.2	13.6	12.6	
Commodore at John Savage	Vehicle Count					83		160	264	165			429	39	
	v/c					0.44		0.82	0.45	0.13			0.33	0.03	
	Delay (s)					49.2		56.1	11.6	3.6			4.7	3.2	15.8
	LOS					D		E	B	A			A	A	B
	95th% Queue (m)					33.6		59.5	45.7	11.0			35.0	2.1	
Commodore at New Access	Vehicle Count														
	v/c														
	Delay (s)														
	LOS														
	95th% Queue (m)														
Commodore at Finlay	Vehicle Count		61	77	22	28	121	143	55	116	77	28	264	55	
	v/c		0.08	0.04	0.02	0.03	0.07	0.16	0.24	0.19	0.24	0.08	0.88	0.18	
	Delay (s)		8.7	12.1	11.9	8.5	13.1	14.1	35.8	40.9	41.6	33.4	56.1	42.3	32.3
	LOS		A	B	B	A	B	B	D	D	D	C	E	D	C
	95th% Queue (m)		9.0	7.1	3.6	4.1	11.5	25.2	18.5	21.2	24.4	9.0	104.7	17.6	
Commodore at Countryview	Vehicle Count		17	28	83	44	61	44	44	110	11	50	286	44	
	v/c		0.02	0.01	0.08	0.05	0.03	0.04	0.22	0.32	0.06	0.18	0.80	0.23	
	Delay (s)		5.0	7.6	8.1	5.2	7.1	7.2	42.6	49.8	48.1	42.1	55.8	49.2	37.2
	LOS		A	A	A	A	A	A	D	D	D	D	E	D	D
	95th% Queue (m)		1.7	1.9	10.4	4.8	4.0	5.0	16.6	22.7	3.7	18.6	62.5	15.2	
Finlay at McClure	Vehicle Count			99	88	66	270					22		44	
	v/c			0.08	0.09	0.07	0.11					0.09		0.38	
	Delay (s)			5.7	5.7	3.2	4.5					40.4		46.8	8.8
	LOS			A	A	A	A					D		D	A
	95th% Queue (m)			8.7	8.4	4.0	10.77					7.4		13.8	
Finlay at Shubie	Vehicle Count			110	33	182	270					66		94	
	v/c			0.07	0.07	0.19	0.12					0.23		0.61	
	Delay (s)			7.4	7.4	4.4	5.2					39.6		47.9	13.2
	LOS			A	A	A	A					D		D	B
	95th% Queue (m)			8.2	8.1	14.1	12.3					22.3		30.5	
Wright at Finlay	Vehicle Count		138	28	39	72	50	17	33	204	176	226	952	187	
	v/c		0.20	0.04	0.06	0.11	0.05	0.05	0.17	0.20	0.33	0.50	0.89	0.33	
	Delay (s)		16.6	20.3	20.5	16.0	20.7	20.7	25.3	27.2	28.7	25.8	37.0	27.7	30.2
	LOS		B	C	C	B	C	C	C	C	C	C	D	C	C
	95th% Queue (m)		29.1	6.6	8.1	15.4	7.9	7.8	7.7	28.2	43.8	59.0	141.9	45.5	
Wright at Hwy 118	Vehicle Count		1056						165						
	v/c		0.51						0.66						
	Delay (s)		7.2						26.3						11.1
	LOS		A						C						B
	95th% Queue (m)		41.8						26.0						
Burnside at Wright	Vehicle Count		336	385	396	182	369	171	55	281	204	204	402	88	
	v/c		0.60	0.25	0.49	0.38	0.25	0.22	0.19	0.43	0.59	0.61	0.58	0.25	
	Delay (s)		17.7	15.5	19.7	12.8	16.6	16.7	26.6	34.9	37.6	33.2	35.9	32.9	24.1
	LOS		B	B	B	B	B	B	C	C	D	C	D	C	C
	95th% Queue (m)		61.8	36.4	72.9	29.7	36.5	29.4	14.5	44.4	58.1	58.2	62.4	22.2	

Table 13 - PM Peak Hour LOS summary for 2043 Background Traffic

Intersection	LOS Criteria	Intersection Control	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Intersection
Burnside at Hwy 111 EB/Highfield Park	Vehicle Count			242	171	968	484		589	6	22				
	v/c			0.76	0.86	0.96	0.93		0.90	0.90					
	Delay (s)			52.8	57.8	54.2	48.1		62.0	62.2					54.6
	LOS			D	E	D	D		E	E					D
	95th% Queue (m)			79.8	83.4	259.7	245.5		125.9	125.5					
Burnside at Hwy 111 WB	Vehicle Count		39	1331			1298	1084				154	6	611	
	v/c		0.51	0.38			0.60	0.84				0.84		-	
	Delay (s)		6.7	5.2			10.6	21.0				56.0		-	14.4
	LOS		A	A			B	C				E		-	B
	95th% Queue (m)		35.3	39.1			94.4	164.5				66.3		-	
Burnside at Commodore	Vehicle Count		336	539	528	121	908	44	132	165	880	264	132	253	
	v/c		1.04	0.40	0.52	0.32	0.75	0.07	0.70	0.84	-	0.86	0.40	0.70	
	Delay (s)		96.2	28.5	23.6	20.3	42.0	28.1	36.9	69.1	-	58.5	47.7	53.2	49.2
	LOS		F	C	C	C	D	C	D	E		E	D	D	D
	95th% Queue (m)		95.5	84.3	104.9	32.4	163.0	12.2	67.5	83.8	-	130.2	59.5	94.6	
Commodore at Brownlow	Vehicle Count		352		127					699	116		627		
	v/c		0.93		0.32					0.37	0.38		0.30		
	Delay (s)		61.0		35.2					9.9	10.2		8.9		20.6
	LOS		E		D					A	B		A		C
	95th% Queue (m)		137.4		36.1					63.8	64.7		47.4		
Commodore at Eileen Stubbs	Vehicle Count		220	17	319	77	17	77	45	699	83	61	374	39	
	v/c		0.78	0.80		0.73	0.22		0.08	0.37		0.30	0.20		
	Delay (s)		51.6	45.9		62.1	33.0		11.7	10.7		18.9	8.9		23.3
	LOS		D	D		E	C		B	B		B	A		C
	95th% Queue (m)		86.7	102.2		35.6	26.2		8.0	65.0		26.5	30.8		
Commodore at John Savage	Vehicle Count					154	0	226	297	798	0	0	248	33	
	v/c					0.64		0.83	0.43	0.66			0.21	0.03	
	Delay (s)					48.5		51.5	11.4	10.9			5.4	4.5	18.0
	LOS					D		D	B	B			A	A	B
	95th% Queue (m)					61.8		75.8	50.8	109.7			23.9	2.3	
Commodore at New Access	Vehicle Count														
	v/c														
	Delay (s)														
	LOS														
	95th% Queue (m)														
Commodore at Finlay	Vehicle Count		99	231	143	39	297	77	270	462	220	66	105	11	
	v/c		0.16	0.15	0.17	0.06	0.19	0.09	0.67	0.70	0.63	0.25	0.31	0.03	
	Delay (s)		10.6	15.1	15.7	10.2	16.5	15.7	40.2	41.6	41.8	29.7	38.0	35.4	29.1
	LOS		B	B	B	B	B	B	D	D	D	C	D	D	C
	95th% Queue (m)		15.9	23.6	26.2	6.1	31.6	13.6	85.0	78.3	66.2	18.9	35.5	2.9	
Commodore at Countryview	Vehicle Count		28	143	275	396	176	72	94	512	39	28	83	33	
	v/c		0.04	0.09	0.32	0.57	0.10	0.08	0.24	0.85	0.12	0.14	0.15	0.11	
	Delay (s)		7.8	14.0	16.9	13.9	11.2	11.1	32.9	46.2	37.2	32.8	38.9	38.8	26.2
	LOS		A	B	B	B	B	B	C	D	D	C	D	D	C
	95th% Queue (m)		3.6	13.7	53.4	70.9	14.8	10.4	29.2	89.9	11.0	8.3	14.0	9.4	
Finlay at McClure	Vehicle Count			336	176	369	308					105		286	
	v/c			0.28	0.29	0.64	0.16					0.24		0.86	
	Delay (s)			13.2	13.3	17.3	9.6					31.3		45.8	20.0
	LOS			B	B	B	A					C		D	B
	95th% Queue (m)			45.0	41.8	60.9	21.9					31.0		84.0	
Finlay at Shubie	Vehicle Count			517	105	220	644					33		105	
	v/c			0.30	0.30	0.35	0.28					0.11		0.66	
	Delay (s)			9.3	9.4	6.2	6.4					38.4		49.0	10.5
	LOS			A	A	A	A					D		D	B
	95th% Queue (m)			43.7	41.9	19.4	33.8					10.9		34.4	
Wright at Finlay	Vehicle Count		209	55	358	253	94	72	50	787	374	396	259	72	
	v/c		0.37	0.11	0.41	0.49	0.16	0.17	0.1	0.94	0.54	1.01	0.21	0.11	
	Delay (s)		23.4	30.6	18.8	26.3	31.3	31.4	18.2	48.5	29.5	85.7	24.1	23.1	40.0
	LOS		C	C	B	C	C	C	B	D	C	F	C	C	D
	95th% Queue (m)		58.3	17.9	72.7	73.6	27.1	24.8	11.2	140.5	92.9	151.6	35.3	16.0	
Wright at Hwy 118	Vehicle Count		1078						1265						
	v/c		0.87						0.96						
	Delay (s)		34.0						24.2						28.7
	LOS		C						C						C
	95th% Queue (m)		121.9						114.1						
Burnside at Wright	Vehicle Count		330	440	154	154	391	50	160	374	380	303	402	220	
	v/c		0.73	0.40	0.26	0.40	0.42	0.10	0.37	0.34	0.66	0.74	0.38	0.39	
	Delay (s)		34.9	28.1	26.9	23.5	32.5	28.7	19.9	27.1	32.9	34.9	28.1	28.5	29.7
	LOS		C	C	C	C	C	C	B	C	C	C	C	C	C
	95th% Queue (m)		91.7	63.0	37.6	39.9	61.4	12.5	38.2	54.6	97.4	82.4	58.1	55.0	

6.2 2043 Total Traffic

6.2.1 2043 Total Traffic Volumes

Future total traffic is the sum of future background traffic and site generated traffic. Pass-by trips associated with the grocery store have been included in the turning movement counts at the new intersection of Commodore Drive and Eileen Stubbs Avenue. With the new connection to Eileen Stubbs Avenue, 50% of traffic traveling to and from Eileen Stubbs Avenue from the east has been diverted to the new intersection as well. Total traffic volumes for study area intersections are shown in the following figures. All westbound left turning vehicles at Brownlow Avenue have been rerouted to the Eileen Stubbs Avenue / Spectacle Lake Drive intersection.

AM Peak - Total Traffic Volumes (2043)



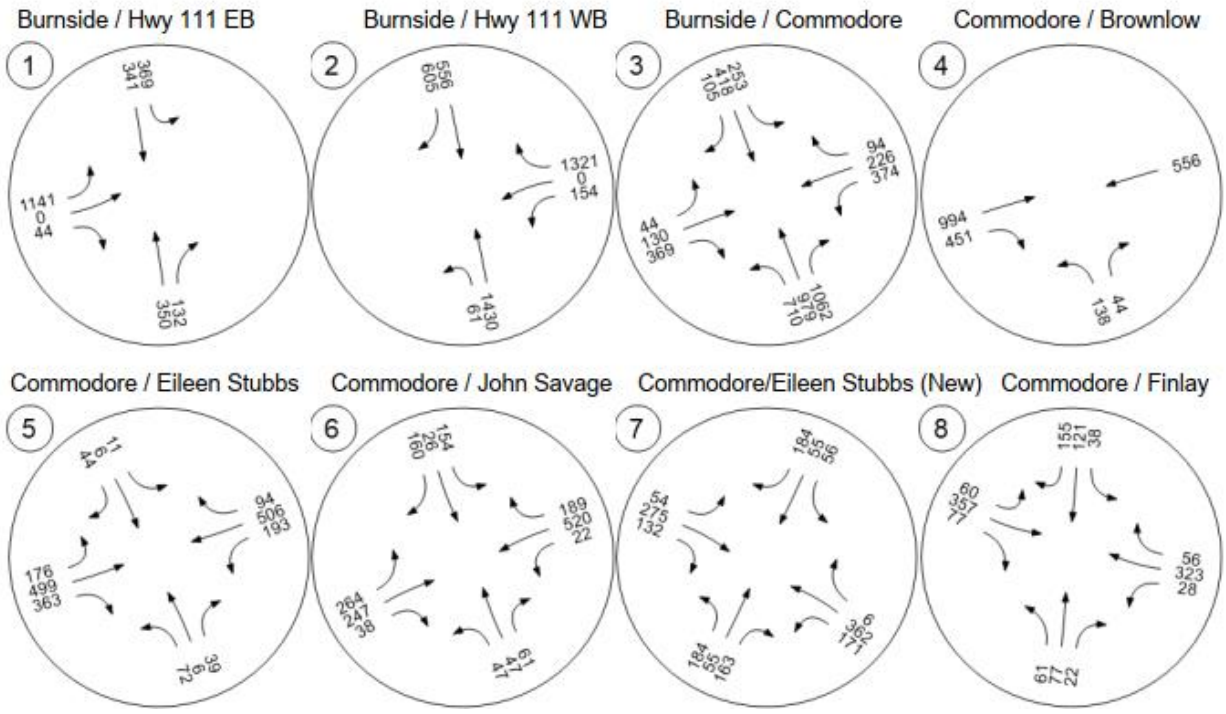


Figure 49 - AM Total Traffic Volumes (Part A)

AM Peak - Total Traffic Volumes (2043)



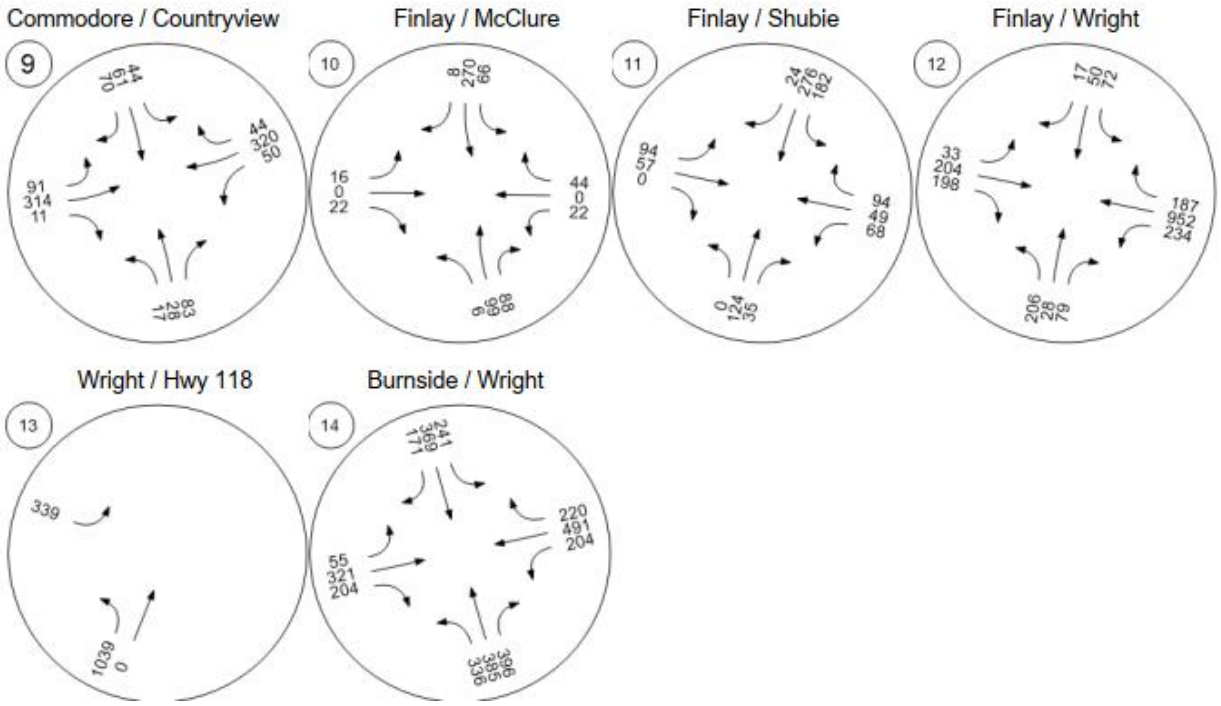


Figure 50 - AM Total Traffic Volumes (Part B)

PM Peak - Total Traffic Volumes (2043)



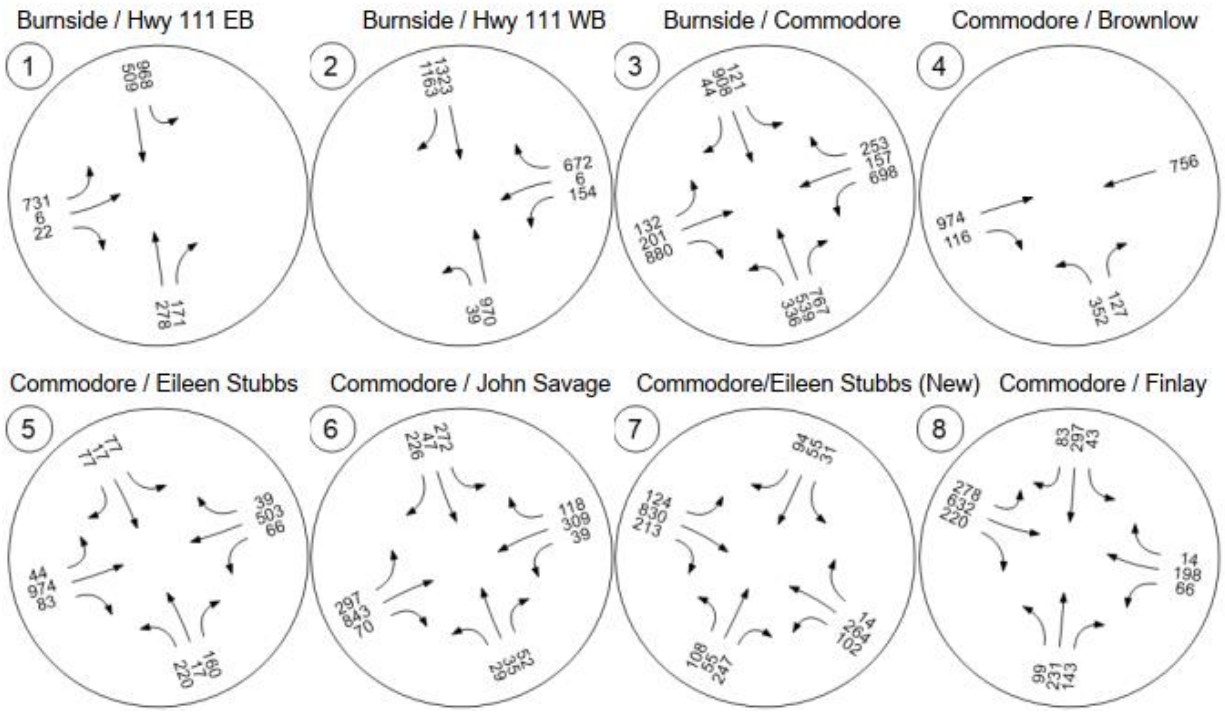


Figure 51 – PM Total Traffic Volumes (Part A)

PM Peak - Total Traffic Volumes (2043)



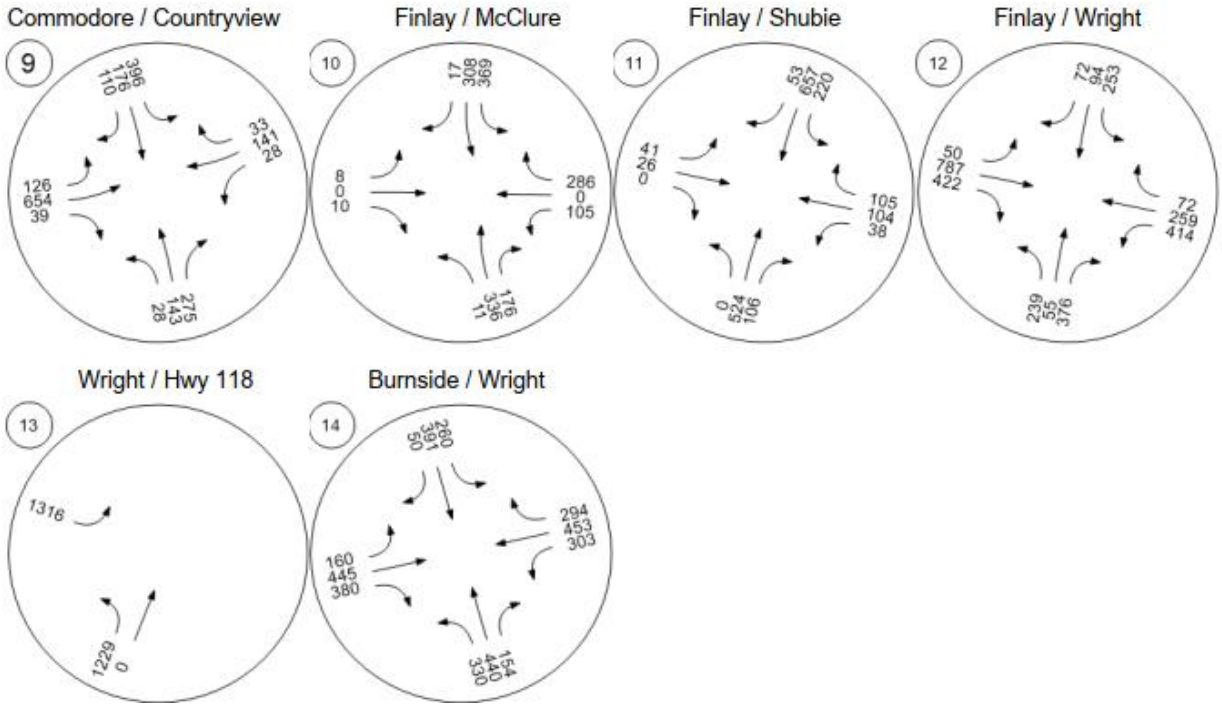


Figure 52 - PM Total Traffic Volumes (Part B)

6.2.2 2043 Total Traffic Operations

A level of service analysis for 2043 Total Traffic evaluates traffic operations of the future street network with all forecasted traffic.

AM Peak Hour

Highway 111 EB / Burnside Interchange

The eastbound approach to the intersection is over capacity under the AM total volumes with a volume-to-capacity ratio of 1.11 and level of service 'F', increasing from a v/c of 1.01 under background volumes.

Burnside Drive / Commodore Drive

The northbound left turn maintains a v/c ratio of 1.01 and average delays over 150 seconds. The intersection delay increases from 56 seconds to 68 seconds. All movements other than the northbound left turn meet the level of service measure thresholds.

Commodore at Country View

The eastbound through movement exceeds the 0.85 HRM threshold.

Wright at Finley

The eastbound through movement exceeds the 0.85 threshold. The westbound left movement exceeds the HRM threshold of 1.00.

PM Peak Hour

Highway 111 / Burnside Interchange

The southbound approach to the intersection is over capacity with a v/c of 1.09 and queues that extend well beyond the adjacent intersection. The eastbound approach is also near capacity with a v/c ratio of 0.95.

Burnside Drive / Commodore Drive

The SB through movement exceeds a v/c ratio of 1.00. The intersection delay increases from 46 seconds to 59 seconds. All movements other than the northbound left turn meet the level of service measure thresholds.

Commodore Drive at Eileen Stubbs

The EB through movement has a v/c ratio of 0.87

Commodore at New Access

The EB through movement has a v/c ratio of 0.90.

Commodore at Countryview

The EB through movement has a v/c ratio of 0.87.

Wright at Finley

The EB through and SB left movements exceed the thresholds.

Table 14 - AM Peak Hour LOS summary for 2043 Total Traffic

Intersection	LOS Criteria	Intersection Control	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Intersection
Burnside at Hwy 111 EB/Highfield Park	Vehicle Count			380	122	401	370		1238		40				
	v/c			0.76	0.82	0.81	0.80		1.10	1.11					
	Delay (s)			38.5	41.0	45.0	43.5		98.5	101.8					71.4
	LOS			D	D	D	D		F	F					E
	95th% Queue (m)			70.5	72.7	106.3	107.2		245.2	249.8					
Burnside at Hwy 111 WB	Vehicle Count		66	1552			603	460				167			
	v/c		0.68	0.70			0.32	0.54				0.69			
	Delay (s)		9.9	10.6			9.2	12.8				32.2			0.6
	LOS		A	B			A	B				C		A	B
	95th% Queue (m)		70.2	68.9			28.2	55.7				36.8			
Burnside at Commodore	Vehicle Count		772	1064	565	275	454	97	48	141	0	361	245	87	
	v/c		1.01	0.72	0.85	0.97	0.46	0.22	0.19	0.54		0.77	0.84	0.38	
	Delay (s)		67.6	33.7	46.4	98.1	40.0	36.8	49.7	53.7		58.1	61.5	51.0	51.9
	LOS		F	C	D	F	D	D	D	D	A	E	E	D	D
	95th% Queue (m)		153.6	151.1	186.7	124.4	76.9	33.7	19.4	60.0		82.2	87.6	36.1	
Commodore at Brownlow	Vehicle Count		150		40					1058	416	72	558		
	v/c		0.66		0.58					0.64	0.42		0.43		
	Delay (s)		41.1		9.5					11.0	16.8		7.6		12.6
	LOS		D		A					B	B		A		B
	95th% Queue (m)		60.8		90.3					97.9	22.7		57.4		
Commodore at Eileen Stubbs	Vehicle Count		78	7	36	12	7	40	191	520	336	138	503	87	
	v/c		0.11	0.05		0.02	0.06		0.53	0.85	0.89	0.53	0.56	0.56	
	Delay (s)		18.4	15.3		17.1	15.3		30.1	43.8	46.8	30.9	36.7	0.6	37.5
	LOS		B	B		B	B		C	D	D	C	D	D	D
	95th% Queue (m)		17.7	8.6		2.6	9.5		55.8	145.5	133.8	37.6	92.2	88.8	
Commodore at John Savage	Vehicle Count		53	54	62	167	28	148	287	255	27	30	516	173	
	v/c		0.18	0.46		0.46	0.68		0.55	0.25	0.03	0.04	0.56	0.23	
	Delay (s)		35.1	46.4		38.0	49.3		17.8	14.0	11.8	8.6	22.9	17.2	25.8
	LOS		D	D		D	D		B	B	B	A	C	B	C
	95th% Queue (m)		16.7	44.1		56.5	67.3		49.6	47.4	4.4	3.7	115.4	36.7	
Commodore at New Access	Vehicle Count		199	60	149	132	60	138	62	305	108	199	388	4	
	v/c		0.61	0.55		0.35	0.68		0.12	0.37	0.16	0.35	0.46	0.01	
	Delay (s)		35.8	40.0		29.5	43.1		14.6	23.0	20.0	15.8	24.3	17.7	28.1
	LOS		D	D		C	D		B	C	B	B	C	B	C
	95th% Queue (m)		60.7	70.7		37.7	70.9		11.2	73.4	24.9	38.1	92.4	0.9	
Commodore at Finlay	Vehicle Count		66	84	21	43	132	139	65	463	71	30	362	52	
	v/c		0.09	0.05	0.03	0.05	0.08	0.19	0.23	0.50	0.18	0.09	0.79	0.14	
	Delay (s)		12.4	16.9	16.7	12.3	17.7	19.2	30.1	37.9	34.2	27.8	45.2	35.1	32.1
	LOS		B	B	B	B	B	B	C	D	C	C	D	D	C
	95th% Queue (m)		11.3	8.7	4.4	7.4	13.9	31.9	17.7	72.9	21.8	8.0	116.8	16.1	
Commodore at Countryview	Vehicle Count		30	155	254	430	191	115	137	749	36	30	139	30	
	v/c		0.04	0.10	0.36	0.62	0.11	0.15	0.30	0.87	0.09	0.14	0.17	0.08	
	Delay (s)		10.4	17.5	21.3	18.8	14.4	14.9	28.8	42.8	32.1	29.4	34.2	33.5	28.2
	LOS		B	B	C	B	B	B	C	D	C	C	C	C	C
	95th% Queue (m)		4.3	15.7	60.6	82.6	17.3	21.9	36.5	112.6	10.0	7.6	20.1	8.6	
Finlay at McClure	Vehicle Count		11	365	163	401	335	14	9	0	9	114	0	264	
	v/c		0.02	0.31	0.32	0.70	0.18	0.18	0.03	0.03		0.21	0.74		
	Delay (s)		9.2	16.4	16.7	24.1	13.0	13.0	26.6	33.7		27.1	38.1		21.8
	LOS		A	B	B	C	B	B	C	C		C	D		C
	95th% Queue (m)		1.3	52.0	48.5	71.4	28.2	27.8	2.1	2.5		28.5	77.7		
Finlay at Shubie	Vehicle Count		0	570	98	239	713	40	33	16	0	39	98	97	
	v/c		0.00	0.36	0.37	0.42	0.35	0.35	0.09	0.05		0.09	0.29	0.36	
	Delay (s)		0.0	18.2	18.4	13.0	13.2	13.3	33.7	40.3		33.6	42.2	43.0	18.9
	LOS		A	B	B	B	B	B	C	D		C	D	43.00	B
	95th% Queue (m)		0.0	73.1	70.8	39.5	67.8	66.9	10.2	5.4		12.0	34.9	35.1	
Wright at Finlay	Vehicle Count		260	60	337	275	102	66	54	855	390	438	282	66	
	v/c		0.43	0.11	0.75	0.71	0.16	0.17	0.10	0.92	0.98	1.03	0.20	0.11	
	Delay (s)		24.7	30.8	48.7	37.3	31.6	31.8	17.9	47.3	76.8	89.5	23.7	22.8	49.9
	LOS		C	C	D	D	C	C	B	E	E	F	C	C	D
	95th% Queue (m)		67.0	18.0	116.6	80.6	27.2	25.0	11.1	139.0	159.5	157.6	35.0	15.8	
Wright at Hwy 118	Vehicle Count		1334						1430						
	v/c		0.99						0.99						
	Delay (s)		53.9						29.1						41.1
	LOS		D						C						D
	95th% Queue (m)		170.9						128.3						
Burnside at Wright	Vehicle Count		359	478	142	283	425	46	174	484	351	329	492	272	
	v/c		0.72	0.40	0.27	0.64	0.39	0.09	0.41	0.46	0.75	0.75	0.44	0.55	
	Delay (s)		33.8	28.5	27.3	31.3	30.3	26.8	21.5	31.5	39.0	34.1	30.0	31.9	31.3
	LOS		C	C	C	C	C	C	C	C	D	C	C	C	C
	95th% Queue (m)		89.5	63.5	38.0	70.6	59.4	12.0	39.8	68.3	105.1	83.7	66.0	74.7	

Table 15-PM Peak Hour LOS Summary for 2043 Total Traffic

Intersection	LOS Criteria	Intersection Control	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Intersection
Burnside at Hwy 111 EB/Highfield Park	Vehicle Count			302	158	1052	553		795		21				
	v/c			0.77	0.87	1.09	1.05		0.95	0.95					
	Delay (s)			52.3	57.2	93.3	81.0		71.1	71.7					77.5
	LOS			D	E	F	F		E	E					E
	95th% Queue (m)			85.6	89.3	336.2	314.6		161.2	161.5					
Burnside at Hwy 111 WB	Vehicle Count		42	1054			1438	921				167			
	v/c		0.55	0.45			0.59	0.85				0.85			
	Delay (s)		6.8	5.8			10.3	21.7				61.5			0.8
	LOS		A	A			B	C				E		A	B
	95th% Queue (m)		48.7	54.1			99.9	183.9				71.8			
Burnside at Commodore	Vehicle Count		365	586	411	132	987	40	143	218	0	722	171	234	
	v/c		0.96	0.49	0.77	0.54	1.01	0.09	0.47	0.68		0.97	0.48	0.70	
	Delay (s)		66.9	32.4	45.3	55.6	75.5	32.3	45.5	48.7		75.3	42.3	46.9	58.6
	LOS		E	C	D	E	F	C	D	D	A	E	D	D	E
	95th% Queue (m)		77.1	83.5	132.7	47.9	194.0	12.3	53.7	79.3		149.1	61.1	83.4	
Commodore at Brownlow	Vehicle Count		383		117					1047	108	48	785		
	v/c		0.89		0.66					0.68	0.57		0.62		
	Delay (s)		30.3		17.6					18.5	16.3		17.0		20.1
	LOS		C		B					B	B		B		C
	95th% Queue (m)		100.5		86.1					88.4	49.4		74.8		
Commodore at Eileen Stubbs	Vehicle Count		239	18	148	84	18	71	48	1047	77	24	510	36	
	v/c		0.40	0.23		0.16	0.12		0.12	0.90	0.90	0.11	0.46	0.46	
	Delay (s)		25.4	18.4		23.4	17.1		20.1	40.7	41.6	24.3	29.5	0.5	33.0
	LOS		C	B		C	B		C	D	D	C	C	C	C
	95th% Queue (m)		63.5	36.2		21.2	18.3		10.3	164.6	163.0	5.1	73.9	72.9	
Commodore at John Savage	Vehicle Count		24	38	49	296	51	209	323	914	57	49	307	109	
	v/c		0.09	0.33		0.68	0.82		0.50	0.84	0.06	0.50	0.35	0.15	
	Delay (s)		30.5	40.8		40.9	48.2		14.6	25.3	9.3	69.7	19.0	16.4	28.1
	LOS		C	D		D	D		B	C	A	E	B	B	C
	95th% Queue (m)		6.5	29.1		89.2	89.0		54.4	193.0	7.6	24.5	64.3	21.1	
Commodore at New Access	Vehicle Count		105	60	229	68	60	83	149	903	183	122	280	10	
	v/c		0.63	0.82		0.29	0.55		0.20	0.90	0.25	0.41	0.28	0.01	
	Delay (s)		53.5	48.4		39.8	39.0		8.4	34.5	13.4	23.4	13.9	11.3	30.5
	LOS		D	D		D	D		A	C	B	C	B	B	C
	95th% Queue (m)		42.0	79.5		22.6	47.9		17.8	224.0	31.4	15.0	49.1	1.5	
Commodore at Finlay	Vehicle Count		108	251	133	48	323	75	302	724	203	72	218	12	
	v/c		0.19	0.18	0.21	0.08	0.23	0.12	0.64	0.72	0.46	0.24	0.42	0.03	
	Delay (s)		15.2	20.7	21.5	14.7	22.2	21.2	34.6	35.9	32.6	24.4	32.6	28.5	28.9
	LOS		B	C	C	B	C	C	C	D	C	C	C	C	C
	95th% Queue (m)		19.9	28.6	31.8	8.8	37.9	17.3	78.8	100.8	59.1	16.3	62.2	3.1	
Commodore at Countryview	Vehicle Count		30	155	254	430	191	115	137	749	36	30	139	30	
	v/c		0.04	0.10	0.36	0.62	0.11	0.15	0.30	0.87	0.09	0.14	0.17	0.08	
	Delay (s)		10.4	17.5	21.3	18.8	14.4	14.9	28.8	42.8	32.1	29.4	34.2	33.5	28.2
	LOS		B	B	C	B	B	B	C	D	C	C	C	C	C
	95th% Queue (m)		4.3	15.7	60.6	82.6	17.3	21.9	36.5	112.6	10.0	7.6	20.1	8.6	
Finlay at McClure	Vehicle Count		11	365	163	401	335	14	9	0	9	114	0	264	
	v/c		0.02	0.31	0.32	0.70	0.18	0.18	0.03	0.03		0.21	0.74		
	Delay (s)		9.2	16.4	16.7	24.1	13.0	13.0	26.6	33.7		27.1	38.1		21.8
	LOS		A	B	B	C	B	B	C	C		C	D		C
	95th% Queue (m)		1.3	52.0	48.5	71.4	28.2	27.8	2.1	2.5		28.5	77.7		
Finlay at Shubie	Vehicle Count		0	570	98	239	713	40	33	16	0	39	98	97	
	v/c		0.00	0.36	0.37	0.42	0.35	0.35	0.09	0.05		0.09	0.29	0.36	
	Delay (s)		0.0	18.2	18.4	13.0	13.2	13.3	33.7	40.3		33.6	42.2	43.0	18.9
	LOS		A	B	B	B	B	B	C	D		C	D	43.00	B
	95th% Queue (m)		0.0	73.1	70.8	39.5	67.8	66.9	10.2	5.4		12.0	34.9	35.1	
Wright at Finlay	Vehicle Count		260	60	337	275	102	66	54	855	390	438	282	66	
	v/c		0.43	0.11	0.75	0.71	0.16	0.17	0.10	0.92	0.98	1.03	0.20	0.11	
	Delay (s)		24.7	30.8	48.7	37.3	31.6	31.8	17.9	47.3	76.8	89.5	23.7	22.8	49.9
	LOS		C	C	D	D	C	C	B	E	E	F	C	C	D
	95th% Queue (m)		67.0	18.0	116.6	80.6	27.2	25.0	11.1	139.0	159.5	157.6	35.0	15.8	
Wright at Hwy 118	Vehicle Count		1334						1430						
	v/c		0.99						0.99						
	Delay (s)		53.9						29.1						41.1
	LOS		D						C						D
	95th% Queue (m)		170.9						128.3						
Burnside at Wright	Vehicle Count		359	478	142	283	425	46	174	484	351	329	492	272	
	v/c		0.72	0.40	0.27	0.64	0.39	0.09	0.41	0.46	0.75	0.75	0.44	0.55	
	Delay (s)		33.8	28.5	27.3	31.3	30.3	26.8	21.5	31.5	39.0	34.1	30.0	31.9	31.3
	LOS		C	C	C	C	C	C	C	C	D	C	C	C	C
	95th% Queue (m)		89.5	63.5	38.0	70.6	59.4	12.0	39.8	68.3	105.1	83.7	66.0	74.7	

6.3 VISSIM Analysis

The operational service levels of the study intersections presented in the previous sections was completed using PTV Vistro software. It is typical to model traffic operations using Vistro (or Synchro) software, which uses formulas to determine the level of service measures and does not model non-auto modes well. A Vistro model provides the basic analysis for traffic, but cannot provide a full picture of this corridor due to the complexity of evaluating a multimodal corridor with planned bus rapid transit service.

VISSIM is a multimodal microscopic simulation software used for a wide variety of transportation planning and operations. These simulations model operations for all road users and consider how users behave within the network. VISSIM is the leading software in multimodal transportation analysis.

For this project, GRIFFIN Transportation Group used VISSIM to prepare a corridor-level microsimulation analysis based on the volume forecasting that has been outlined in this report. This analysis focused on the critical signalized intersections along the Rapid Transit Strategy Route on Commodore Drive. For the purposes of this analysis, the future scenario of full development build out with dedicated transit lanes on Commodore Drive was considered.

The initial modelling resulted in long vehicle queues in the peak travel direction along Commodore Drive that created queue spillbacks into the upstream intersections. GRIFFIN undertook an iterative exercise to optimize the traffic signals to improve the flow of the corridor.

Analysis of the corridor found that after converting the outside lanes of the corridor to dedicated transit lanes between Eileen Stubbs and Countryview Drive, intersection delays for vehicles are manageable with travel time for vehicles on this corridor increasing to approximately 4.5-5 minutes. For buses operating along this corridor using dedicated transit lanes, travel time can be estimated to be similar to existing non-peak travel time of approximately 2-3 minutes.

The process and results of the VISSIM analysis prepared by GRIFFIN has been included in Appendix G of this report.

7.0 HIGHWAY CONNECTIONS

There are three connections to the surrounding 100-series highways around the development: Highway 111 / Burnside Drive, Highway 118 / Wright Avenue, and Highway 118 / Commodore Drive. The connections from Burnside Drive and Commodore Drive are both overcapacity during PM peak hours under existing traffic volumes. While the proposed development will add traffic to the three[2] interchanges, it is not development generated traffic that is creating capacity issues. Preliminary analysis has been completed for each connection, and no clear improvement has been identified. It is recommended that a detailed study be completed that focuses on the surrounding highway interchanges and long-term capacity for regional traffic.

7.1 Burnside Drive / Hwy 111 Interchange

The Burnside Drive and Highway 111 interchange is composed of two signalized intersections and a four-lane overpass. The eastbound intersection, on the south side of the interchange, is especially congested during the PM peak hour when there is a high-volume of eastbound left turning vehicles from Highway 111 and southbound left turning vehicles to Highway 111.

A roundabout at this intersection was considered, but is unlikely to be an appropriate solution. With significant truck traffic, it is estimated that the roundabout would require a minimum inscribed circle diameter of 60 m. The close proximity of the Highway 111 Off-Ramp and Highfield Park Drive would require significant realignment to achieve proper approach angles. There would also be no conflicting movements with the southbound approach, which would result in little to no gaps for eastbound and northbound traffic. The unbalanced flow would cause extreme queueing on the Highway 111 Off-Ramp.



interchange

One solution to improve traffic capacity at this intersection is to rebuild the overpass and with an additional southbound lane. This would remove over 500 southbound through vehicles from the left turn lanes. It would also remove the need for split phasing the north-south signal phases allowing for better optimization of signal phasing.

The Highway 107 Phase 1 study (Genivar, 2011) evaluated the impacts of traffic changes on Burnside Drive, Duke Street, and Glendale Avenue caused by the opening of the Highway 107 Extension. An objective of the study was to

[2] This includes the right-turn-in, right-turn-out interchange at the end of Commodore Drive.

identify necessary improvements for 2016 and 2026 horizon years. The study used three analysis scenarios: Projected 2016 Volumes without Highway 107, Projected 2016 Volumes with Highway 107 and Projected 2026 Volumes with Highway 107. The analysis included the Burnside Drive and Highway 111 interchange and concluded that the eastbound intersection would have a level of service 'F' under all three scenarios based on its current configuration, but did not provide a solution.

7.2 Weave Analysis for Commodore Drive / Highway 118

Commodore Drive is one of the main vehicle access points for the proposed development. Commodore Drive to Highway 118 is a key exit from Dartmouth Crossing to the network of 100-series highways. A weave analysis has been completed using the Transportation Research Board's Highway Capacity Software and PTV VISSIM simulation software to analyze the capacity of the Highway 118 Collector-Distributor road and The Highway 118 / Highway 111 interchange. The full analysis is included as Appendix H.

There are existing operational concerns with the Highway 118 Collector-Distributor road and Highway 118 / Highway 111 interchange. The interchange creates a bottleneck and at times, results in queues extending to Commodore Drive.



Figure 54 - Highway 111 Collector-Distributor road facing south from Commodore Drive

Four lane configurations have been explored to improve traffic capacity. Due to the constrained area between the Commodore Drive ramps and the Highway 118 / 111 interchange, surface level improvements are limited. Minor improvements can be made to provide capacity for 200-250 vehicles per hour, which is within the range of traffic added by the proposed development, without including background traffic growth.

Long-term solutions to improve regional traffic through the Highway 118 corridor and Highway 118 / 111 interchange should be further investigated by the Nova Scotia Department of Public Works.

8.0 COST ESTIMATES

The proposed upgrades to support the Dartmouth Crossing developed have been reviewed and high-level cost estimates prepared. These estimates are summarized in the following table.

It is important to note that these are high-level estimates that have been prepared based on experience and engineering judgement. At this stage of the project, design for the recommended upgrades has not been completed, and so a detailed cost estimate for these upgrades has not been undertaken.

Overall, these estimates are intended to provide general guidance to assist with decision-making as these projects are considered. Next steps would include the preparation of functional design and associated cost estimates.

Item No.	Cost Item	Estimated Cost
1	Traffic Signals at Commodore Drive/New Access/ Eileen Stubbs West	$500k
2	Traffic Signals at Commodore Drive/John Savage Avenue	$700k
3	Modify lane to receive right turns from Burnside Drive to eastern leg of Commodore Drive	$100k
4	New signal heads at Wright Avenue and Finlay Drive	$30k

All other recommendations discussed in this report are either internal to the proposed development; captured by existing municipal plans (eg. Halifax's Rapid Transit Strategy); or will be determined by future functional studies (eg. provincial highway interchanges).

9.0 RECOMMENDATIONS

The following transportation network improvements are recommended to accommodate this proposed development:

1. It is recommended that HRM undertake a functional plan for the Commodore Drive corridor as part of its BRT planning. This plan should consider improvements to AT infrastructure along this roadway.

2. As recapitalization projects are untaken in the area, HRM should review the opportunity to improve active transportation facilities. Based on the analysis undertaken as part of this study, it is likely that MUPs will continue to be adequate to accommodate the volumes of pedestrians and cyclists in the area.

3. The planned BRT Transit Hub be relocated from the proposed location on Commodore Drive near John Savage Avenue and instead placed at the main entrance to this proposed development.

4. Halifax Transit should consider modifying the "Burnside" Route 64 so it loops through the proposed development to the new connection with Eileen Stubbs.

5. The Finlay Drive approach to Wright Avenue should be converted to a left lane, through lane, and right lane. A dedicated right turn signals should be added with overlapping phases for the northbound right turn and eastbound right turn.

6. Traffic signals should be installed at the new intersection of Commodore Drive and Eileen Stubbs Avenue. This upgrade is associated with traffic added by the development.

7. Traffic signals should be installed at the intersection of Commodore Drive and John Savage Avenue. This upgrade is associated with traffic added by the development.

8. The intersection of Burnside Drive and Commodore Drive should be reconfigured as shown in section 5.3.1 to address capacity and safety concerns.

9. HRM should upgrade the signals along Commodore Drive to improve flow by implementing a common cycle length and synchronizing start phases. This should adequately accommodate future 2043 peak hour demand.

10. The Nova Scotia Department of Public Works should complete further study on improvements to the Burnside Drive / Highway 111 interchange. The need for upgrading the interchange is an existing condition, and not caused by development traffic.

11. The Nova Scotia Department of Public Works should undertake a study to evaluate long-term solutions to congestion at the Highway 118 / Highway 111 interchange and access from Commodore Drive.

10.0 CONCLUSIONS

The proposed residential development within Dartmouth Crossing adds approximately 4,200 residential units, a grocery store, and a potential hotel within HRM's largest employment and retail area. Locating density close to employment and retail complements the existing uses and is a key component of creating a complete community.

The development is located directly on a proposed bus rapid transit route with a proposed station at the centre of the site. Most residents will be within 400 m of the transit station (and almost entirely within 800 m) making transit accessible to all. The planned BRT "Purple Line" terminates two blocks east of the development.

Converting this development area from the planned office space instead to focus on residential buildings and amenities shifts many of the new vehicle trips generated from the development to instead be travelling opposite the most dominant peak hour direction. This further compliments the planned BRT line, with the potential to also add riders to buses travelling back along in the non-peak direction. With the upgrades recommended in the previous section the road network can accommodate the proposed development.

The analysis completed through this study shows that the municipal street network can accommodate future travel demand for the area including the completed development. Two of the three connections to the surrounding 100-series highways are at capacity under current traffic volumes and will require additional study to evaluate improvements for regional traffic.

APPENDIX A – PROPOSED SITE PLAN

EILEEN STUBS AVE.

JOHN SAVAGE AVE.

WRIGHT AVENUE

FRENCHMAN LAKE

LOT C-1

COMMODORE DRIVE

FINLAY DRIVE

SHUBIE DRIVE

COSTCO

SCHOOL SITE 2.04 Ha / 5.04 acres

CANADIAN TIRE FFE ±52m

WALMART

COUNTRYVIEW DRIVE

PRELIMINARY

LEGEND

- Site Boundary
- Adjacent Property Boundary
- Existing Internal Boundary
- Proposed Property Boundary
- Wetland

SCALE:

0 20 40 100 200m

1 : 4,000

FILE: C:\Users\Ken Zwicker Zareski Architecture & Planning\Projects - Documents\2020\20-100 Dartmouth Crossing\20-100-06 Residential L1 and L2\4_PLAN\1_DWG\1_Site Plan\20-100-06-SITE_PLAN-110.dwg SHEET: Overall

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CLIENT
DARTMOUTH CROSSING LTD.

PROJECT
DARTMOUTH CROSSING : PAD 60 | FRENCHMAN LAKE
Dartmouth, Nova Scotia

DRAWING
OVERALL SITE PLAN

PROJECT NO. **20-100-06**
DRAWN BY: KJW
DATE: SEPTEMBER 19, 2023

DRAWING NUMBER
110

APPENDIX B – TRAFFIC COUNT DATA

See attached document "*Appendix B – Traffic Count Data*"

APPENDIX C – VISTRO REPORTS

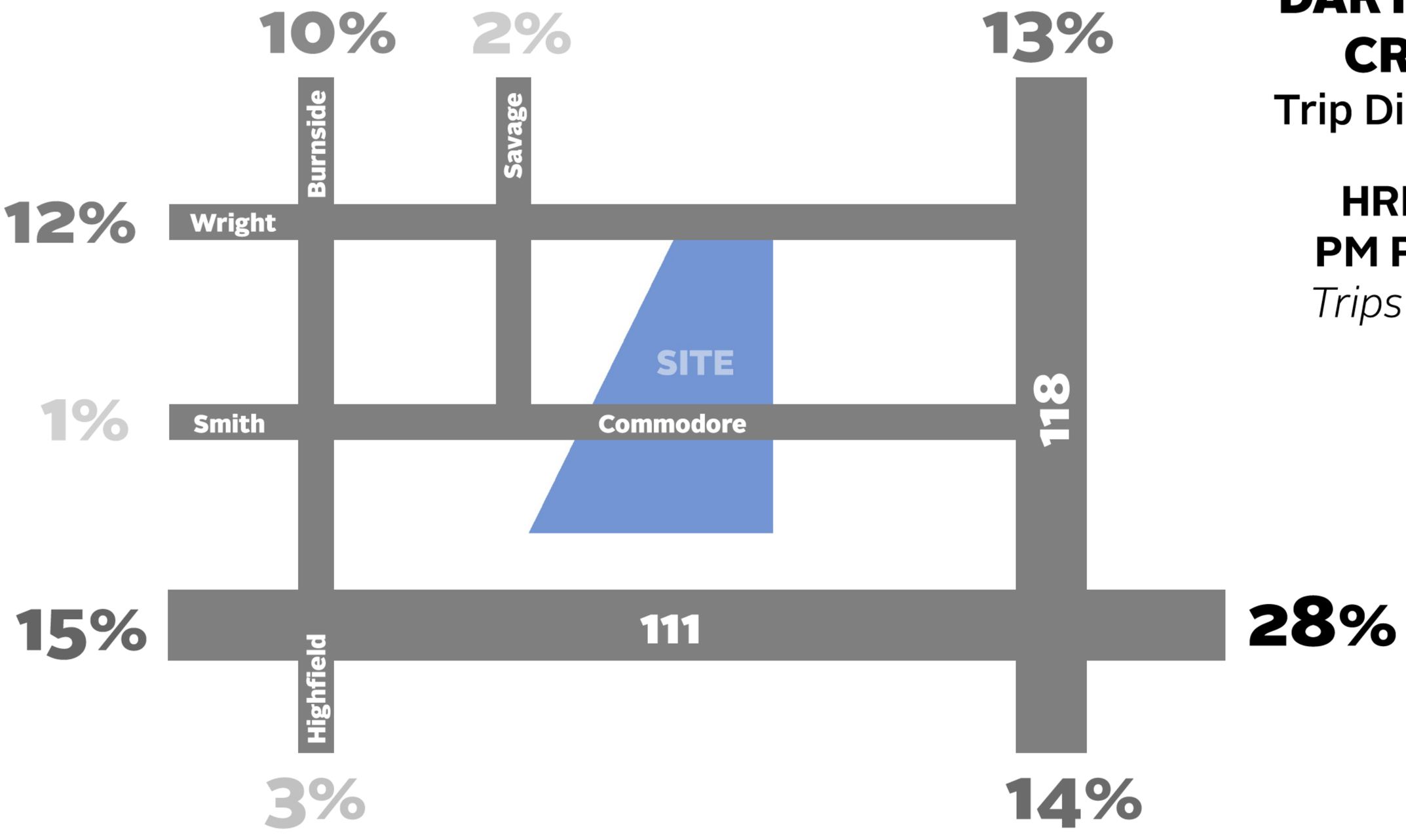
See attached document "*Appendix C – Vistro Reports*"

APPENDIX D – HRM TRIP DISTRIBUTION DATA

DARTMOUTH CROSSING

Trip Distribution

HRM MODEL
PM Peak Hour
Trips From Site

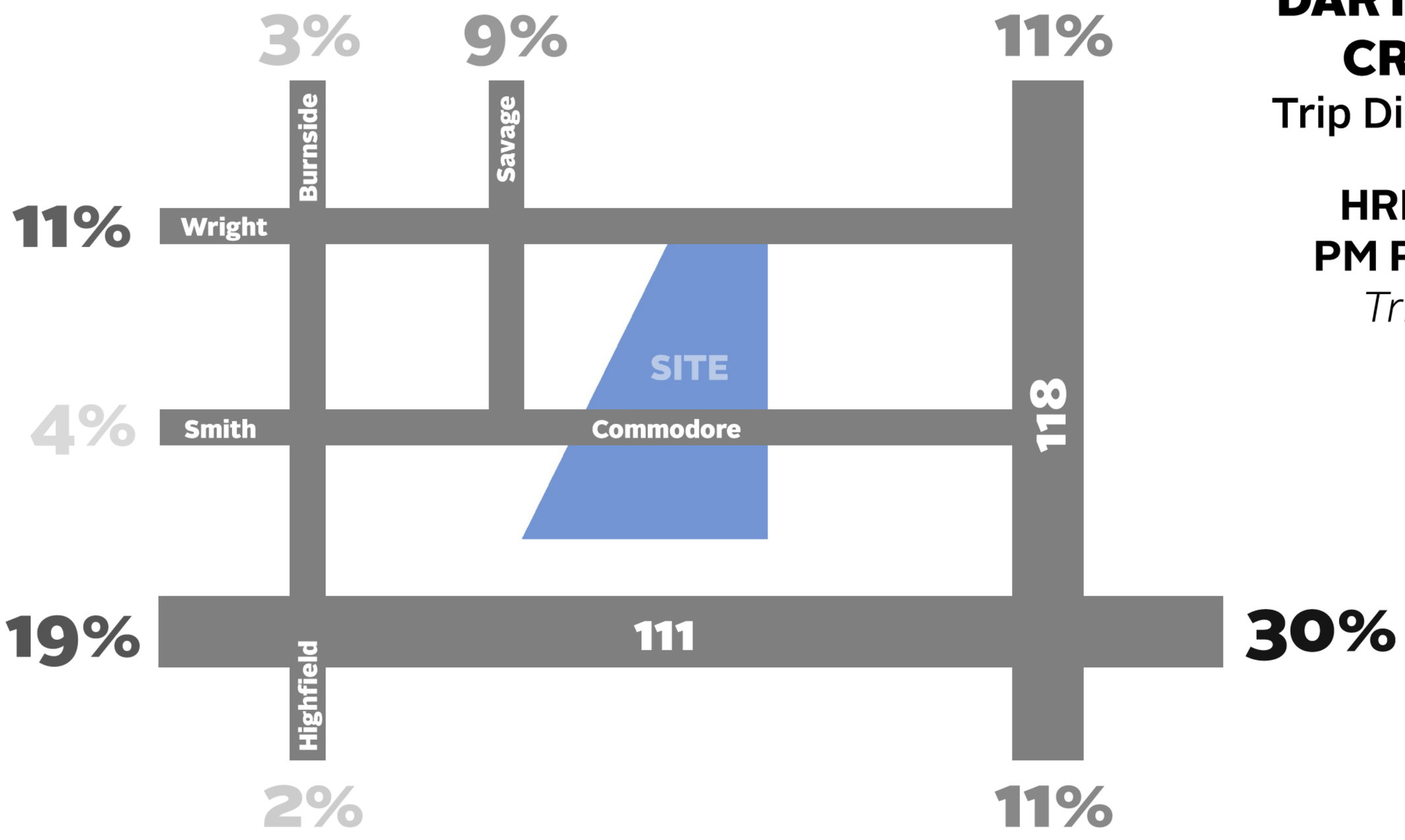


June 20, 2023

DARTMOUTH CROSSING

Trip Distribution

HRM MODEL
PM Peak Hour
Trips To Site

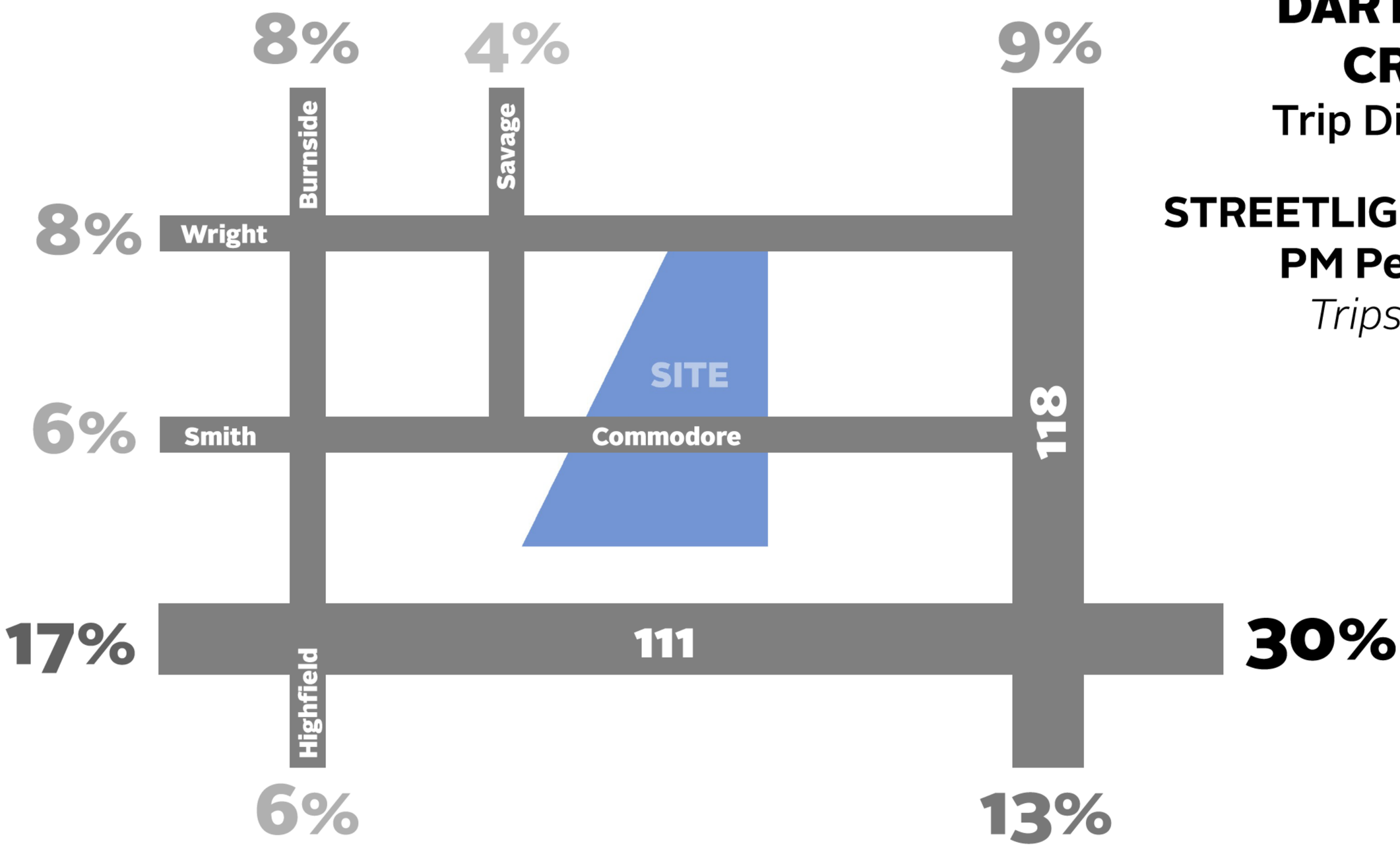


June 20, 2023

DARTMOUTH CROSSING

Trip Distribution

STREETLIGHT (2019)
PM Peak Period
Trips From Site

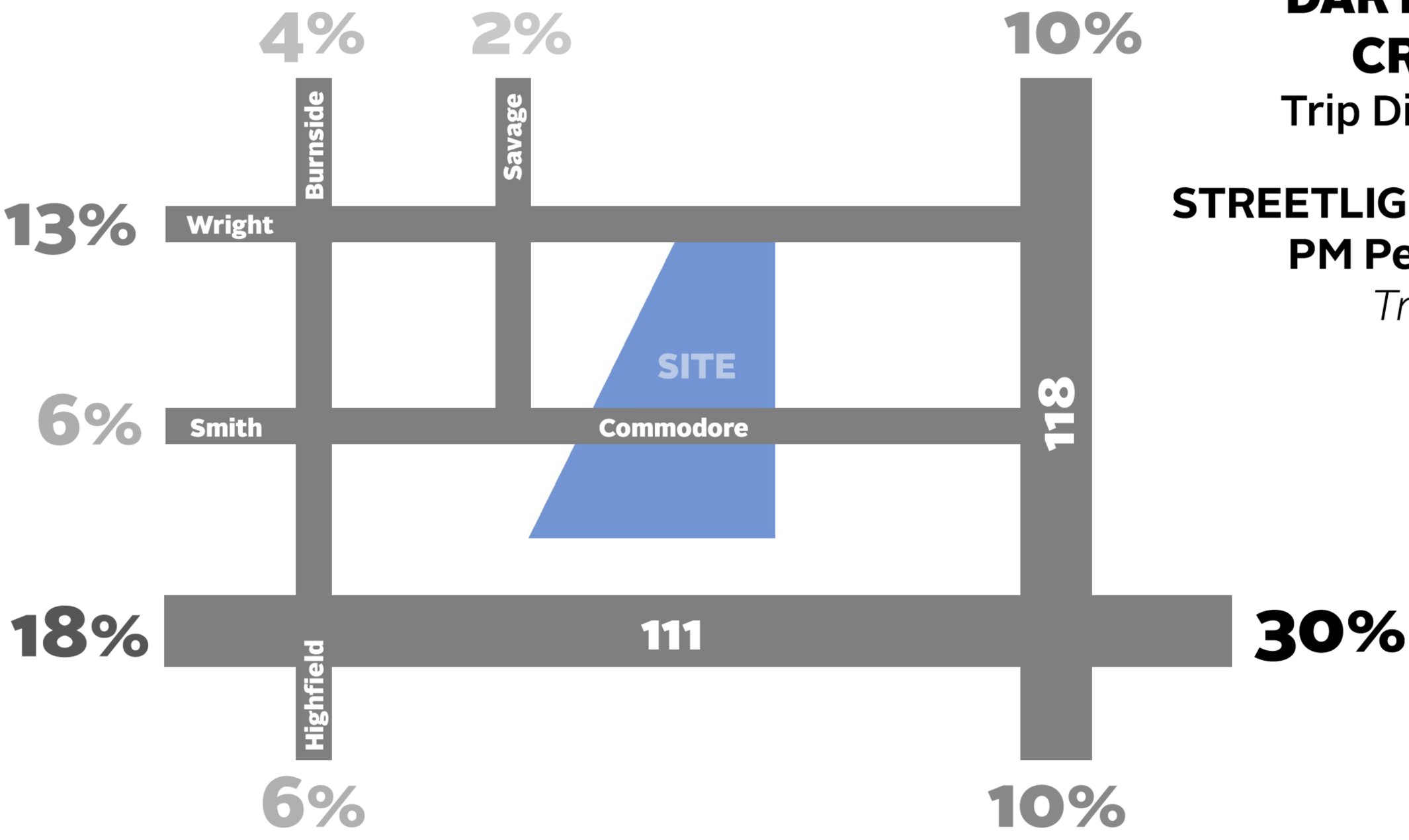


June 20, 2023

DARTMOUTH CROSSING

Trip Distribution

STREETLIGHT (2019)
PM Peak Period
Trips To Site

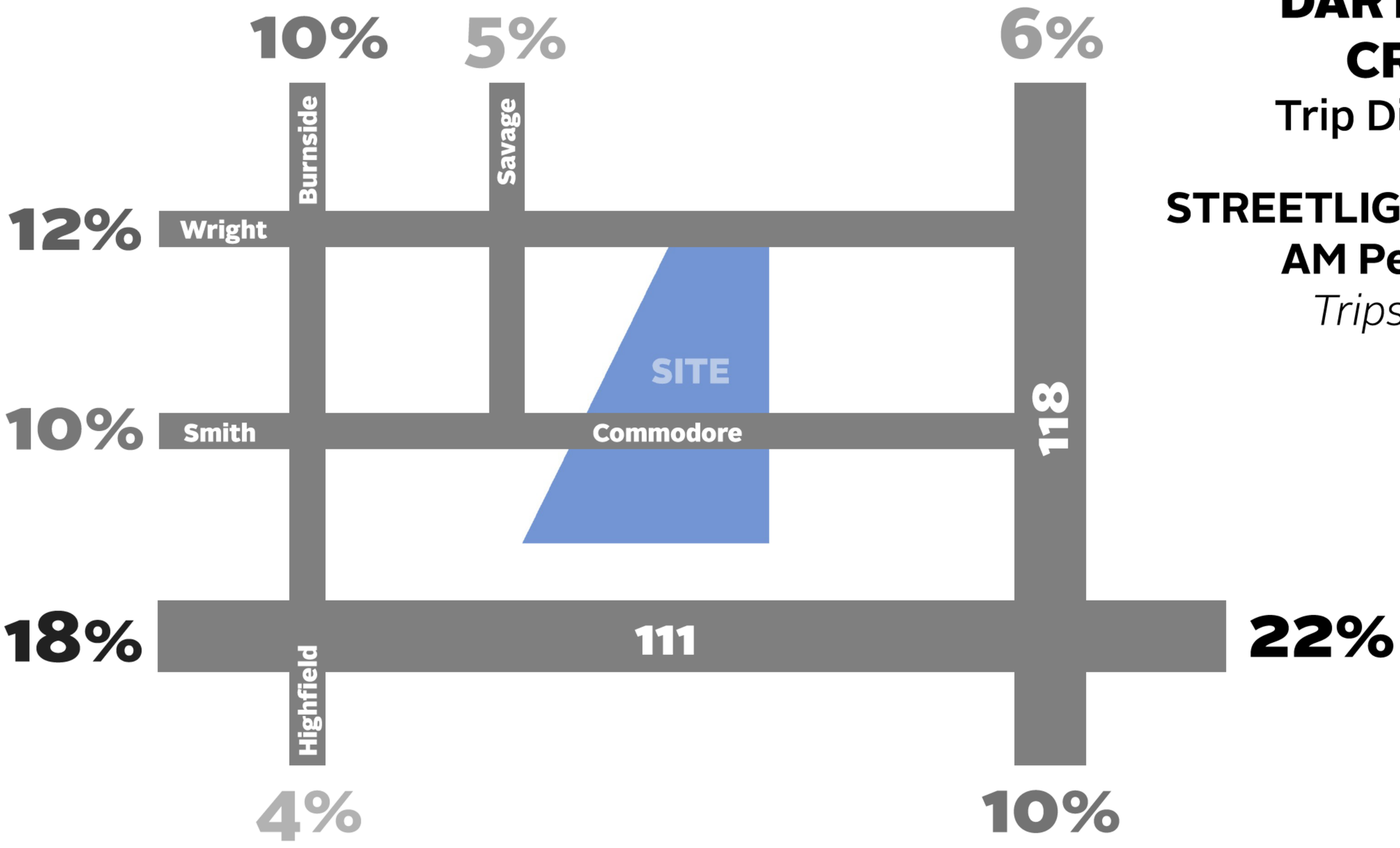


June 20, 2023

DARTMOUTH CROSSING

Trip Distribution

STREETLIGHT (2019)
AM Peak Period
Trips From Site



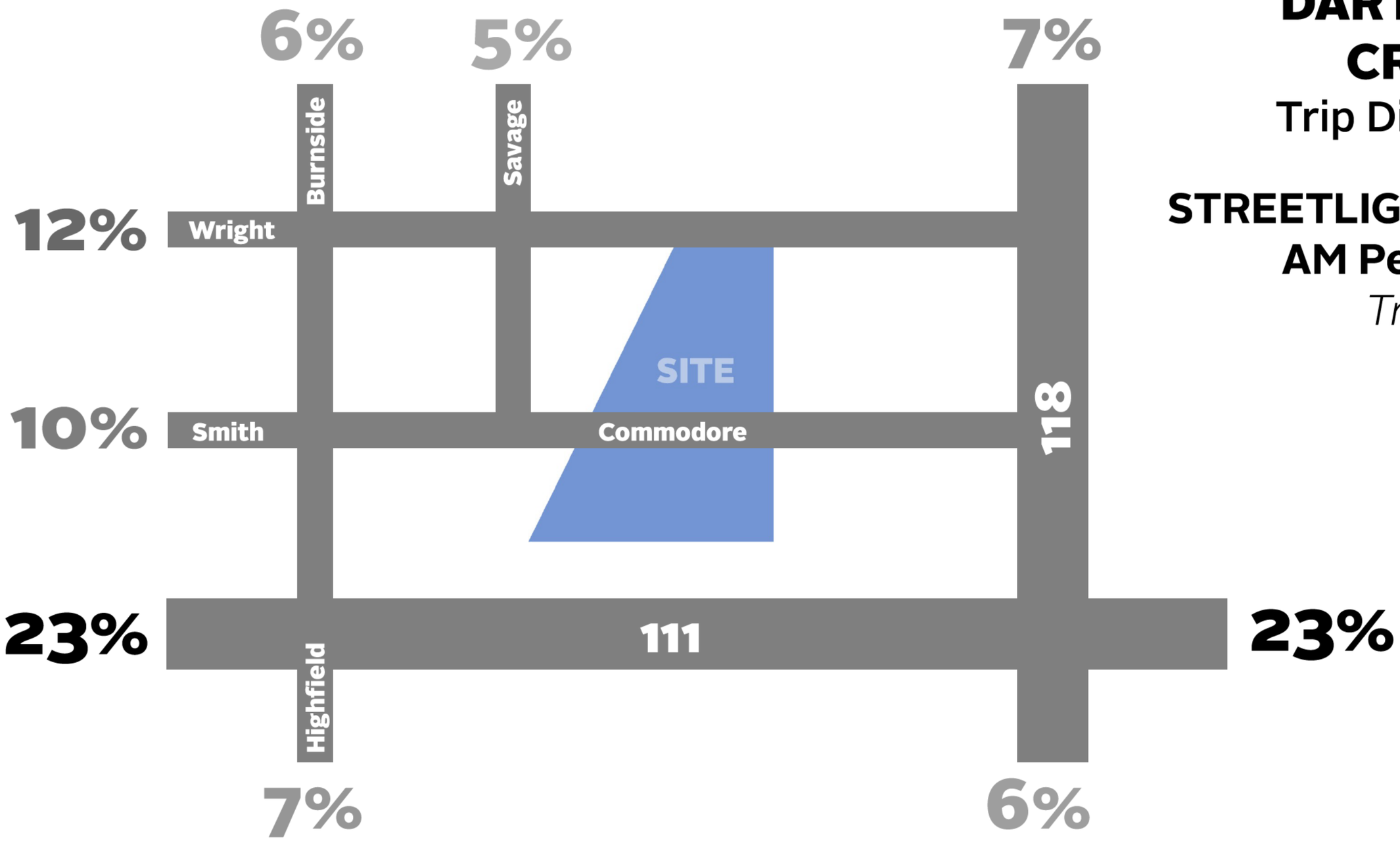
June 20, 2023

DARTMOUTH CROSSING

Trip Distribution

STREETLIGHT (2019)
AM Peak Period

Trips To Site

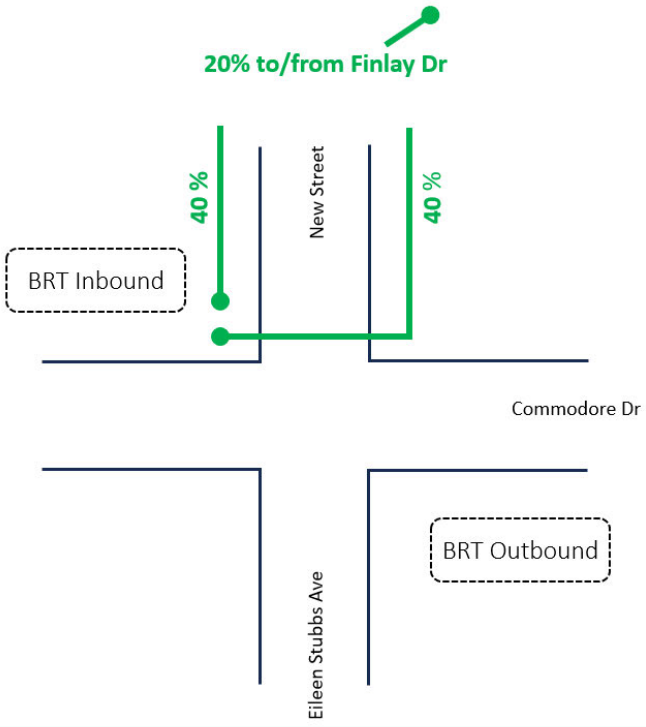


June 20, 2023

APPENDIX E – INTERNAL PEDESTRIAN TRIP DISTRIBUTION

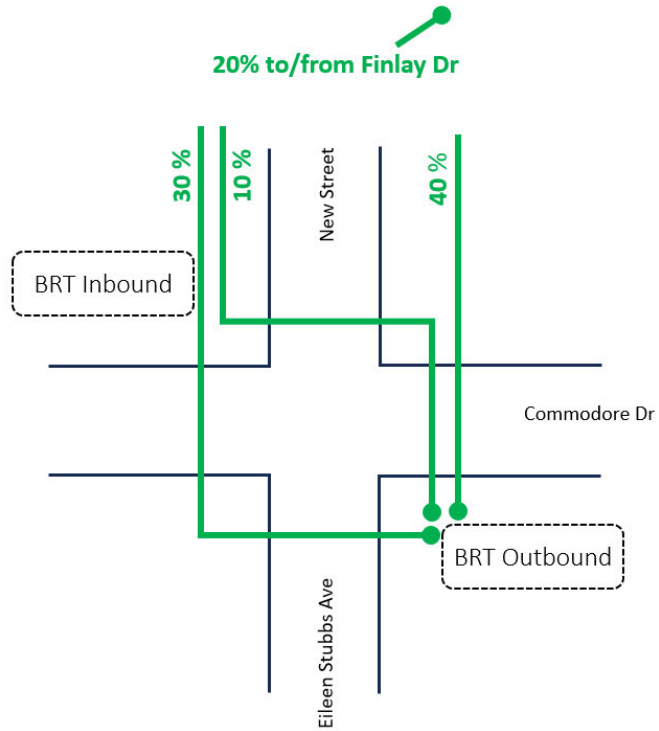
Transit Pedestrian Distribution

AM Peak Zone 1



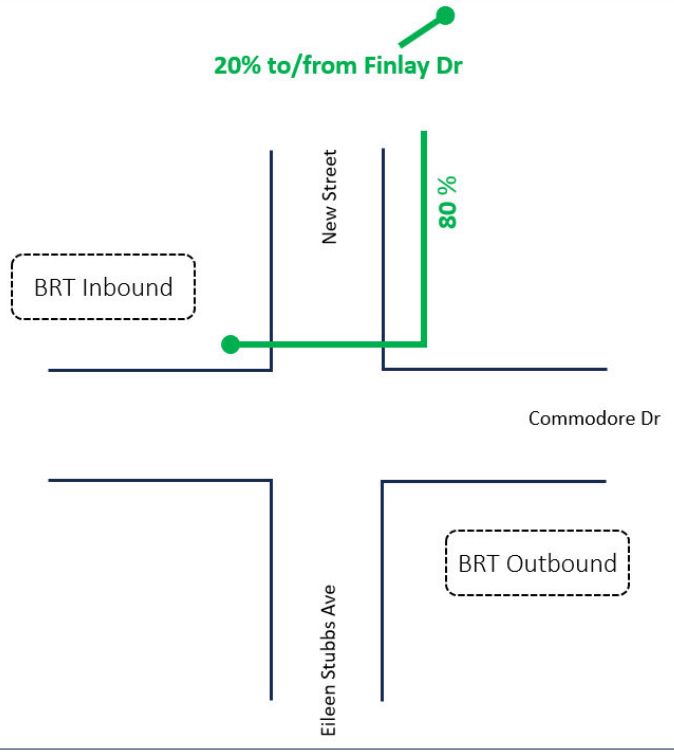
Transit Pedestrian Distribution

PM Peak Zone 1



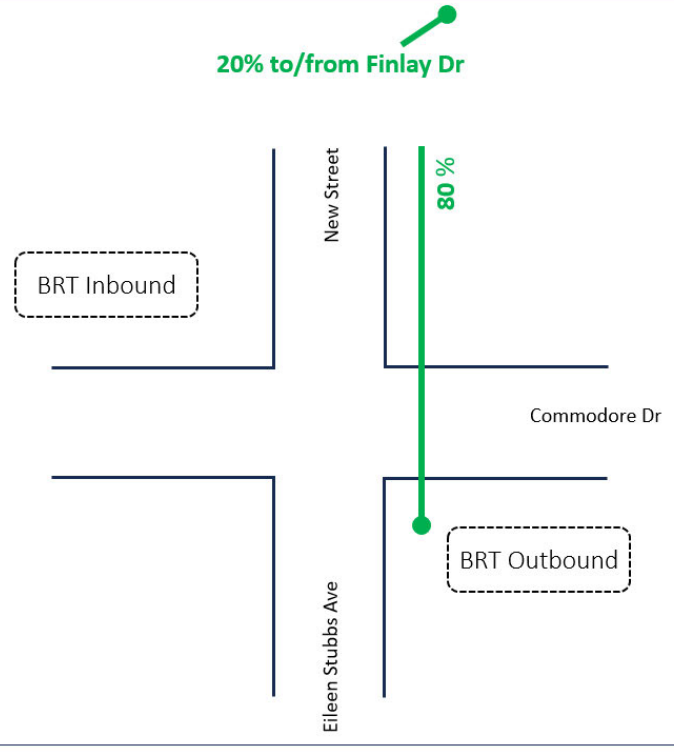
Transit
Pedestrian
Distribution

AM Peak
Zone 2



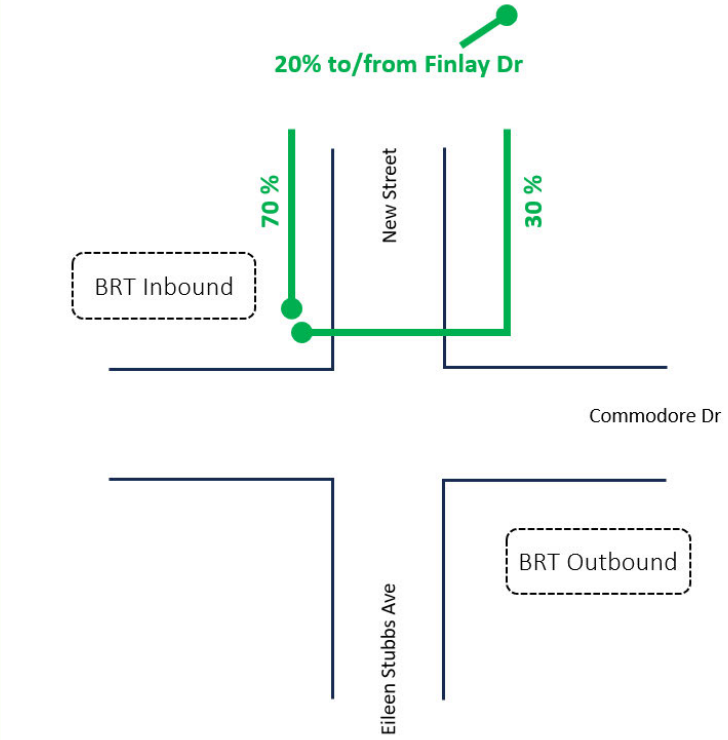
Transit
Pedestrian
Distribution

PM Peak
Zone 2



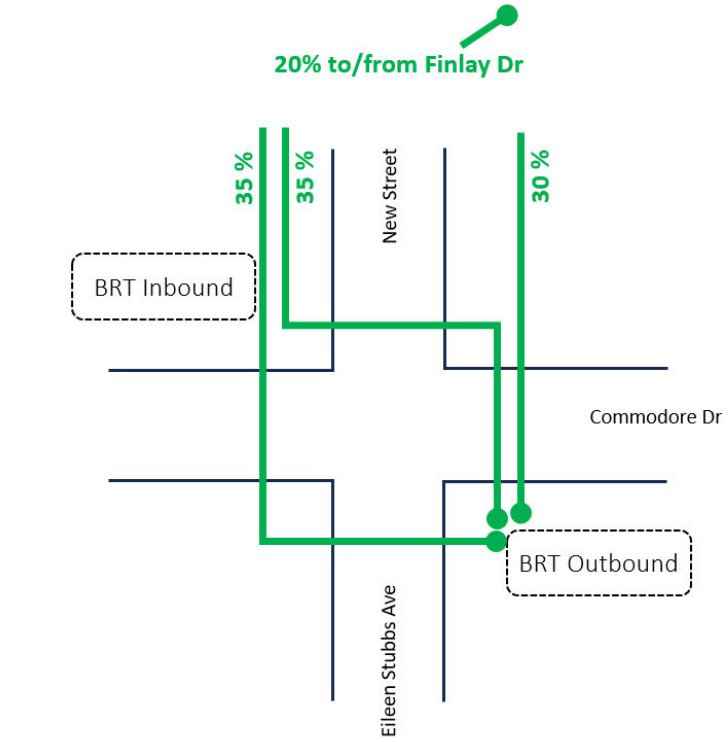
Transit Pedestrian Distribution

AM Peak Zone 3



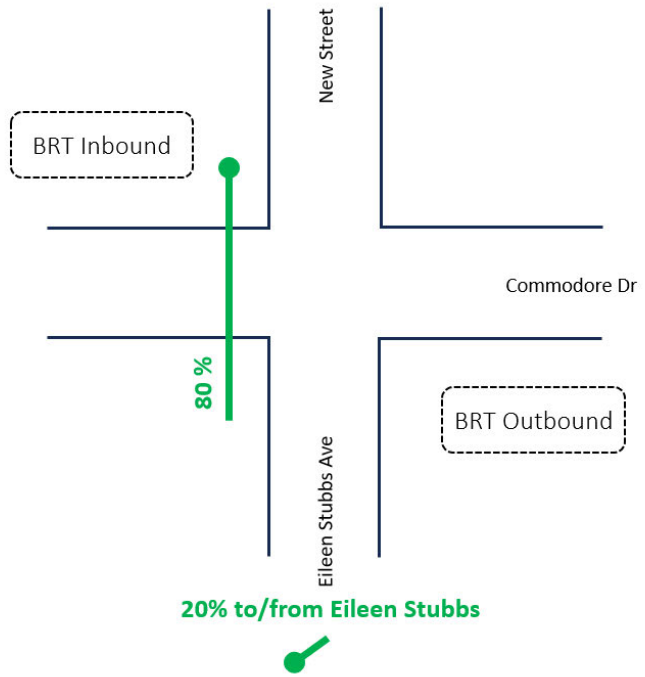
Transit Pedestrian Distribution

PM Peak Zone 3



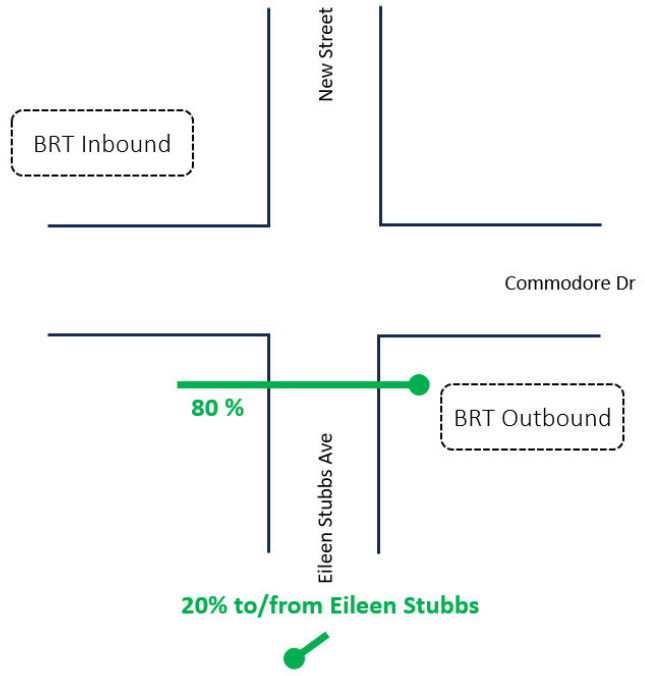
Transit Pedestrian Distribution

AM Peak Zone 4



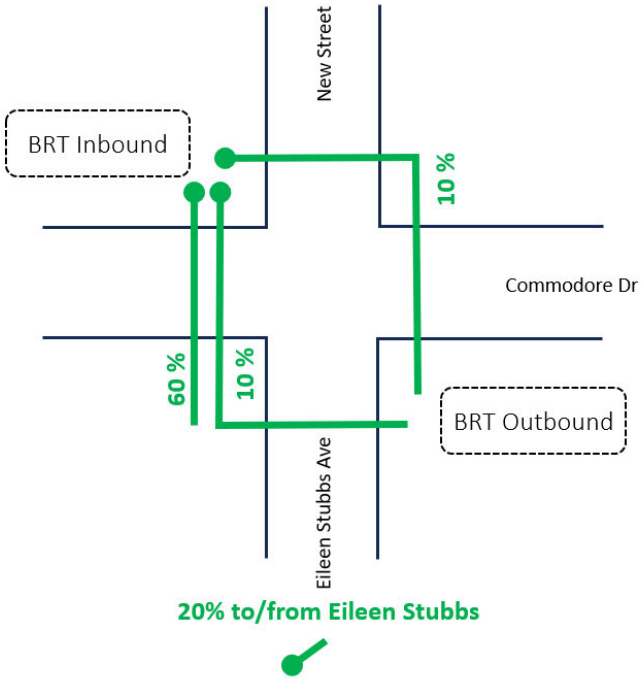
Transit Pedestrian Distribution

PM Peak Zone 4



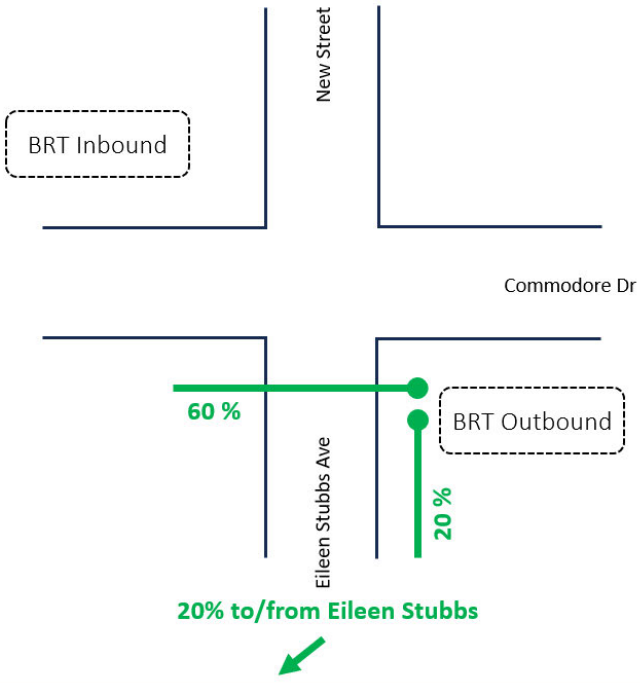
Transit Pedestrian Distribution

AM Peak Zone 5



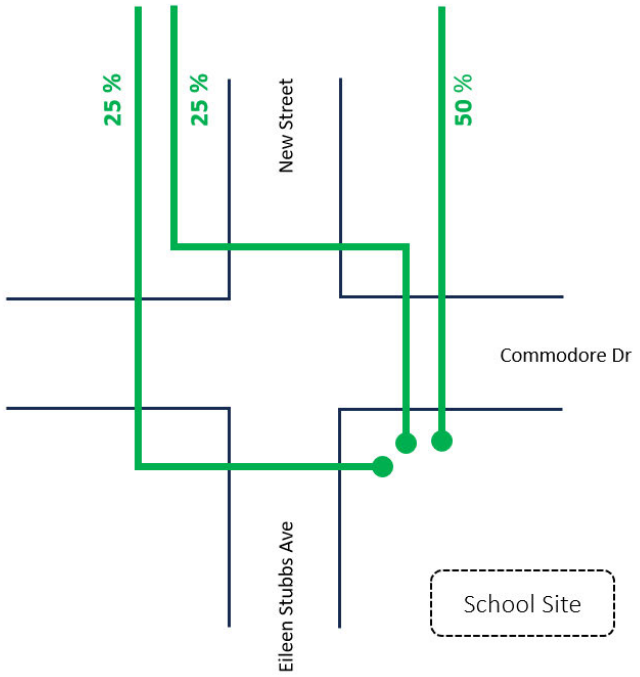
Transit Pedestrian Distribution

PM Peak Zone 5



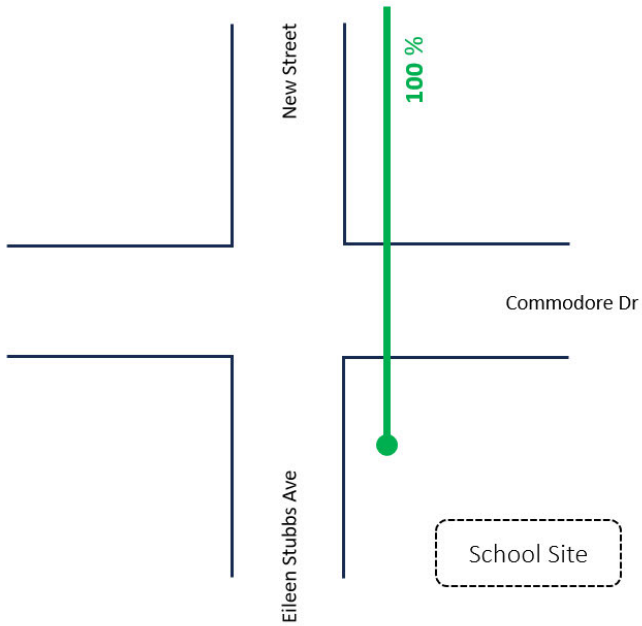
School Pedestrian Distribution

Zone 1



School Pedestrian Distribution

Zone 2



School Pedestrian Distribution

Zone 3

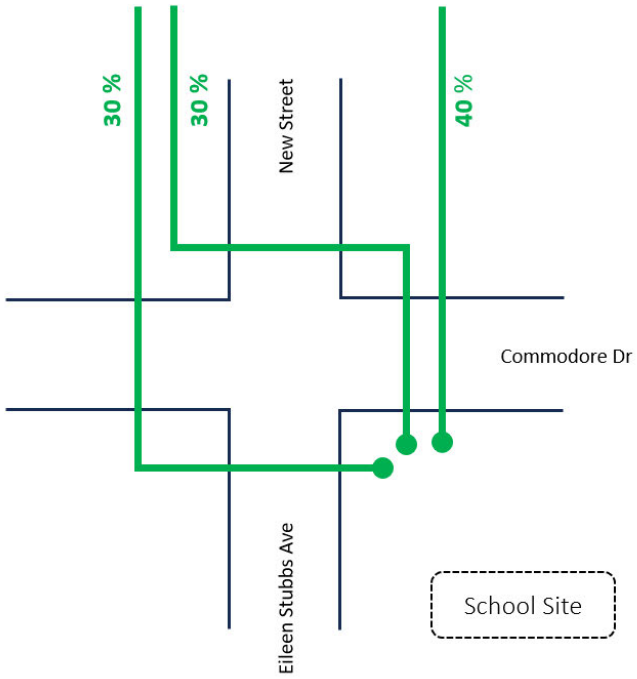


Table E-1 - Pedestrian Trips Generated per Zone

Zone	Trips Generated															
	Active Transportation				Transit				School				Total			
	AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
1	6	20	14	9	28	90	63	40	29	24	6	6	35	110	77	48
2	1	4	3	2	6	18	14	9	6	5	1	1	7	22	17	11
3	7	20	15	9	30	92	68	42	30	25	6	6	36	113	83	51
4	7	24	17	11	32	107	77	48	34	29	7	7	39	131	94	59
5	4	12	10	6	16	55	46	28	19	16	4	4	20	68	56	34
Total	**25**	**81**	**59**	**37**	**112**	**363**	**268**	**166**	**118**	**100**	**23**	**25**	**137**	**443**	**327**	**203**

Table 2 - Pedestrian Crossing Volumes at Commodore/Eileen Stubbs/New Street Intersection

Source	Zone	Ped Volume (In+Out)		Crossing %								Crossing Volume							
				New Street		Commodore East Leg		Eileen Subbs		Commodore West Leg		New Street		Commodore East Leg		Eileen Subbs		Commodore West Leg	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Transit	1	118	103	40%	10%		50%		30%		30%	47	10	0	51	0	31	0	31
	2	24	23	80%			80%					19	0	0	18	0	0	0	0
	3	122	110	30%	35%		65%		35%		35%	37	38	0	71	0	38	0	38
	4	138	124						80%	80%		0	0	0	0	0	100	111	0
	5	72	74	10%		10%		10%	60%	70%		7	0	7	0	7	44	50	0
School*	1	32	7	25%	25%	75%	75%	25%	25%	25%	25%	8	2	24	5	8	2	8	2
	2	7	1			100%	100%					0	0	7	1	0	0	0	0
	3	33	7	30%	30%	70%	70%	30%	30%	30%	30%	10	1	23	5	10	2	10	2
											Total School + Transit	129	51	61	153	25	217	179	73
											Assume - Additional 20 per crossing for AT out of/into area	20	20	20	20	20	20	20	20
											Total Peds	149	71	81	173	45	237	199	93

*Assume 60% of internal school trips are pedestrians

APPENDIX F – TRAFFIC SIGNAL WARRANTS

Halifax Regional Municipality - Traffic Signal & Pedestrian Signal Head Warrant Analysis

Main Street (name)	Commodore Drive
Side Street (name)	Eileen Stubbs Avenue
Quadrant / Int #	
Comments	2043 Total Traffic
Direction (EW or NS)	EW
Direction (EW or NS)	NS
Road Authority:	Halifax Regional Municipality
City:	Halifax
Analysis Date:	2023 Jul 11, Tue
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

CHECK SHEET

for Warrant Calculation Results, please hit 'Page Down'

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	RT Channelization (y/n)	UpStream Signal (m)	# of Thru Lanes	LT Phase Type	RTOR Allowed (y/n)	Actuated Thru Phase
Commodore Drive	WB	1		1		1			350	2			
Commodore Drive	EB	1		1		1			275	2			
Eileen Stubbs Avenue	NB	1		1		0	1	n	500	1			
Eileen Stubbs Avenue	SB	1		1			1	n	500	1			
							n						
							n						
Are the Commodore Drive WB right turns significantly impeded by through movements? (y/n)							n						
Are the Commodore Drive EB right turns significantly impeded by through movements? (y/n)							n						

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

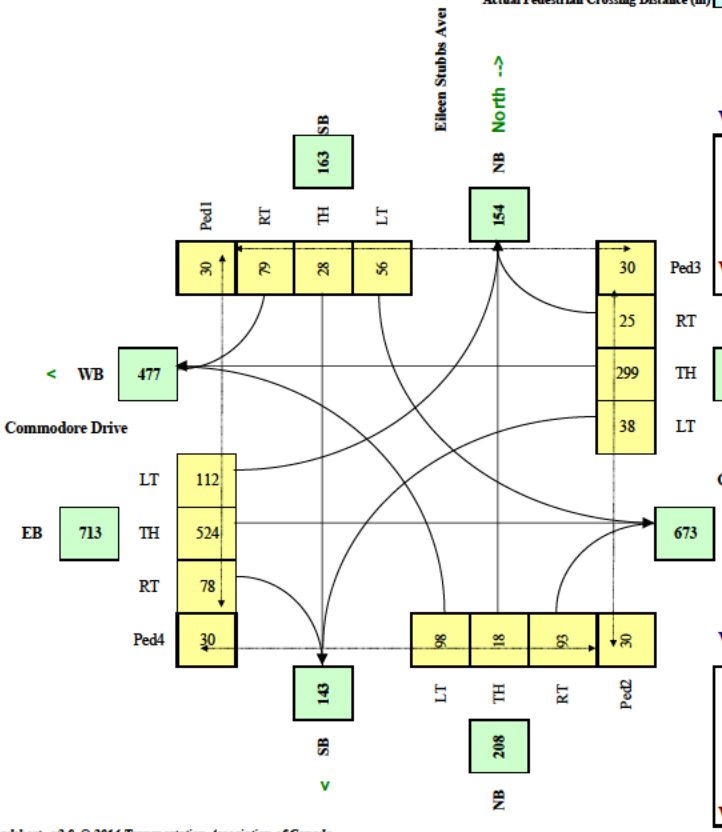
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	480,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Commodore Drive	EW	70	2.0%	n	0.0
Eileen Stubbs Avenue	NS		2.0%	n	0.0

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
07:00 - 09:00 11:00 - 13:00 16:00 - 18:00	115	10	120	55	20	115	10	320	25	40	190	60	30	30	30	30
	150	10	160	70	25	150	15	420	25	55	250	80	30	30	30	30
	65	15	55	40	25	40	40	210	25	115	535	65	30	30	30	30
	90	25	75	60	35	60	55	290	25	160	750	90	30	30	30	30
	100	25	85	65	35	65	60	325	25	175	830	100	30	30	30	30
	70	20	60	45	25	45	45	230	25	125	590	70	30	30	30	30
Total (6-hour peak)	590	105	555	335	165	475	225	1,795	150	670	3,145	465	180	180	180	180
Average (6-hour peak)	98	18	93	56	28	79	38	299	25	112	524	78	30	30	30	30
Actual Pedestrian Crossing Distance (m)													14.0	14.0	16.0	16.0

Average 6-hour Peak Turning Movements



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

W = 198 131 67

Veh *Ped*

Warranted

RESET SHEET

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

W = 73

Warranted - Complex Intersection

Traffic Signal Warrant Spreadsheet - v2.0 © 2014 Transportation Association of Canada

Halifax Regional Municipality - Traffic Signal & Pedestrian Signal Head Warrant Analysis

Main Street (name)	Commodore Drive
Side Street (name)	John Savage Ave
Quadrant / Int #	
Direction (EW or NS)	EW
Direction (EW or NS)	NS
Comments	2023 Existing Traffic
Road Authority:	Halifax Regional Municipality
City:	Halifax
Analysis Date:	2023 Jul 11, Tue
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

CHECK SHEET

for Warrant Calculation Results, please hit 'Page Down'

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	RT Channelization (y/n)	UpStream Signal (m)	# of Thru Lanes	LT Phase Type	RTOR Allowed (y/n)	Actuated Thru Phase
Commodore Drive	WB			1		1		n	650	2			
Commodore Drive	EB	1		2					450	2			
John Savage Ave	NB									0			
John Savage Ave	SB	1					1	n	750	0			

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

Are the Commodore Drive WB right turns significantly impeded by through movements? (y/n) — n

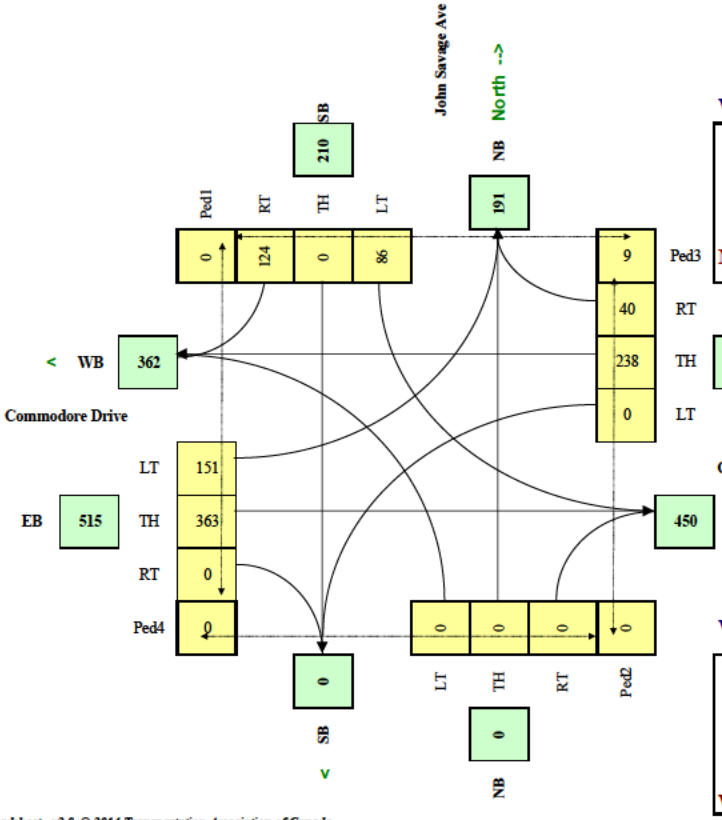
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	480,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Commodore Drive	EW	70	2.0%	n	0.0
John Savage Ave	NS		2.0%	n	0.0

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
07:00 - 09:00	0	0	0	18	0	85	0	223	23	182	116	0	0	0	1	0
11:00 - 13:00	0	0	0	62	0	128	0	315	47	161	135	0	0	0	0	0
16:00 - 18:00	0	0	0	86	0	107	0	178	47	119	355	0	0	0	18	0
	0	0	0	113	0	133	0	324	68	117	498	0	0	0	34	0
	0	0	0	141	0	204	0	224	29	211	579	0	0	0	1	0
	0	0	0	98	0	84	0	164	25	118	496	0	0	0	1	0
Total (6-hour peak)	0	0	0	518	0	741	0	1,428	239	908	2,179	0	0	0	55	0
Average (6-hour peak)	0	0	0	86	0	124	0	238	40	151	363	0	0	0	9	0
Actual Pedestrian Crossing Distance (m)													14.0	14.0	16.0	16.0

Average 6-hour Peak Turning Movements



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

W =	54	54	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

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

W = 49

Warranted - Complex Intersection

Traffic Signal Warrant Spreadsheet - v2.0 © 2014 Transportation Association of Canada

Halifax Regional Municipality - Traffic Signal & Pedestrian Signal Head Warrant Analysis

Main Street (name)	Commodore Drive
Side Street (name)	John Savage Ave
Quadrant / Int #	
Direction (EW or NS)	EW
Direction (EW or NS)	NS
Comments	2043 Background Traffic
Road Authority:	Halifax Regional Municipality
City:	Halifax
Analysis Date:	2023 Jul 11, Tue
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

CHECK SHEET

for Warrant Calculation Results, please hit 'Page Down'

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	RT Channelization (y/n)	UpStream Signal (m)	# of Thru Lanes	LT Phase Type	RTOR Allowed (y/n)	Actuated Thru Phase
Commodore Drive	WB			1		1		n	650	2			
Commodore Drive	EB	1		2					450	2			
John Savage Ave	NB									0			
John Savage Ave	SB	1					1	n	750	0			

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

Are the Commodore Drive WB right turns significantly impeded by through movements? (y/n): n

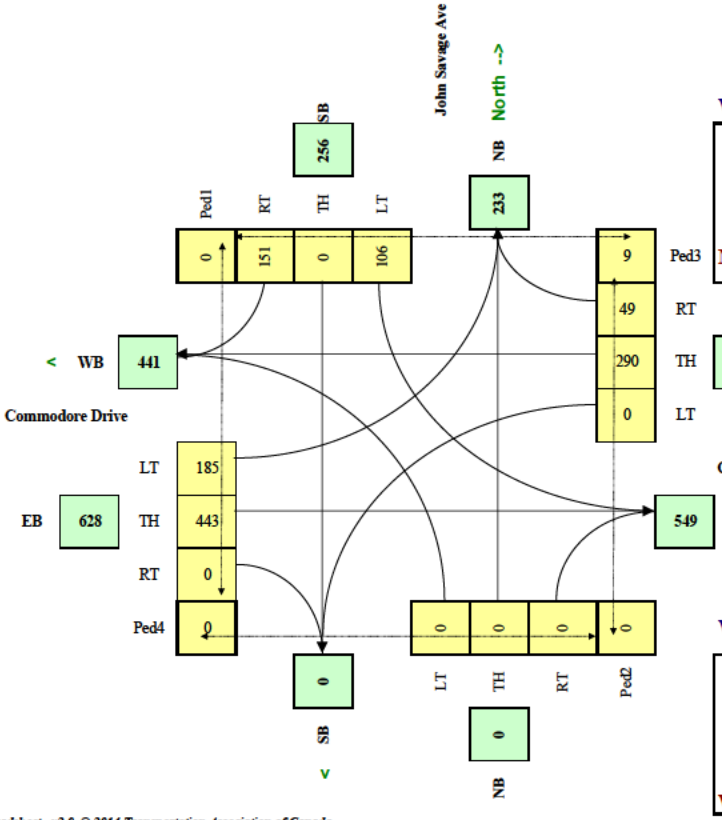
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	480,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Commodore Drive	EW	70	2.0%	n	0.0
John Savage Ave	NS		2.0%	n	0.0

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
07:00 - 09:00	0	0	0	22	0	104	0	272	28	222	142	0	0	0	1	0
11:00 - 13:00	0	0	0	76	0	156	0	384	57	196	165	0	0	0	0	0
16:00 - 18:00	0	0	0	105	0	131	0	217	57	145	433	0	0	0	18	0
	0	0	0	138	0	162	0	395	83	143	608	0	0	0	34	0
	0	0	0	172	0	249	0	273	35	257	706	0	0	0	1	0
	0	0	0	120	0	103	0	200	31	144	605	0	0	0	1	0
Total (6-hour peak)	0	0	0	633	0	905	0	1,741	291	1,107	2,659	0	0	0	55	0
Average (6-hour peak)	0	0	0	106	0	151	0	290	49	185	443	0	0	0	9	0
Actual Pedestrian Crossing Distance (m)													14.0	14.0	16.0	16.0

Average 6-hour Peak Turning Movements



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

W =	82	82	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

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

W = 59

Warranted - Complex Intersection

Traffic Signal Warrant Spreadsheet - v2.0 © 2014 Transportation Association of Canada

Halifax Regional Municipality - Traffic Signal & Pedestrian Signal Head Warrant Analysis

Main Street (name)	Commodore Drive
Side Street (name)	John Savage Ave
Quadrant / Int #	
Direction (EW or NS)	EW
Direction (EW or NS)	NS
Comments	2023 Existing Traffic
Road Authority:	Halifax Regional Municipality
City:	Halifax
Analysis Date:	2023 Jul 11, Tue
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

CHECK SHEET

for Warrant Calculation Results, please hit 'Page Down'

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	RT Channelization (y/n)	UpStream Signal (m)	# of Thru Lanes	LT Phase Type	RTOR Allowed (y/n)	Actuated Thru Phase
Commodore Drive	WB	1		1		1			650	2			
Commodore Drive	EB	1		1		1			450	2			
John Savage Ave	NB	1		1		0	1	n		1			
John Savage Ave	SB	1		1			1	n	750	1			
							n						
							n						
Are the Commodore Drive WB right turns significantly impeded by through movements? (y/n)							n						
Are the Commodore Drive EB right turns significantly impeded by through movements? (y/n)							n						

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

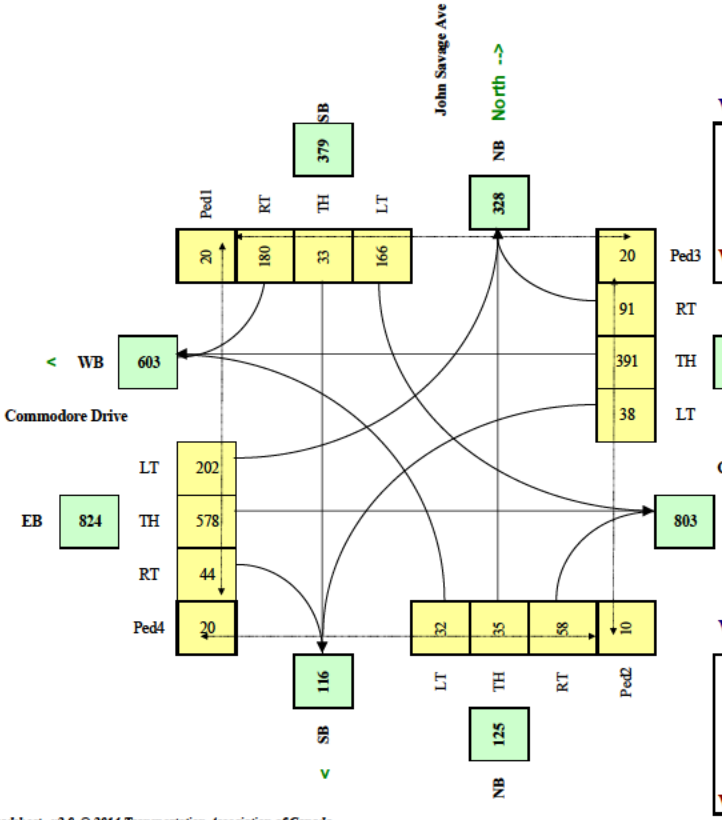
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	480,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Commodore Drive	EW	70	2.0%	n	0.0
John Savage Ave	NS		2.0%	n	0.0

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
07:00 - 09:00 11:00 - 13:00 16:00 - 18:00	35	45	50	80	25	115	15	465	115	165	185	5	20	10	10	20
	45	60	70	105	30	155	15	610	150	215	240	5	20	10	10	20
	20	20	45	160	30	160	40	250	55	165	600	50	20	10	30	20
	30	30	65	225	40	225	55	355	80	230	845	70	20	10	50	20
	35	30	70	250	45	250	60	390	85	255	935	80	20	10	10	20
	25	25	50	175	30	175	45	275	60	180	665	55	20	10	10	20
Total (6-hour peak)	**190**	**210**	**350**	**995**	**200**	**1,080**	**230**	**2,345**	**545**	**1,210**	**3,470**	**265**	**120**	**60**	**120**	**120**
Average (6-hour peak)	**32**	**35**	**58**	**166**	**33**	**180**	**38**	**391**	**91**	**202**	**578**	**44**	**20**	**10**	**20**	**20**
													Actual Pedestrian Crossing Distance (m)			
													14.0	14.0	16.0	16.0

Average 6-hour Peak Turning Movements



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

W =	284	240	44
		Veh	*Ped*

Warranted

RESET SHEET

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

W = 68

Warranted - Complex Intersection

Traffic Signal Warrant Spreadsheet - v2.0 © 2014 Transportation Association of Canada

APPENDIX G – VISSIM CORRIDOR ANALYSIS

James J. Copeland, P.Eng., RSP1
GRIFFIN transportation group inc.
30 Bonny View Drive
Fall River, NS B2T 1R2

April 3, 2024

Att: Ellen Dalton, P.Eng.
DesignPoint Engineering & Surveying
500-90 Western Parkway
Bedford, NS B4B 2J3

RE: VISSIM Corridor Simulation – Commodore Drive

1.0 INTRODUCTION

1.1 – Overview

DesignPoint has recently completed a mobility assessment of a large residential growth area on vacant lands in the vicinity of the Commodore Drive / John Savage Drive intersection, in the Burnside Business Park. As part of this study, HRM has requested that a corridor-level microsimulation analysis be carried out to understand the future traffic flow interactions between intersections – and whether it is feasible to implement managed lanes in the area to support their Rapid Transit Strategy (RTS).

To meet these HRM requirements, *DesignPoint* has engaged the GRIFFIN transportation group inc. (GRIFFIN) to complete the corridor-level microsimulation analysis. Our analysis was based on the following key inputs:

- Future 2043 full build-out traffic volume forecasts developed by *DesignPoint*.
- A set of intersection lane configurations at the critical intersections along the RTS route provided by *DesignPoint*, as reported in their mobility analysis report.

1.2 – Study Area Intersections

GRIFFIN has been tasked with conducting a traffic microsimulation analysis of the Commodore Drive and Burnside Drive corridors that include the following intersections:

Table 1: Study Area Intersections

All Intersections Included in Simulation Models	
RTS Route - Critical Intersections	**Outer Area Intersections**
• Commodore Dr / Burnside Dr • Commodore Dr / Brownlow Dr • Commodore Dr / Eileen Stubbs-Spectacle Lake • Commodore Dr / John Savage Dr • Commodore Dr / New Access	• Highway 111 / Burnside Dr signalized ramp intersections, • Commodore Dr / Finlay Dr • Commodore Dr / Countryview Dr

Our analysis focused on the critical signalized intersections along the Rapid Transit Strategy route. These particular intersections were examined explicitly, and detailed results were extracted from the VISSIM models. The outer area intersections were included in the VISSIM model but were considered to be less critical to the focus of our analysis process.

1.3 – Our Analysis Approach

The main objective of our microsimulation modeling was to validate the isolated intersection analysis results prepared by *DesignPoint*, as well as identify any corridor traffic flow issues with future managed transit bus lanes installed along Commodore Drive in select locations.

To meet these objectives, and work with the available information provided by DesignPoint, GRIFFIN examined the following future conditions using the VISSIM microsimulation software tool:

Table 2: VISSIM Analysis Scenarios

	VISSIM Analysis Scenarios	
Road Layout Alternatives	**Future Full Build-out AM Peak Hour**	**Future Full Build-out PM Peak Hour**
Existing Roads and Existing Lane Configurations	*n/a*	*n/a*
Existing Roads and Modified Lane Configurations: - New Signalized Intersection - RTS Lanes on Commodore	✓	✓

2.0 THE SIMULATION MODELLING

2.1 – Future Year Traffic Volumes

As noted earlier in this letter, *DesignPoint* provided the future year full build-out traffic volumes forecasts to GRIFFIN, to be included in their VISSIM models. The *DesignPoint* volumes were referenced from their most recently published March 28, 2024 Mobility Analysis report. We have provided these same volumes in *Figures 1* and *2* below.

Figure 1: Future 2043 Volumes – AM Peak Hour (developed by DesignPoint)

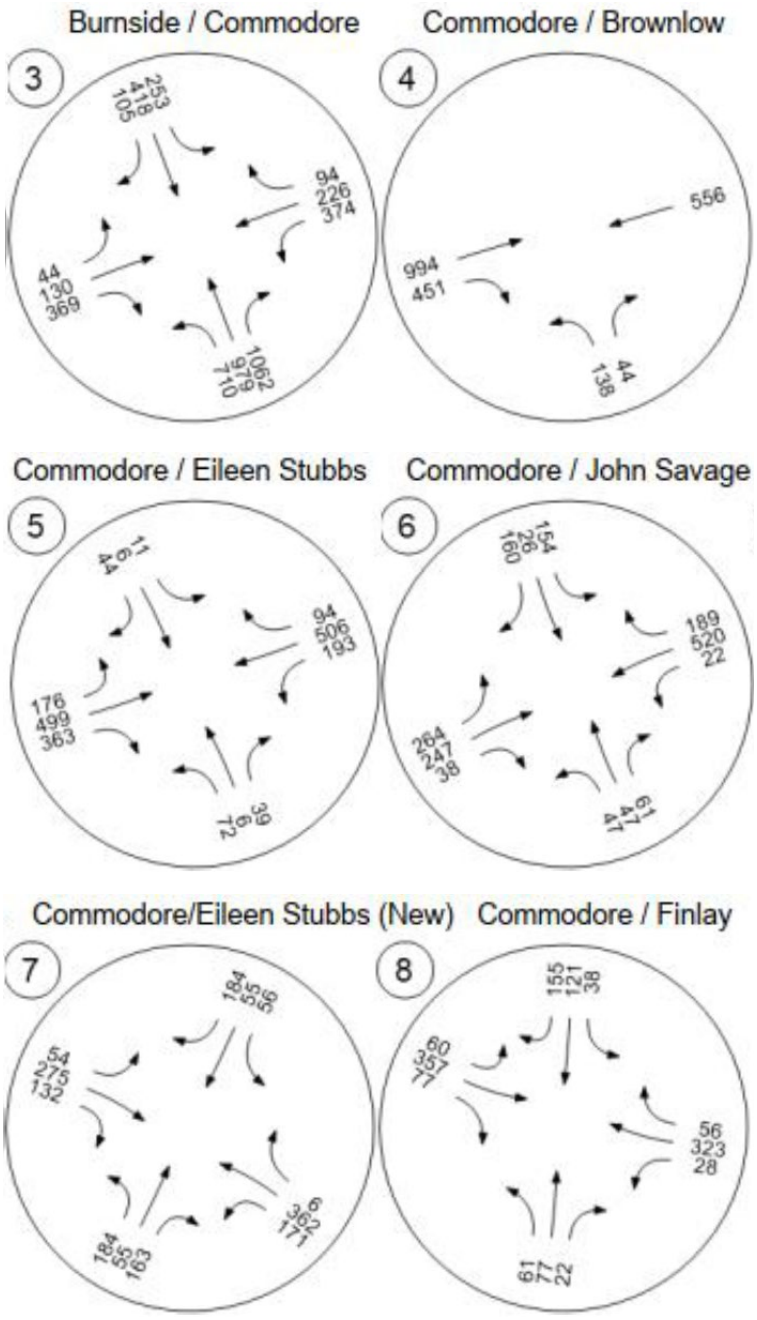
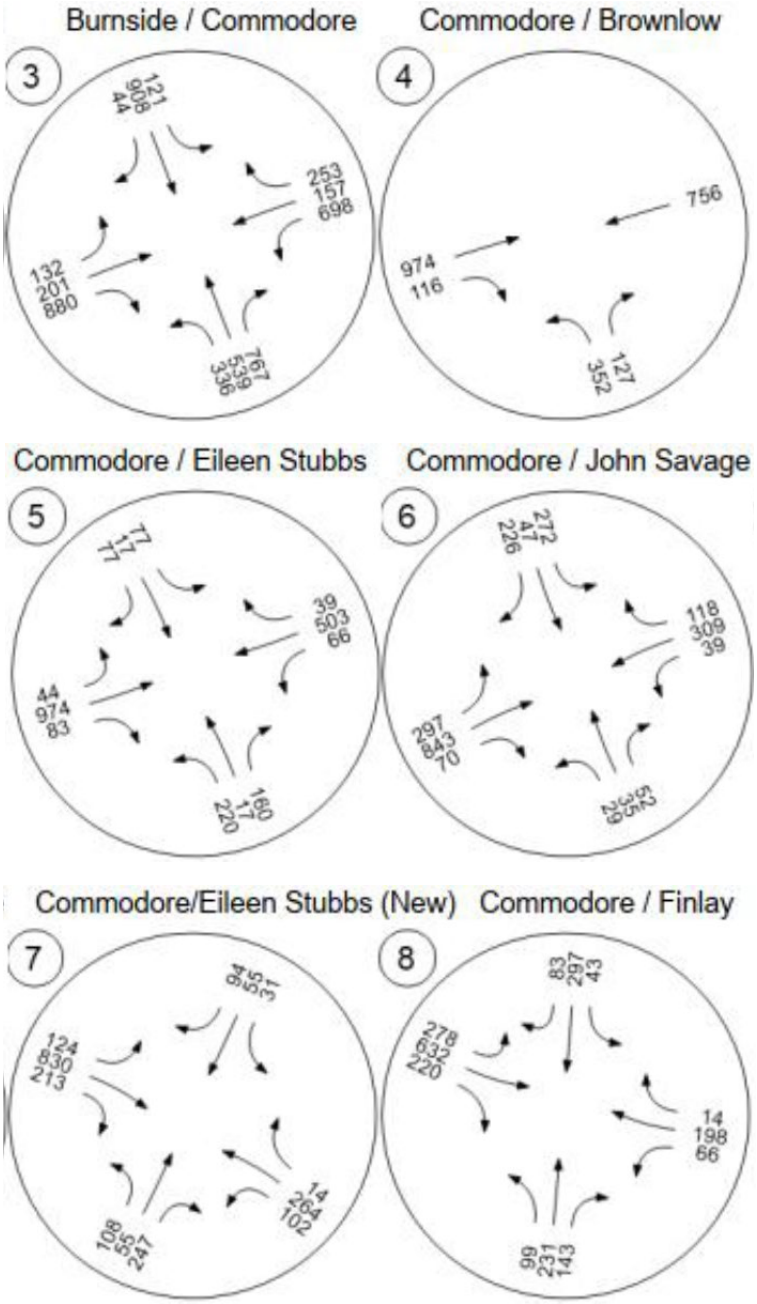


Figure 2: Future 2043 Volumes – PM Peak Hour (developed by DesignPoint)



The weekday 2043 AM and PM peak hour volumes developed by *DesignPoint* were applied to the VISSIM simulation assessment. It should be noted that these peak volumes were incorporated into the VISSIM models via export files from *DesignPoint's* VISTRO software. Thus, the 2043 volumes include all vehicle types (eg. cars, buses, trucks) and does not provide a breakdown of the expected future year transit bus volumes moving through the study area intersections. As such, GRIFFIN did

not have the necessary data to explicitly examine transit bus performance results – particularly along HRM's proposed RTS route.

It should be noted that *DesignPoint* made slight adjustments to the westbound left turning volumes at the Browlow Avenue and Eileen Stubbs-Spectacle Lake Drive intersections. These adjustments were made to mitigate operational issues identified in the VISSIM modelling results at Brownlow Avenue – due in part to the lack of a westbound auxiliary turn lane at the Brownlow Avenue intersection. As such, *DesignPoint* updated the peak hour traffic volumes for this movement which resulted in no westbound left turns at Brownlow and a slight increase in left turns at the upstream Eileen Stubbs-Spectacle Lake intersection. GRIFFIN did not update the VISSIM model results to reflect this minor volume adjustment as it was estimated to have little to no impact on the overall VISSIM analysis results, findings, and conclusions.

2.2 – The Model Structure

Typically, a microsimulation modeling study starts with the development and calibration of an existing conditions model, and then future conditions models stem from this starting point. This initial step was not possible to execute given the project time constraints and the fact that GRIFFIN was not provided with the necessary model inputs until February 28th, 2024. Therefore, to ensure a reasonable delivery time, GRIFFIN obtained the necessary model input information by having *DesignPoint* export their VISTRO software results. GRIFFIN then imported the VISTRO software information into the VISSIM simulation software. This process enabled GRIFFIN to establish the intersection lane configurations, future year full build-out volumes, and traffic signal timing and phasing relatively quickly which helped to expedite the microsimulation analysis timeline.

For this study, GRIFFIN applied the latest version of PTV's VISSIM simulation software (version 2024).

2.3 – Executing the Model

GRIFFIN followed Federal Highway Administration (FHWA) simulation modelling guidelines and best practices when executing the simulation models and producing the simulation results. This included the following:

- The use of a 900 second simulation "seed time",
- A total of five (5) separate simulation runs were executed and the five different random numbers were applied to both the future AM and PM peak hour simulations.
- The results flowing from each of the five model runs were assembled and average results quantified.

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3.0 ANALYSIS RESULTS

3.1 – Overview

Once the model runs were completed GRIFFIN extracted and summarized the results. There were two key metrics examined using the VISSIM simulation results:

- *Intersection Level of Service (LOS) and average intersection delay*: The critical Commodore Drive corridor intersections were included in this evaluation as these junctions had the greatest potential to impact the future success of the Rapid Transit Strategy (RTS).
- *Corridor Travel Times*: The time required for a vehicle to travel through the study area was recorded. GRIFFIN used a 1.8km route from immediately north of the Highway 111 interchange, along Burnside Drive, then along Commodore Drive to immediately east of the new signalized intersection.

A discussion of the findings from both evaluations is provided in the next Sections.

3.2 – Intersection Delay Times

The overall intersection delay times and corresponding levels of service were extracted from the VISSIM models at the critical Commodore Drive corridor intersections. These critical intersections included Burnside Drive, Brownlow Avenue, Eileen Stubbs-Spectacle Lake, John Savage Drive, and the new signalized access.

The initial 2043 signal timing and phasing at these intersections resulted in long vehicle queues in the peak travel direction along Commodore Drive. This created queue spillbacks into the upstream intersection – particularly at the closely spaced intersections of Burnside Drive, Brownlow Avenue, and Eileen Stubbs. Therefore, GRIFFIN conducted an iterative traffic signal optimization process to modify the signal timing and phase sequences to allow for better vehicle progression and flow. This alleviated the likelihood of queue spillbacks into the upstream intersections and generally managed the queues at adequate levels throughout the simulation period. It should be noted that our analysis assumed managed bus-only lanes were installed from immediately east of Eileen Stubbs-Spectacle Lake through to east of the new signalized access. Our VISSIM results for each simulation run are provided in the *Appendix*.

The resulting preferred future signal timing and phasing sequences were applied to the VISSIM analysis. GRIFFIN has prepared a summary of these future 2043 results with the RTS managed bus lanes in place, and compared these intersection delay results with the existing 2023 intersection delays – referenced from *DesignPoint's* March 2024 report.

Figure 3: Critical Intersection Delay Time Comparison – AM Peak Hour

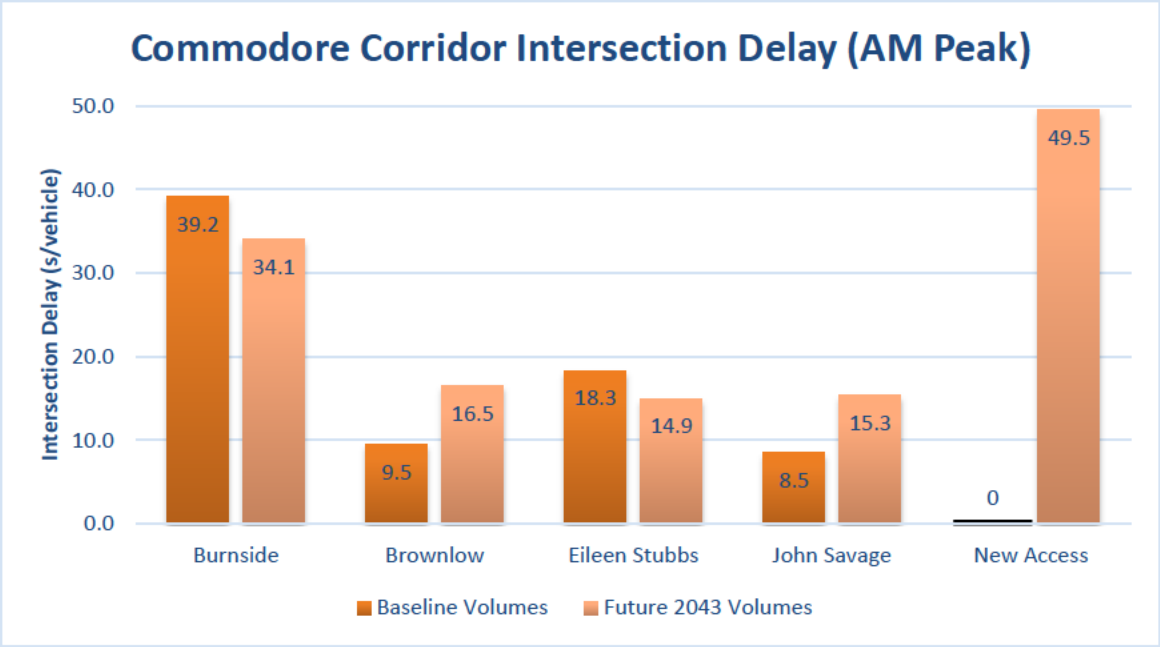
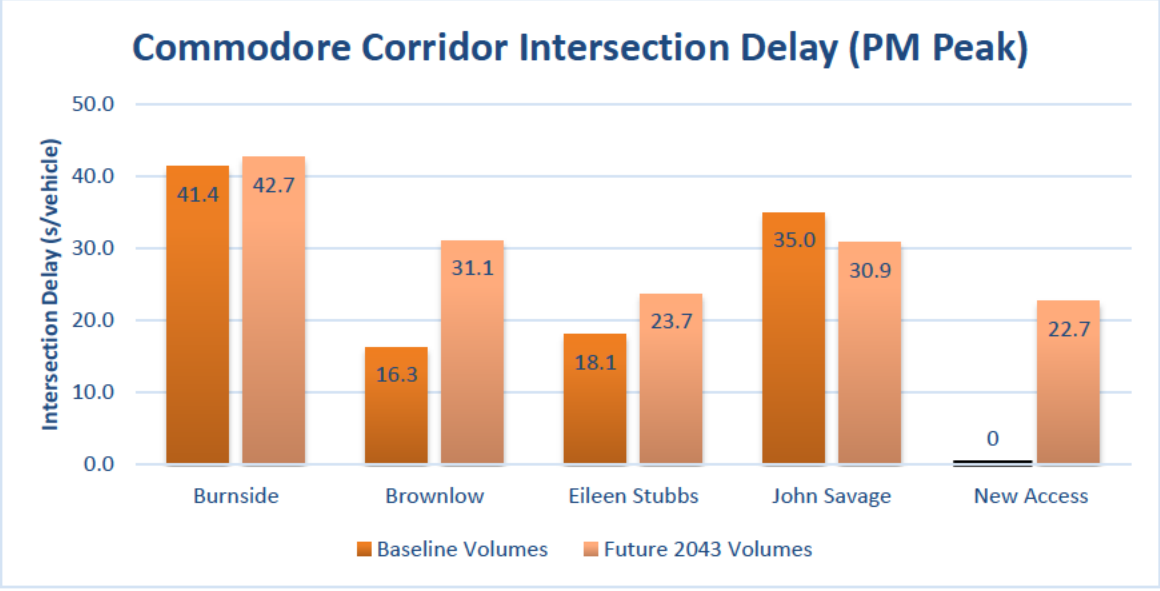


Figure 4: Critical Intersection Delay Time Comparison – PM Peak Hour



As shown in *Figures 3* and *4*, the before and after comparison of the intersection delay times suggests that GRIFFIN's recommended signalized timing plans at the critical corridor intersections is expected to generally maintain existing levels of service for general traffic. Obviously, the implementation of the RTS managed bus lanes and any additional bus queue jump opportunities

would allow transit users to travel through the corridor with less delay relative to single-occupant vehicles.

The recommended future traffic signal timing plans for each of the critical corridor intersections are provided in the Appendix. The other study area signalized intersections not specifically referenced in *Figures 3* and *4* can utilize the signal timing plans that are proposed in *DesignPoint's* mobility analysis report.

3.3 – Corridor Travel Times

The second corridor performance assessment examined the vehicle travel times through the corridor. This is a relative and tangible metric that is relatable to drivers. Similar to the previous assessment, GRIFFIN compared the future 2043 simulated corridor travel times with those experienced today. The comparative summary is provided in *Figures 5* and *6*.

Figure 5: Vehicle Corridor Travel Times – AM Peak Hour

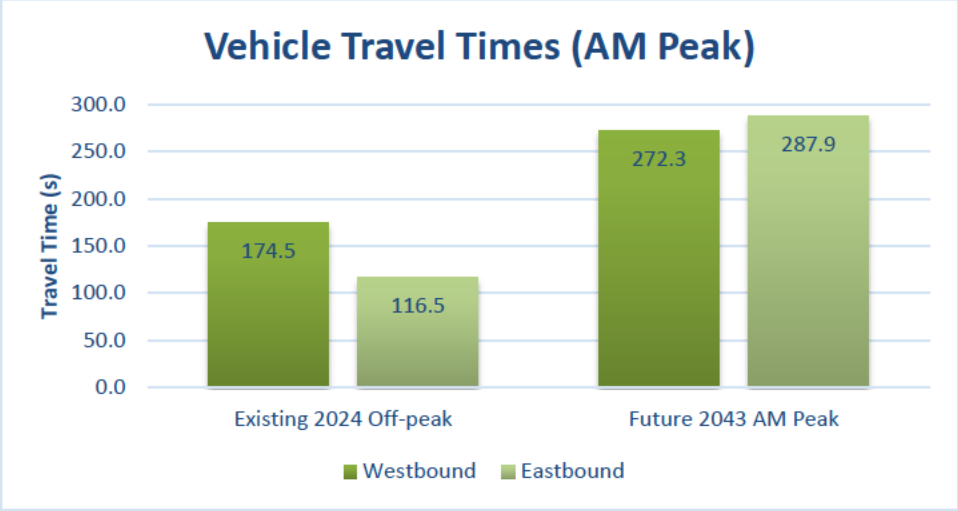
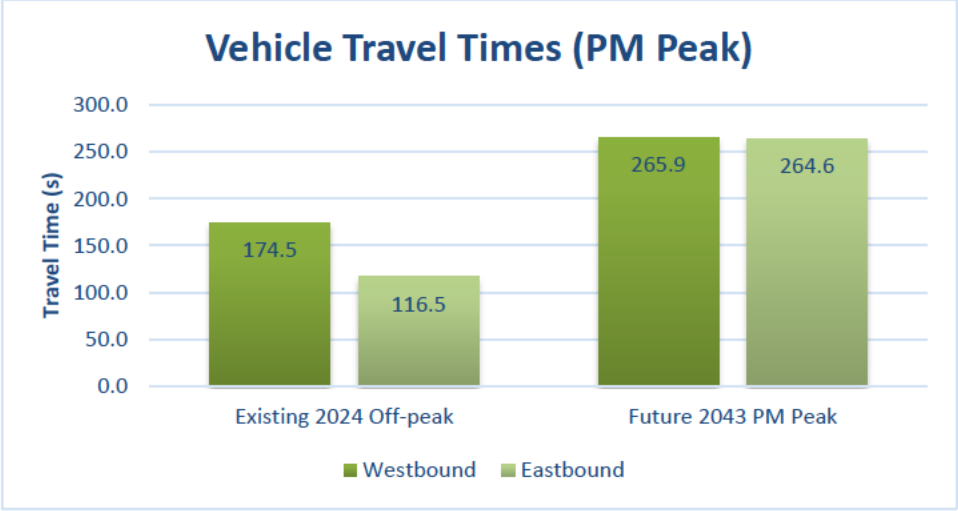


Figure 6: Vehicle Corridor Travel Times – PM Peak Hour



Generally, the future travel times are expected to increase relative to the current off-peak travel times; however, drivers will still be able to traverse the corridor in the future in less than 300 seconds, or 5 minutes. This suggests that GRIFFIN's recommended future year traffic signal timing plans can adequately accommodate the future 2043 peak hour demand through the critical Commodore Drive corridor intersections, along with the implementation of bus-only managed curb lanes.

GRIFFIN has concluded that with traffic signal optimization and a successful implementation of HRM's RTS, the study area intersections can adequately accommodate *DesignPoint's* future estimate of peak hour traffic demand. However, should the future vehicle demand forecasts change, then further examination and a reassessment of the traffic signal optimization process will be required.

3.4 – A Word on Transit Bus Operations

GRIFFIN expects the future 2043 corridor travel times contained in *Figures 5 and 6* will be less for transit buses. This is based on the fact the managed bus lanes assumed to be installed on Commodore Drive will allow the buses to by-pass the long queues generated at the John Savage signalized intersection, for example. Further, if HRM is able to install queue jump lanes at select locations, the transit buses can gain further travel time benefits.

It is understood that concerns have been raised about accommodating managed bus lanes on Burnside Drive – between Commodore Drive and the Highway 111 interchange. If there are limitations to utilizing the existing space within the 6-lane cross-section, then HRM could give consideration to the use of paved shoulder bus lanes. This type of transit facility has been successfully implemented in locations throughout North America, including the City of Ottawa. GRIFFIN has observed the operations of shoulder bus lanes in Ottawa and feel Burnside Drive is a good candidate location. Implementation would require the existing gravel shoulders to be upgraded with a sufficient asphalt design, signs and pavement markings indicating their managed use, and transit driver training for proper merging and lane changing. It is assumed the shoulder bus lanes would only be used during peak periods when north-south queues extend along Burnside Drive.

4.0 CONCLUSIONS

The following conclusions were gleaned from the VISSIM corridor assessment:

- *Future 2043 Analysis*: GRIFFIN applied the VISSIM simulation software to provide an understanding of the future operational results along Commodore Drive and Burnside Drive. Initially, operational issues were identified and vehicle queue spillback into upstream intersections was prevalent. Therefore, GRIFFIN successfully carried out an iterative traffic signal optimization process which resulted in mitigating the corridor operational issues. In completing this optimization process GRIFFIN was able to

successfully accommodate *DesignPoint's* 2043 peak hour volumes within a reduced set of lanes along Commodore Drive – the proposed Rapid Transit Strategy (RTS) scenario.

- *Optimized Signal Timing Plans*: GRIFFIN prepared optimized signal timing plans for the future 2043 AM and PM peak hours. The recommended signal timing plans are provided in the Appendix, for the critical corridor intersections. These timing plans improved east-west flow along Commodore Drive by implementing a common cycle length and synchronizing the start phases. The result was good corridor progression in the peak travel direction which minimized the likelihood of queue spillbacks into upstream intersections. This was a critical requirement to facilitate the implementation of HRM's RTS.
- *Rapid Transit Strategy*: Utilizing a set of optimized signal timing plans at the critical corridor intersections improves the east-west traffic flow. Achieving these future traffic conditions yields a two-fold result:
    - Minimizes congestion and delay between the closely-spaced intersections of Burnside Drive-Brownlow-Eileen Stubbs and is expected to improve the efficient movement of transit buses through this constrained area, and
    - Allows for lane reductions along Commodore Drive where excess vehicle capacity exists. GRIFFIN has determined that the east and west curb lanes can be converted to managed bus lanes from a point east of the Eileen Stubbs-Spectacle Lake intersection, through to a point east of the new signalized access.

In summary, GRIFFIN's VISSIM assessment demonstrates that HRM can implement their planned RTS along Commodore Drive – assuming the future 2043 vehicle demand forecasts prepared by *DesignPoint* become a reality.

5.0 RECOMMENDATIONS

GRIFFIN offers the following recommendations based on the findings of the VISSIM corridor assessment:

1. That HRM begin the planning process to design managed bus lanes along Commodore Drive, and identify locations where queue jump lanes can be installed. Further planning and assessment should be completed to examine the benefits of implementing paved shoulder bus lanes along Burnside Drive, south of Commodore Drive.
2. That HRM monitor traffic growth and performance results along the critical section of Commodore Drive to determine the optimal timeframe to modify the traffic signal timing plans at the key intersections. GRIFFIN's recommended signal timing plans are contained in the Appendix – but these plans have been optimized for future 2043 vehicle demand. Interim modifications may be required as vehicle demand changes between now and 2043.

3. That additional simulation modeling occur if the 2043 vehicle peak hour demand forecasts change. The peak hour demand utilized in GRIFFIN's VISSIM modeling assessment are provided in *Figures 1* and *2*, earlier in this letter.

6.0 CLOSING

I would be happy to provide you with additional information or clarification regarding these matters and can be reached anytime by phone at (902) 266-9436 or by email at jcopeland@griffininc.ca.

Sincerely,

[Original to be signed]

James J. Copeland, P.Eng., RSP1
Managing Principal – Traffic & Road Safety Engineer
GRIFFIN transportation group inc.

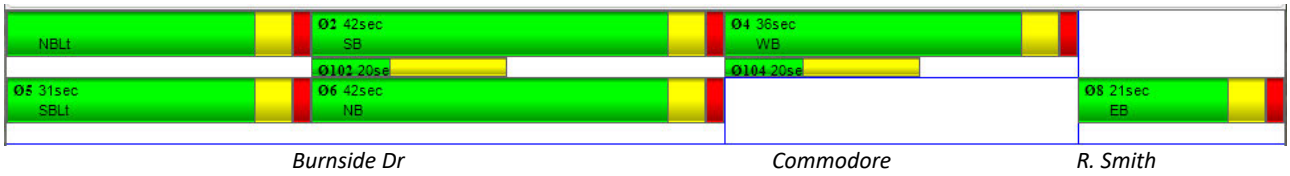
Appendix A
Future 2043
Traffic Signal Plans

Proposed Signal Timing Plans – Future 2043 RTS Scenario

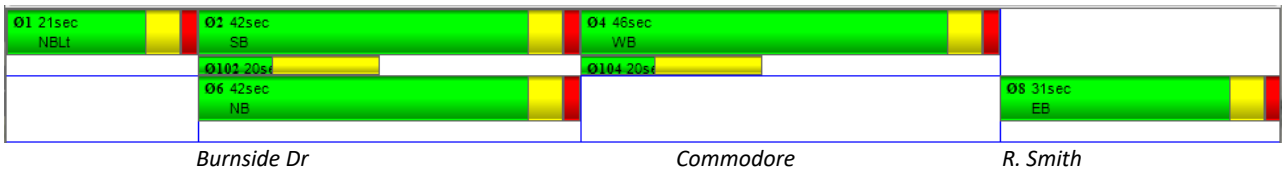
Burnside Drive Intersection:

A cycle length of **130 seconds** (AM peak) and **140 seconds** (PM peak) is needed with the following phasing sequence. Split times are provided for each phase. No off-set required.

AM Peak Hour:



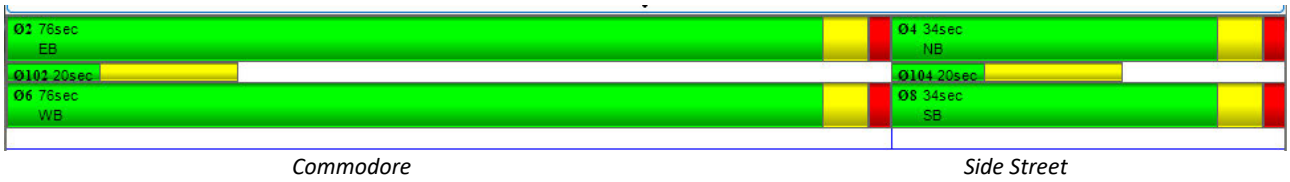
PM Peak Hour:



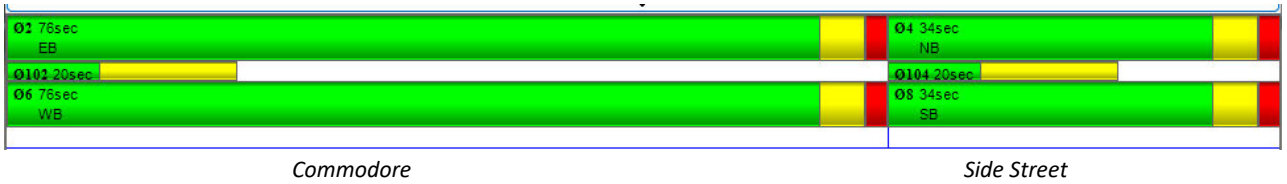
Brownlow / Eileen Stubbs / John Savage / New Access Intersections

A cycle length of **110 seconds** is required with the following phasing sequence. Split times are provided for each phase. No off-set required, all signals start with the same phase, at the same time in the simulation period.

AM Peak Hour:



PM Peak Hour:



NOTE: The off-peak vehicle demand was not provided and was not part of GRIFFIN's scope of work, and therefore was not examined. Off-peak signal timing along the Commodore Drive corridor could potentially have reduced cycle lengths and fully-actuated operations.

Appendix B
VISSIM Software
Simulation Run Results

Commodore Drive & Burnside Drive Corridor Traffic Simulation Review
Simulation Analysis Results - AM Peak Hour

Road Network **: Existing Roads with Future RTS Lanes on Commodore Drive**
Volumes **: Future Full Build-out - AM Peak Hour**

Intersection Operational Results (VISSIM):

			Rapid Transit Strategy Route - Critical Intersection Performance Results														
			Commodore / Burnside			Commodore / Brownlow			Commodore / Eileen Stubbs-Spectacle Lake			Commodore / John Savage			Commodore / New Access		
	Simulation Analysis	Random Number	Inters'n LOS	Avg. Delay (s/veh)	Queues (m) Avg / Max	Inters'n LOS	Avg. Delay (s/veh)	Queues (m) Avg / Max	Inters'n LOS	Avg. Delay (s/veh)	Queues (m) Avg / Max	Inters'n LOS	Avg. Delay (s/veh)	Queues (m) Avg / Max	Inters'n LOS	Avg. Delay (s/veh)	Queues (m) Avg / Max
12	VISSIM Run #1	42	LOS_C	34.6	13 / 224	LOS_B	17.5	15 / 170	LOS_B	15.7	5 / 114	LOS_B	15.3	4 / 166	LOS_D	54.0	35 / 505
13	VISSIM Run #2	53	LOS_C	34.8	13 / 210	LOS_B	18.0	16 / 125	LOS_B	13.4	4 / 82	LOS_B	14.1	8 / 187	LOS_D	50.8	25 / 360
14	VISSIM Run #3	60	LOS_C	32.6	12 / 152	LOS_B	16.0	12 / 173	LOS_B	16.2	5 / 106	LOS_B	17.6	3 / 104	LOS_D	46.9	50 / 506
15	VISSIM Run #4	87	LOS_C	34.4	13 / 194	LOS_B	16.1	13 / 133	LOS_B	14.2	5 / 179	LOS_B	16.3	5 / 95	LOS_D	50.5	31 / 483
16	VISSIM Run #5	28	LOS_C	33.9	13 / 200	LOS_B	15.1	11 / 118	LOS_B	15.2	4 / 122	LOS_B	13.4	2 / 92	LOS_D	45.2	22 / 365
	Overall Average		***LOS_C***	***34.1***	***13 / 196***	***LOS_B***	***16.5***	***13 / 144***	***LOS_B***	***14.9***	***4 / 120***	***LOS_B***	***15.3***	***4 / 129***	***LOS_D***	***49.5***	***33 / 444***

Commodore-Burnside Corridor Travel Time Results (1.8km Route):

			Westbound - All Traffic		Eastbound - All Traffic	
	Analysis Alternative	Random Number	Vehicle Flow (vph)	Avg. Travel Time (s)	Vehicle Flow (vph)	Avg. Travel Time (s)
12	VISSIM Run #1	42	100	278.2	169	337.0
13	VISSIM Run #2	53	106	297.2	143	272.0
14	VISSIM Run #3	60	114	254.9	150	297.1
15	VISSIM Run #4	87	105	258.7	170	297.9
16	VISSIM Run #5	28	116	272.3	196	287.9
	Overall Average		***108***	***272.3***	***166***	***298.4***

Commodore Drive & Burnside Drive Corridor Traffic Simulation Review
Simulation Analysis Results - PM Peak Hour

Road Network **: Existing Roads with Future RTS Lanes on Commodore Drive**
Volumes **: Future Full Build-out - PM Peak Hour**

Intersection Operational Results (VISSIM):

			Rapid Transit Strategy Route - Critical Intersection Performance Results														
			Commodore / Burnside			Commodore / Brownlow			Commodore / Eileen Stubbs-Spectacle Lake			Commodore / John Savage			Commodore / New Access		
	Simulation Analysis	Random Number	Inters'n LOS	Avg. Delay (s/veh)	Queues (m) Avg / Max	Inters'n LOS	Avg. Delay (s/veh)	Queues (m) Avg / Max	Inters'n LOS	Avg. Delay (s/veh)	Queues (m) Avg / Max	Inters'n LOS	Avg. Delay (s/veh)	Queues (m) Avg / Max	Inters'n LOS	Avg. Delay (s/veh)	Queues (m) Avg / Max
6	VISSIM Run #1	42	LOS_D	43.6	18 / 215	LOS_C	27.7	36 / 260	LOS_C	20.7	5 / 153	LOS_C	29.3	21 / 460	LOS_C	27.2	8 / 295
7	VISSIM Run #2	53	LOS_D	39.5	16 / 210	LOS_C	29.2	39 / 249	LOS_C	21.9	5 / 160	LOS_C	24.9	16 / 456	LOS_C	21.8	5 / 294
8	VISSIM Run #3	60	LOS_D	40.7	17 / 187	LOS_D	36.3	46 / 249	LOS_D	38.9	11 / 169	LOS_D	50.2	29 / 456	LOS_C	22.3	7 / 295
9	VISSIM Run #4	87	LOS_D	45.6	19 / 234	LOS_C	30.6	57 / 260	LOS_B	17.6	5 / 130	LOS_C	25.2	9 / 455	LOS_C	22.6	6 / 294
10	VISSIM Run #5	28	LOS_D	44.0	19 / 213	LOS_C	31.8	51 / 260	LOS_B	19.3	5 / 152	LOS_C	24.9	12 / 456	LOS_B	19.7	5 /294
	Overall Average		***LOS_D***	***42.7***	***18 / 212***	***LOS_C***	***31.1***	***46 / 256***	***LOS_C***	***23.7***	***6 / 153***	***LOS_C***	***30.9***	***17 / 456***	***LOS_C***	***22.7***	***6 / 294***

Commodore-Burnside Corridor Travel Time Results (1.8km Route):

			Westbound - All Traffic		Eastbound - All Traffic	
	Analysis Alternative	Random Number	Vehicle Flow (vph)	Avg. Travel Time (s)	Vehicle Flow (vph)	Avg. Travel Time (s)
6	VISSIM Run #1	42	106	284.7	252	265.2
7	VISSIM Run #2	53	97	255.1	269	244.3
8	VISSIM Run #3	60	98	251.9	281	359.7
9	VISSIM Run #4	87	109	265.5	289	224.7
10	VISSIM Run #5	28	106	272.1	268	229.2
	Overall Average		***103***	***265.9***	***272***	***264.6***

APPENDIX H – WEAVE ANALYSIS FOR COMMODORE DRIVE / HIGHWAY 118

James J. Copeland, P.Eng., RSP1
GRIFFIN transportation group inc.
30 Bonny View Drive
Fall River, NS B2T 1R2

March 21, 2024

Att: Harrison McGrath, P.Eng.
DesignPoint Engineering & Surveying
500-90 Western Parkway
Bedford, NS B4B 2J3

RE: Weaving Analysis of the Commodore Drive / Highway 118 Southbound Lanes

1.0 INTRODUCTION

1.1 – Overview

At the request of *DesignPoint*, the GRIFFIN transportation group inc. (GRIFFIN) has been engaged as a sub-consultant to carry out a weaving analysis and VISSIM simulation assessment in support of a broader traffic impact study process being carried out by *DesignPoint*, for a large residential growth area in Dartmouth Crossing.

Commodore Drive is one of the main vehicle access points for the proposed development. In recent years, vehicle traffic volumes have increased along Commodore Drive during the afternoon peak period as employees exit the Burnside Business Park. One of the critical exits is the Commodore Drive connection to the Highway 118 southbound Collector/Distributor (C/D) lanes. During the afternoon peak period, platoons of vehicles exit the Commodore Drive / Countryview Drive signalized intersection and travel onto the Highway 118 southbound C/D lanes. These platoons of vehicles occupy much of the capacity in the downstream weave segment and traffic flow is reduced to very low speeds and queueing often occurs.

1.2 – Objectives and Analysis

GRIFFIN has been tasked with evaluating the Highway 118 southbound C/D lane weave segment, located immediately downstream of the Commodore Drive ramps, to quantify the following:

- The current congestion and traffic operating conditions in the weave segment, and
- The future traffic operating conditions in the weave segment as well as potential mitigating changes to alleviate future congestion.

GRIFFIN utilized two software analysis tools to quantify the traffic operating conditions:

- **TRB's Highway Capacity Software (version 7)**: The HCS software was used to provide an assessment of the operating conditions within the weave segment immediately downstream of the Commodore Drive ramps. The HCS software tool provides a focused set of results for the weaving segment; however, it does not account for up and downstream operational constraints associated with traffic signals, other merge areas, or other weave segments.
- **PTV's VISSIM Simulation Software (version 2023)**: The VISSIM simulation software was used to provide a more broad-based and accurate representation of the unique operating characteristics of the weaving segment as it provides the opportunity to model the road system up and downstream. This included the upstream Commodore Drive / Countryview Drive intersection, as well as the downstream merge areas and weaving segments approaching the Highway 118 / Highway 111 interchange.

The road network included in our evaluation effort is provided in *Figure 1*. *Figure 2* contains the several different weave segment lane configurations along the Highway 118 southbound Collector/Distributor (C/D) lanes examined by GRIFFIN.

Figure 1: Existing Lane Configuration and Study Area



Figure 2: Various Weave Segment Lane Configurations



Existing Weave Segment Lane Configuration



Proposed Weave Segment #1:
Two Lanes to Highway 111



Proposed Weave Segment #2:
Two Lanes to Highway 118



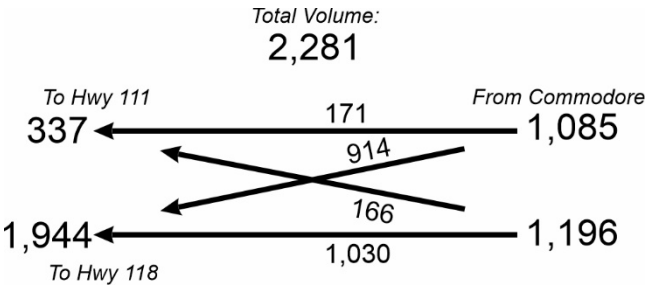
Proposed Weave Segment #3:
Three-lane Weave segment



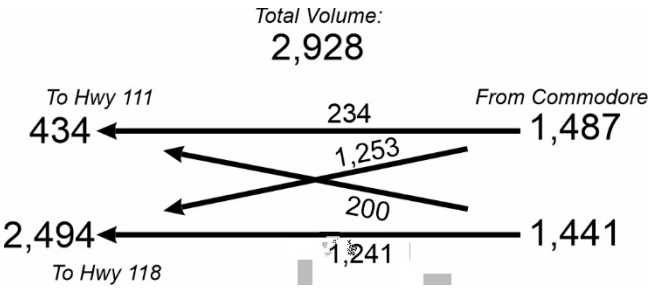
Source: Google Maps

Proposed Weave Segment #4:
Two separate merge lanes onto Highway 118 core lanes
(Existing Weave segment lane configuration)

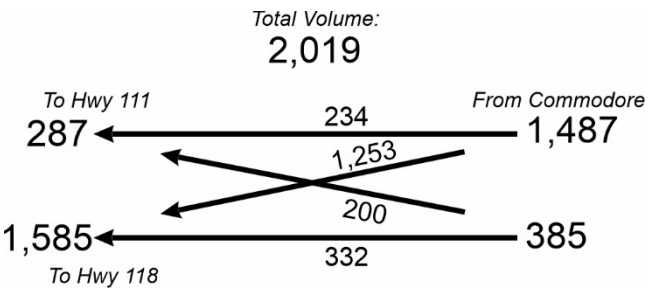
Figure 3: Weekday Afternoon Peak Design Hour Volumes – Provided by DesignPoint



Existing 2023 Volumes
(PM DHV)



Future Volumes
Proposed Weave Segments #1, #2, #3
(PM DHV)

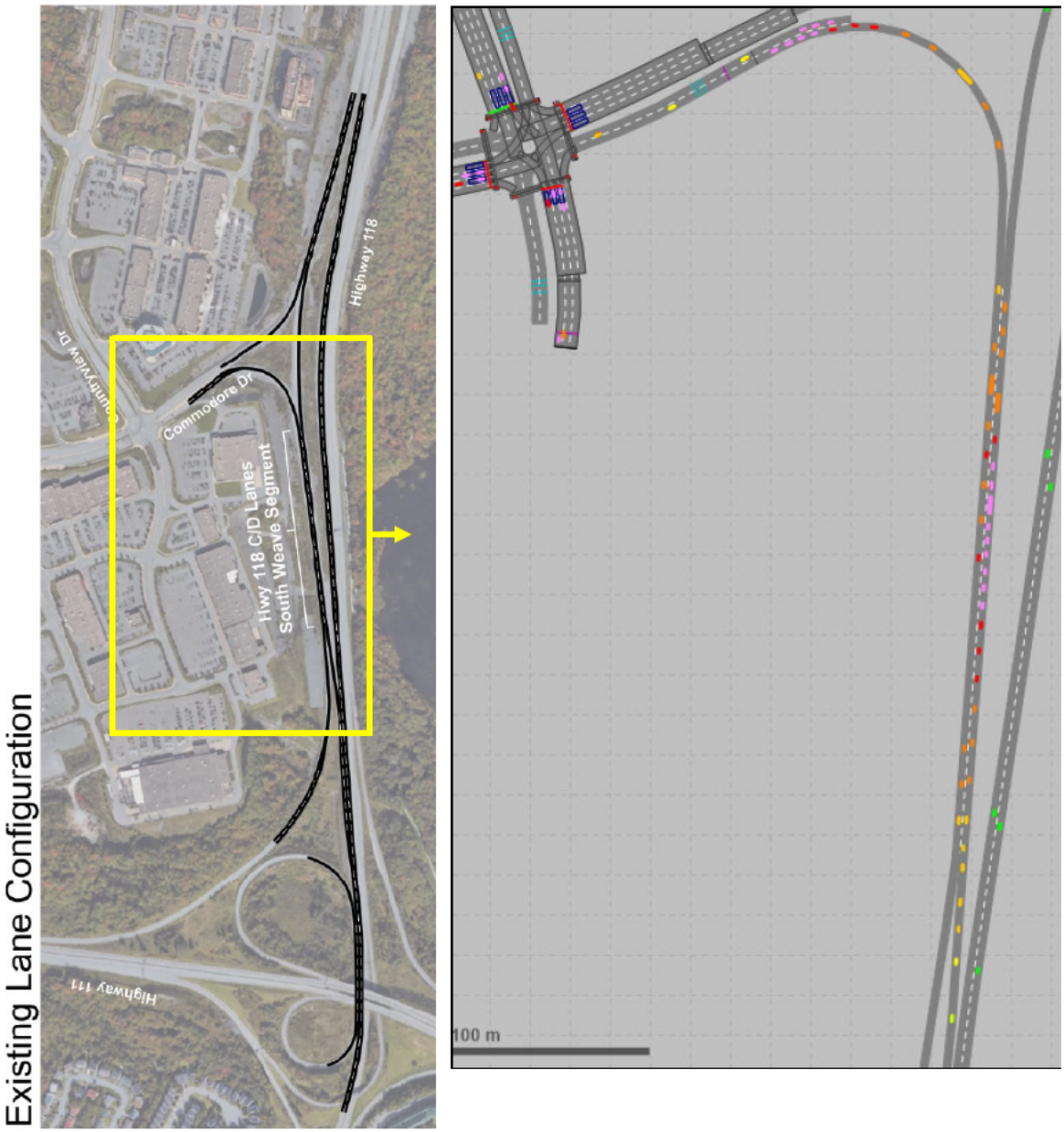


Future Volumes
Proposed Weave Segment #4
(PM DHV)

3.0 ANALYSIS RESULTS

3.1 – Analysis Using the Existing 2023 Volumes

Figure 4: Existing Conditions – VISSIM Results



The VISSIM simulation model was calibrated to represent the current 2023 afternoon peak period congestion that is experienced through the Highway 118 southbound C/D weave segment – as shown in *Figure 4*. The simulated vehicle colours denote vehicle speeds and purple shows very slow / stopped vehicles. It is in these locations where existing capacity constraints exist.

The HCS software weave analysis results are provided in *Table 1*. The HCS existing conditions results confirm and reinforce the VISSIM simulation results for existing conditions, as illustrated in *Figure 4*.

Table 1: HCS Weave Analysis Results – Existing 2023 Volumes

	Highway 118 SB C/D Lanes 2023 Baseline Volumes Existing Lanes		**Highway 118 SB C/D Lanes 2023 Baseline Volumes Proposed Lanes #1**	
	Imperial	Metric	Imperial	Metric
Weaving Segment (L)	968 ft	295 m	968 ft	295 m
Average Speed (S)	36.2 mi/h	58.3 km/h	37.3 mi/h	60.0 km/h
Volume/Capacity Ratio	**0.78**		**0.78**	
Density (pc/mi/ln)	**36.1**		**34.9**	
Level of Service (LOS)	**LOS E**		**LOS D**	

	Highway 118 SB C/D Lanes 2023 Baseline Volumes Proposed Lanes #2		**Highway 118 SB C/D Lanes 2023 Baseline Volumes Proposed Lanes #3**	
	Imperial	Metric	Imperial	Metric
Weaving Segment (L)	968 ft	295 m	968 ft	295 m
Average Speed (S)	42.1 mi/h	67.8 km/h	42.1 mi/h	67.8 km/h
Volume/Capacity Ratio	**0.79**		**0.74**	
Density (pc/mi/ln)	**30.9**		**30.9**	
Level of Service (LOS)	**LOS C**		**LOS C**	

Additional sets of analysis were carried out using the existing 2023 design hourly volumes – yet applied to the proposed weave segment lane configurations #1, #2, and #3. Using current vehicle demand assigned to the several different weaving lane configurations helped to understand if there could be any short-term benefits to help alleviate the congestion that is experienced today.

It was concluded that installing proposed lane configuration #1, #2, or #3 would offer some immediate operational benefits within the weave segment. It is also anticipated that lane configuration #1 would be the least costly to implement.

3.2 – Future Year Conditions – Proposed Lanes #1

Figure 5: Future Year Conditions – Proposed Lanes #1 – VISSIM Results

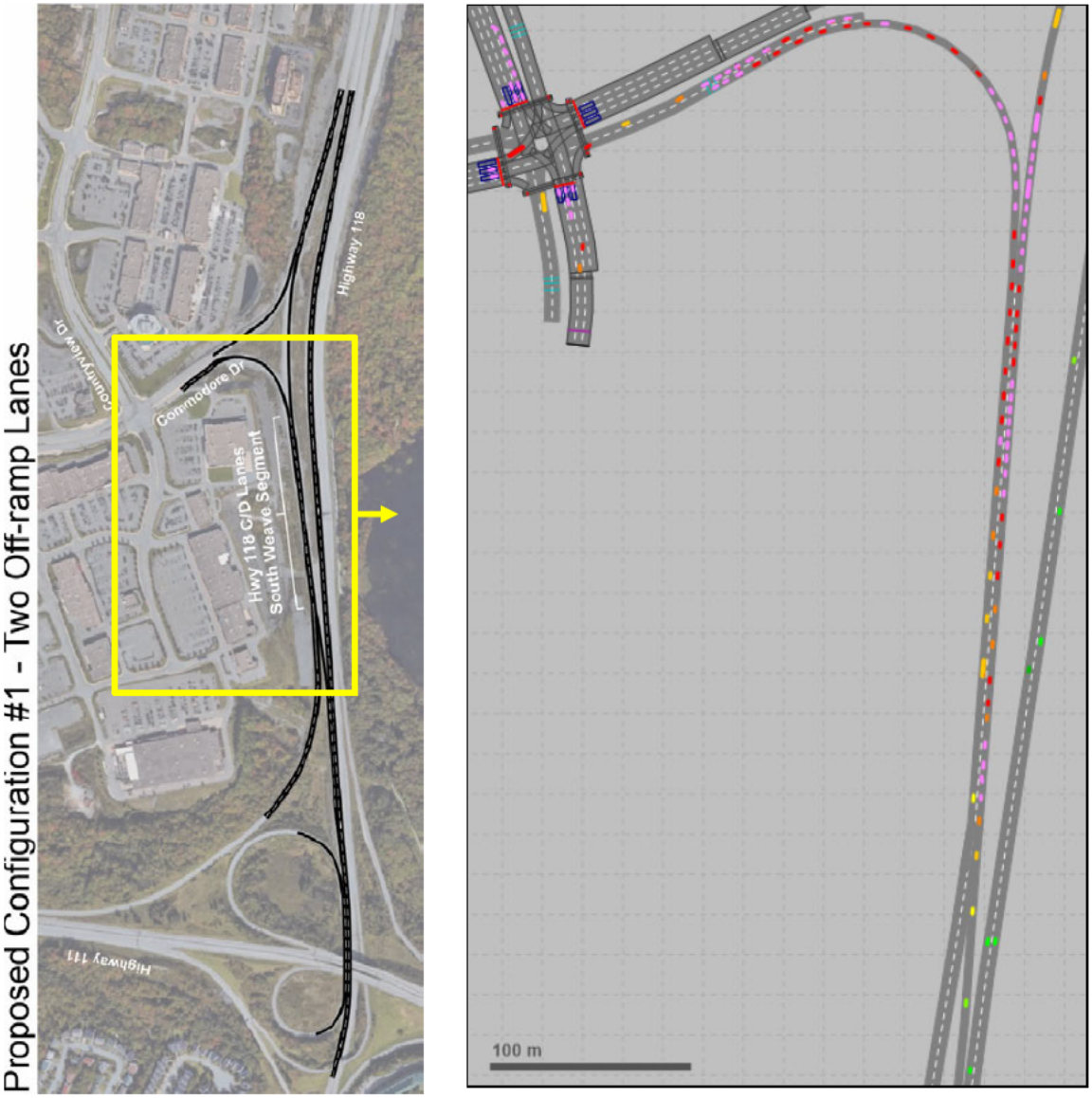


Table 2: HCS Weave Analysis Results – Future Year Proposed Lanes #1

	Highway 118 SB C/D Lanes Future Year Volumes Proposed Lanes #1	
	Imperial	Metric
Weaving Segment (L)	968 ft	295 m
Average Speed (S)	- mi/h	- km/h
Volume/Capacity Ratio	**1.06**	
Density (pc/mi/ln)	**-**	
Level of Service (LOS)	**LOS F**	

3.3 – Future Year Conditions – Proposed Lanes #2

Figure 6: Future Year Conditions – Proposed Lanes #2 – VISSIM Results



This lane configuration scenario was not modelled using VISSIM. It was assumed that having a two-lane downstream exit towards the Highway 118 core lanes would introduce an additional lane drop / merge area within an area that is currently operationally constrained. Further, the HCS analysis results did not demonstrate a notable improvement relative to proposed lane configuration #1 (Figure 5).

Table 3: HCS Weave Analysis Results – Future Year Proposed Lanes #2

	Highway 118 SB C/D Lanes Future Year Volumes Proposed Lanes #2	
	Imperial	Metric
Weaving Segment (L)	968 ft	295 m
Average Speed (S)	- mi/h	- km/h
Volume/Capacity Ratio	**1.06**	
Density (pc/mi/ln)	**-**	
Level of Service (LOS)	**LOS F**	

3.4 – Future Year Conditions – Proposed Lanes #3

Figure 7: Future Year Conditions – Proposed Lanes #3 – VISSIM Results

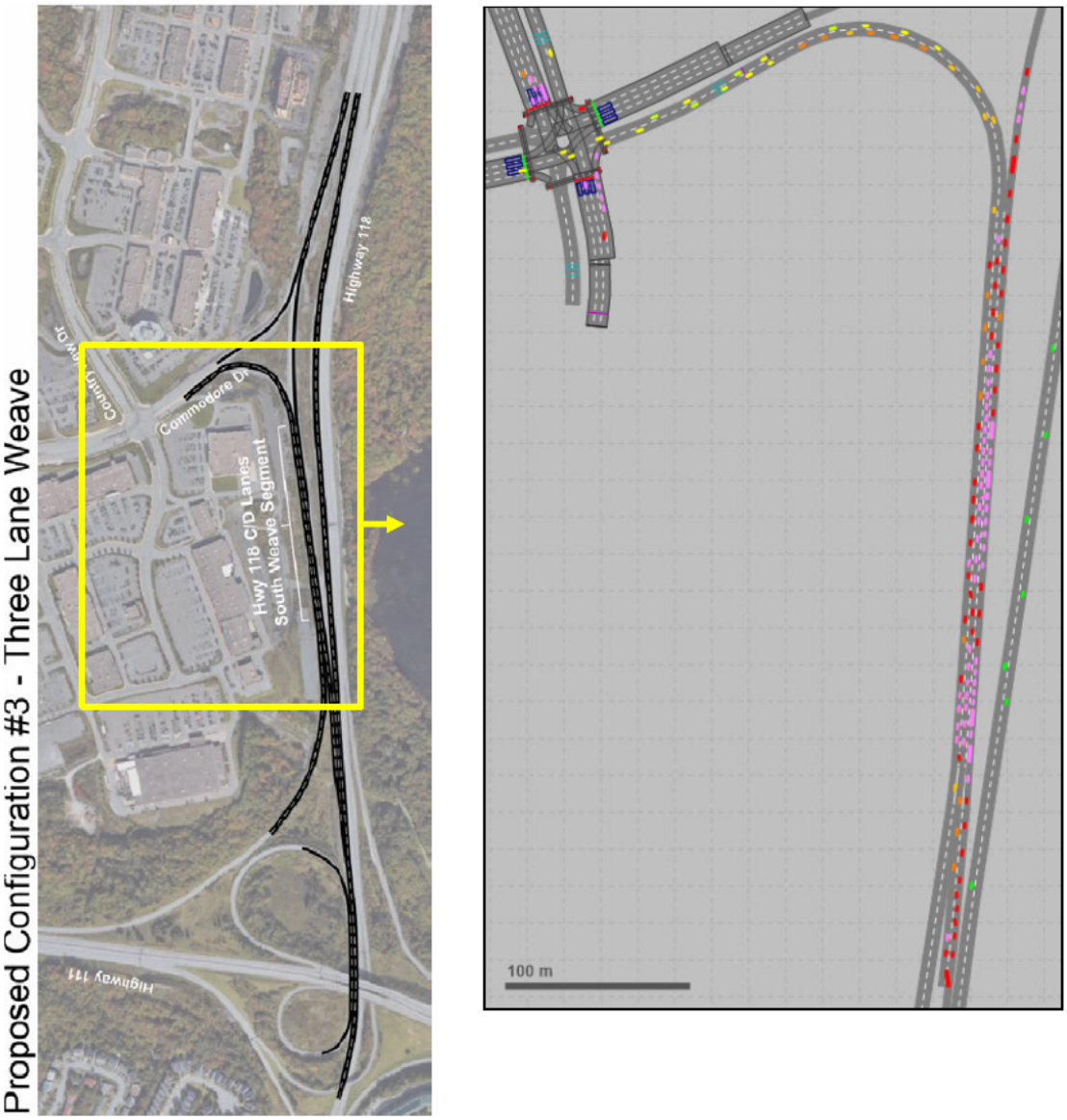


Table 4: HCS Weave Analysis Results – Future Year Proposed Lanes #3

	Highway 118 SB C/D Lanes Future Year Volumes Proposed Lanes #3	
	Imperial	Metric
Weaving Segment (L)	968 ft	295 m
Average Speed (S)	42.0 mi/h	67.6 km/h
Volume/Capacity Ratio	**0.66**	
Density (pc/mi/ln)	**27.6**	
Level of Service (LOS)	**LOS C**	

3.5 – Future Year Conditions – Proposed Lanes #4

Figure 8: Future Year Conditions – Proposed Lanes #4 – VISSIM Results

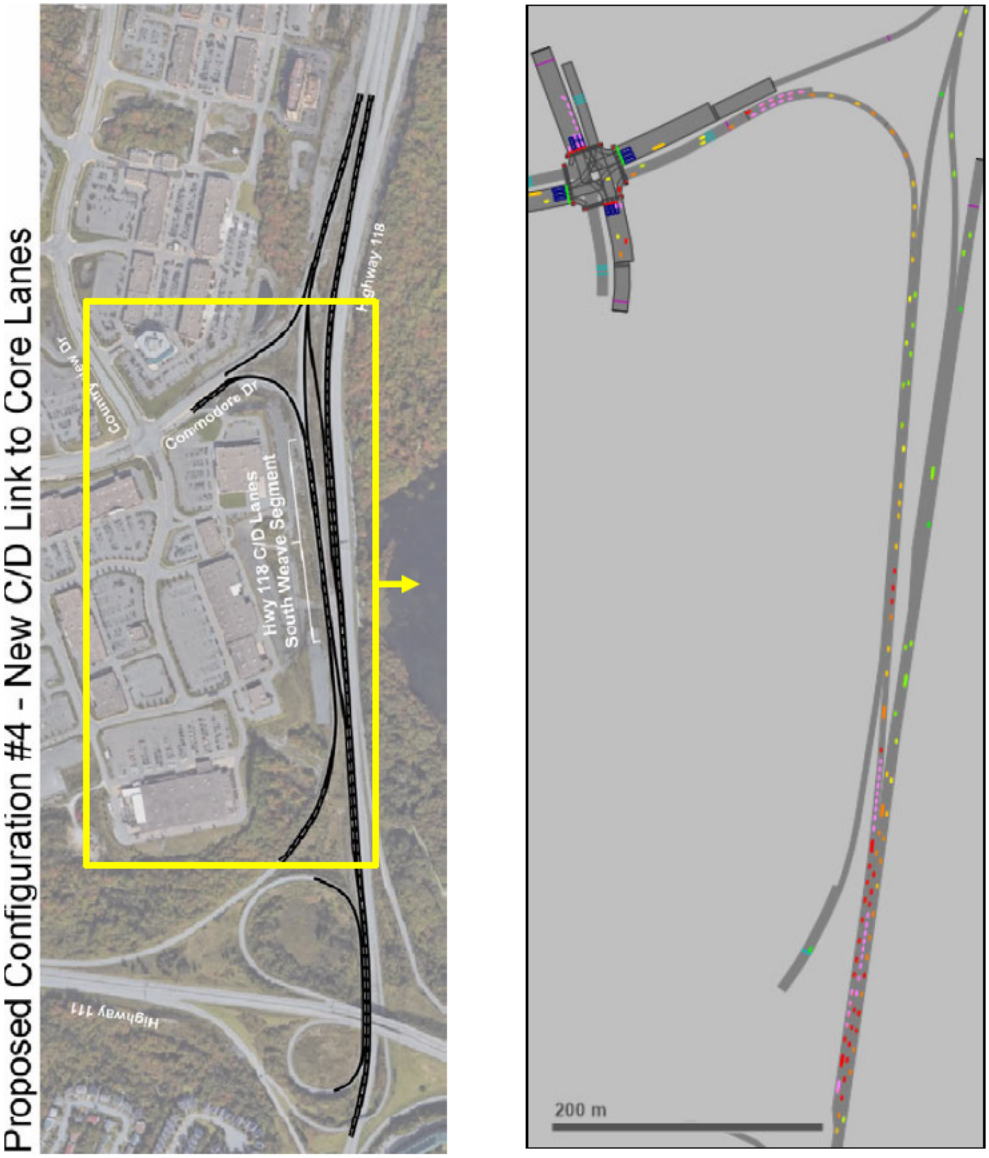


Table 5: HCS Weave Analysis Results – Future Year Proposed Lanes #4

	Highway 118 SB C/D Lanes Future Year Volumes Proposed Lanes #4	
	Imperial	Metric
Weaving Segment (L)	968 ft	295 m
Average Speed (S)	37.5 mi/h	60.4 km/h
Volume/Capacity Ratio	**0.80**	
Density (pc/mi/ln)	**30.7**	
Level of Service (LOS)	**LOS C**	

4.0 CONCLUSIONS

The following conclusions were gleaned from the Highway 118 southbound C/D lane weaving segment analysis:

- *Existing Operational Concerns*: Under current afternoon peak period conditions there are traffic flow issues through the southbound weave segment immediately south of the Commodore Drive ramps. This is due in part to the upstream traffic signal releasing platoons of vehicles which occupy the capacity of the weave segment.
- *Limited Space for Improvements*: The existing weaving segment south of the Commodore Drive ramps have a length of about 295m. Due to the confined space immediately downstream of this weave segment, there are a limited number of mitigating options to add capacity. Examples of the existing constraints include the southbound merge onto the 118 core lanes, as well as the Highway 118 / Highway 111 interchange loop ramps.
- *Future Year Analysis*: Our analysis of future year conditions examined several different weave segment lane configurations – with the goal of minimize the number of lane changes, which in turn can add vehicle capacity. It was determined through our analysis that minor improvements to the lane configuration could be made that could potentially add a limited amount of vehicle capacity (i.e. about 200-250 vph or less). A discussion of the findings associated with each future proposed analysis scenarios is provided below:
    - *Proposed Lane Configuration #1*: This modification attempted to limit the number of lane changes by providing two exit lanes to the Highway 111 ramp – traveling toward the MacKay Bridge. The implementation costs appear relatively low as there are already two downstream lanes provided on the Highway 111 ramp. The forecast future year volumes provided by *DesignPoint* are expected to exceed the capacity of this weave segment and eliminate any benefit of this change. The VISSIM analysis corroborated this finding. This was not found to be a viable long-term solution.
    - *Proposed Lane Configuration #2*: This modification was similar to lane configuration #1; however, two exit lanes were provided towards the Highway 118 core lanes. This lane configuration change would require a double lane drop / merge at the Highway 118 core lanes in an already confined operating environment. The available space for a double lane drop does not appear to meet current human factors lane change distance requirements. The forecast future year volumes provided by *DesignPoint* are expected to exceed the capacity of the weave segment. This was not found to be a viable long-term solution.

- *Proposed Lane Configuration #3*: This modification attempted to widen the weave segment to a three-lane cross-section and link the two upstream on-ramp lanes from Commodore Drive with the two downstream off-ramp lanes to Highway 111. This configuration offered the most operational improvement likely due to a reduced number of lane changes required along the three-lane weave segment. However, the network-level analysis using VISSIM identified downstream operational issues through the lane drop/ merge area where the southbound C/D lanes merge with the core lanes. This solution is likely to offer a short-term benefit for the current afternoon congestion; however, it was not found to be a viable long-term solution.
- *Proposed Lane Configuration #4*: This modification attempted to shift vehicle demand away from the weave segment by installing a new upstream link to divert demand away from the weave segment. The new upstream link would take drivers from the southbound C/D lanes to the core lanes immediately upstream of Commodore Drive. This change allows southbound traffic entering from Wright Avenue – and destined to Woodland Avenue or Highway 111 – to merge into the core lanes early and avoid the weave segment. Using the forecast future year volumes provided by *DesignPoint* it was determined that there would be a significant reduction in volume moving through the C/D lane weave segment; however, this shifted a greater number of vehicles into the core lanes. As identified through the VISSIM analysis, this is expected to create significant operational issues at the existing downstream merge point of the C/D lanes and core lanes. This was not found to be a viable long-term solution.

In summary, the potential mitigating solutions described above did not identify a reasonable solution to carry forward for further evaluation. Therefore, the next steps will require *DesignPoint* and their client to revisit future mode-share percentages, business park access capacities, and so forth, that would reasonably and realistically reflect future commuter vehicle demand in this area. Alternatively, if future mode share trends are not enough to limit commuter vehicle demand growth in this area, there will be a need to identify grade separated weaving movements similar to NSDPW's recent improvements at the Highway 102 / Highway 103 interchange.

5.0 CLOSING

I would be happy to provide you with additional information or clarification regarding these matters and can be reached anytime by phone at (902) 266-9436 or by email at jcopeland@griffininc.ca.

Sincerely,

[Original to be signed]

James J. Copeland, P.Eng., RSP1
Managing Principal – Traffic & Road Safety Engineer
GRIFFIN transportation group inc.

Appendix A
Highway Capacity Software
Weaving Segment Reports

HCS7 Freeway Weaving Report

Project Information

Analyst		Date	7/10/2023
Agency	GRIFFIN	Analysis Year	2023 - Baseline Traffic
Jurisdiction	NSDPW	Time Period Analyzed	Afternoon DHV - Peak Hour Volumes
Project Description	Dartmouth Crossing - Hwy 118 SB C/D Lanes - South Weave Section - Existing Lanes		

Geometric Data

Number of Lanes (N), ln	2	Segment Type	Highway/CD Roadway
Short Length (L_S), ft	968	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-2.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1030	914	171	166
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.939	0.939	0.939	0.869
Flow Rate (v_i), pc/h	1167	1036	194	203

Weaving Flow Rate (v_w), pc/h	1239	Freeway Max Capacity (c_{IFL}), pc/h/ln	2200
Non-Weaving Flow Rate (v_{NW}), pc/h	1361	Density-Based Capacity (c_{IWL}), pc/h/ln	1696
Total Flow Rate (v), pc/h	2600	Demand Flow-Based Capacity (c_{IW}), pc/h	5031
Volume Ratio (VR)	0.477	Weaving Segment Capacity (cw), veh/h	3185
Minimum Lane Change Rate (LC_{MIN}), lc/h	1239	Adjusted Weaving Area Capacity, pc/h	3303
Maximum Weaving Length (L_{MAX}), ft	7559	Volume-to-Capacity Ratio (v/c)	0.79

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	263	Average Weaving Speed (S_W), mi/h	39.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	420	Average Non-Weaving Speed (S_{NW}), mi/h	33.3
Weaving Lane Change Rate (LC_W), lc/h	1336	Average Speed (S), mi/h	36.0
Total Lane Change Rate (LC_{All}), lc/h	1756	Density (D), pc/mi/ln	36.1
Weaving Intensity Factor (W)	0.362	Level of Service (LOS)	E

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HCS7 Freeway Weaving Report

Project Information

Analyst		Date	7/10/2023
Agency	GRIFFIN	Analysis Year	Future Year Traffic
Jurisdiction	NSDPW	Time Period Analyzed	Afternoon DHV - Peak Hour Volumes
Project Description	Dartmouth Crossing - Hwy 118 SB C/D Lanes - South Weave Section - Existing Lanes		

Geometric Data

Number of Lanes (N), ln	2	Segment Type	Highway/CD Roadway
Short Length (L_S), ft	968	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-2.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1348	1253	234	217
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.939	0.939	0.939	0.869
Flow Rate (v_i), pc/h	1527	1420	265	266

Weaving Flow Rate (v_w), pc/h	1686	Freeway Max Capacity (c_{IFL}), pc/h/ln	2200
Non-Weaving Flow Rate (v_{NW}), pc/h	1792	Density-Based Capacity (c_{IWL}), pc/h/ln	1689
Total Flow Rate (v), pc/h	3478	Demand Flow-Based Capacity (c_{IW}), pc/h	4948
Volume Ratio (VR)	0.485	Weaving Segment Capacity (cw), veh/h	3172
Minimum Lane Change Rate (LC_{MIN}), lc/h	0	Adjusted Weaving Area Capacity, pc/h	3289
Maximum Weaving Length (L_{MAX}), ft	7652	Volume-to-Capacity Ratio (v/c)	1.06

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Total Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

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HCS7 Freeway Weaving Report

Project Information

Analyst		Date	7/10/2023
Agency	GRIFFIN	Analysis Year	2023 - Baseline Traffic
Jurisdiction	NSDPW	Time Period Analyzed	Afternoon DHV - Peak Hour Volumes
Project Description	Dartmouth Crossing - Hwy 118 SB C/D Lanes - South Weave Section - Proposed 1 (2 Ramp)		

Geometric Data

Number of Lanes (N), ln	2	Segment Type	Highway/CD Roadway
Short Length (L_S), ft	968	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-2.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.33	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1030	914	171	166
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.939	0.939	0.939	0.869
Flow Rate (v_i), pc/h	1167	1036	194	203

Weaving Flow Rate (v_w), pc/h	1239	Freeway Max Capacity (c_{IFL}), pc/h/ln	2200
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Volume Ratio (VR)	0.477	Weaving Segment Capacity (cw), veh/h	3185
Minimum Lane Change Rate (LC_{MIN}), lc/h	1036	Adjusted Weaving Area Capacity, pc/h	3303
Maximum Weaving Length (L_{MAX}), ft	7559	Volume-to-Capacity Ratio (v/c)	0.79

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	44	Average Weaving Speed (S_W), mi/h	40.4
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	420	Average Non-Weaving Speed (S_{NW}), mi/h	34.8
Weaving Lane Change Rate (LC_W), lc/h	1087	Average Speed (S), mi/h	37.3
Total Lane Change Rate (LC_{All}), lc/h	1507	Density (D), pc/mi/ln	34.9
Weaving Intensity Factor (W)	0.320	Level of Service (LOS)	D

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HCS7 Freeway Weaving Report

Project Information

Analyst		Date	7/10/2023
Agency	GRIFFIN	Analysis Year	Future Year Traffic
Jurisdiction	NSDPW	Time Period Analyzed	Afternoon DHV - Peak Hour Volumes
Project Description	Dartmouth Crossing - Hwy 118 SB C/D Lanes - South Weave Section - Proposed 1 (2 Ramp)		

Geometric Data

Number of Lanes (N), ln	2	Segment Type	Highway/CD Roadway
Short Length (L_S), ft	968	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-2.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.33	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1348	1253	234	217
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.939	0.939	0.939	0.869
Flow Rate (v_i), pc/h	1527	1420	265	266

Weaving Flow Rate (v_w), pc/h	1686	Freeway Max Capacity (c_{IFL}), pc/h/ln	2200
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Volume Ratio (VR)	0.485	Weaving Segment Capacity (cw), veh/h	3172
Minimum Lane Change Rate (LC_{MIN}), lc/h	0	Adjusted Weaving Area Capacity, pc/h	3289
Maximum Weaving Length (L_{MAX}), ft	7652	Volume-to-Capacity Ratio (v/c)	1.06

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Total Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

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HCS7 Freeway Weaving Report

Project Information

Analyst		Date	7/10/2023
Agency	GRIFFIN	Analysis Year	2023 - Baseline Traffic
Jurisdiction	NSDPW	Time Period Analyzed	Afternoon DHV - Peak Hour Volumes
Project Description	Dartmouth Crossing - Hwy 118 SB C/D Lanes - South Weave Section - Proposed 2 (2 Fwy)		

Geometric Data

Number of Lanes (N), ln	2	Segment Type	Highway/CD Roadway
Short Length (L_S), ft	968	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	0
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-2.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.33	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1030	914	171	166
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.939	0.939	0.939	0.869
Flow Rate (v_i), pc/h	1167	1036	194	203

Weaving Flow Rate (v_w), pc/h	1239	Freeway Max Capacity (c_{IFL}), pc/h/ln	2200
Non-Weaving Flow Rate (v_{NW}), pc/h	1361	Density-Based Capacity (c_{IWL}), pc/h/ln	1696
Total Flow Rate (v), pc/h	2600	Demand Flow-Based Capacity (c_{IW}), pc/h	5031
Volume Ratio (VR)	0.477	Weaving Segment Capacity (cw), veh/h	3185
Minimum Lane Change Rate (LC_{MIN}), lc/h	203	Adjusted Weaving Area Capacity, pc/h	3303
Maximum Weaving Length (L_{MAX}), ft	7559	Volume-to-Capacity Ratio (v/c)	0.79

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	43	Average Weaving Speed (S_W), mi/h	43.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	420	Average Non-Weaving Speed (S_{NW}), mi/h	40.8
Weaving Lane Change Rate (LC_W), lc/h	254	Average Speed (S), mi/h	42.1
Total Lane Change Rate (LC_{All}), lc/h	674	Density (D), pc/mi/ln	30.9
Weaving Intensity Factor (W)	0.170	Level of Service (LOS)	C

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HCS7 Freeway Weaving Report

Project Information

Analyst		Date	7/10/2023
Agency	GRIFFIN	Analysis Year	Future Year Traffic
Jurisdiction	NSDPW	Time Period Analyzed	Afternoon DHV - Peak Hour Volumes
Project Description	Dartmouth Crossing - Hwy 118 SB C/D Lanes - South Weave Section - Proposed 2 (2 Fwy)		

Geometric Data

Number of Lanes (N), ln	2	Segment Type	Highway/CD Roadway
Short Length (L_S), ft	968	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	0
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-2.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1348	1253	234	217
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.939	0.939	0.939	0.869
Flow Rate (v_i), pc/h	1527	1420	265	266

Weaving Flow Rate (v_w), pc/h	1686	Freeway Max Capacity (c_{IFL}), pc/h/ln	2200
Non-Weaving Flow Rate (v_{NW}), pc/h	1792	Density-Based Capacity (c_{IWL}), pc/h/ln	1689
Total Flow Rate (v), pc/h	3478	Demand Flow-Based Capacity (c_{IW}), pc/h	4948
Volume Ratio (VR)	0.485	Weaving Segment Capacity (cw), veh/h	3172
Minimum Lane Change Rate (LC_{MIN}), lc/h	0	Adjusted Weaving Area Capacity, pc/h	3289
Maximum Weaving Length (L_{MAX}), ft	7652	Volume-to-Capacity Ratio (v/c)	1.06

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	-	Average Weaving Speed (S_W), mi/h	-
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	-	Average Non-Weaving Speed (S_{NW}), mi/h	-
Weaving Lane Change Rate (LC_W), lc/h	-	Average Speed (S), mi/h	-
Total Lane Change Rate (LC_{All}), lc/h	-	Density (D), pc/mi/ln	-
Weaving Intensity Factor (W)	-	Level of Service (LOS)	F

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HCS7 Freeway Weaving Report

Project Information

Analyst		Date	7/10/2023
Agency	GRIFFIN	Analysis Year	2023 - Baseline Traffic
Jurisdiction	NSDPW	Time Period Analyzed	Afternoon DHV - Peak Hour Volumes
Project Description	Dartmouth Crossing - Hwy 118 SB C/D Lanes - South Weave Section - Proposed 3 (3 Lane Weave Segment)		

Geometric Data

Number of Lanes (N), ln	2	Segment Type	Highway/CD Roadway
Short Length (L_S), ft	968	Number of Maneuver Lanes (N_{WL}), ln	3
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	0
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-2.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.33	Cross Weaving Managed Lane	Yes

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1030	914	171	166
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.939	0.939	0.939	0.869
Flow Rate (v_i), pc/h	1167	1036	194	203

Weaving Flow Rate (v_w), pc/h	1239	Freeway Max Capacity (c_{IFL}), pc/h/ln	2200
Non-Weaving Flow Rate (v_{NW}), pc/h	1361	Density-Based Capacity (c_{IWL}), pc/h/ln	1816
Total Flow Rate (v), pc/h	2600	Demand Flow-Based Capacity (c_{IW}), pc/h	7338
Volume Ratio (VR)	0.477	Weaving Segment Capacity (cw), veh/h	3410
Minimum Lane Change Rate (LC_{MIN}), lc/h	203	Adjusted Weaving Area Capacity, pc/h	3537
Maximum Weaving Length (L_{MAX}), ft	5993	Volume-to-Capacity Ratio (v/c)	0.74

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	43	Average Weaving Speed (S_W), mi/h	43.6
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	420	Average Non-Weaving Speed (S_{NW}), mi/h	40.8
Weaving Lane Change Rate (LC_W), lc/h	254	Average Speed (S), mi/h	42.1
Total Lane Change Rate (LC_{All}), lc/h	674	Density (D), pc/mi/ln	30.9
Weaving Intensity Factor (W)	0.170	Level of Service (LOS)	C

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HCS7 Freeway Weaving Report

Project Information

Analyst		Date	7/10/2023
Agency	GRIFFIN	Analysis Year	Future Year Traffic
Jurisdiction	NSDPW	Time Period Analyzed	Afternoon DHV - Peak Hour Volumes
Project Description	Dartmouth Crossing - Hwy 118 SB C/D Lanes - South Weave Section - Proposed 3 (3 Lane Weave Segment)		

Geometric Data

Number of Lanes (N), ln	3	Segment Type	Highway/CD Roadway
Short Length (L_S), ft	968	Number of Maneuver Lanes (N_{WL}), ln	3
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	0
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	1
Percent Grade, %	-2.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	2.00	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	1348	1253	234	217
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.939	0.939	0.939	0.869
Flow Rate (v_i), pc/h	1527	1420	265	266

Weaving Flow Rate (v_w), pc/h	1686	Freeway Max Capacity (c_{IFL}), pc/h/ln	2200
Non-Weaving Flow Rate (v_{NW}), pc/h	1792	Density-Based Capacity (c_{IWL}), pc/h/ln	1808
Total Flow Rate (v), pc/h	3478	Demand Flow-Based Capacity (c_{IW}), pc/h	7216
Volume Ratio (VR)	0.485	Weaving Segment Capacity (cw), veh/h	5093
Minimum Lane Change Rate (LC_{MIN}), lc/h	266	Adjusted Weaving Area Capacity, pc/h	5281
Maximum Weaving Length (L_{MAX}), ft	6086	Volume-to-Capacity Ratio (v/c)	0.66

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	347	Average Weaving Speed (S_W), mi/h	43.1
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	316	Average Non-Weaving Speed (S_{NW}), mi/h	41.0
Weaving Lane Change Rate (LC_W), lc/h	484	Average Speed (S), mi/h	42.0
Total Lane Change Rate (LC_{All}), lc/h	800	Density (D), pc/mi/ln	27.6
Weaving Intensity Factor (W)	0.194	Level of Service (LOS)	C

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HCS7 Freeway Weaving Report

Project Information

Analyst		Date	7/10/2023
Agency	GRIFFIN	Analysis Year	Future Year Traffic
Jurisdiction	NSDPW	Time Period Analyzed	Afternoon DHV - Peak Hour Volumes
Project Description	Dartmouth Crossing - Hwy 118 SB C/D Lanes - South Weave Section - Proposed 4		

Geometric Data

Number of Lanes (N), ln	2	Segment Type	Highway/CD Roadway
Short Length (L_S), ft	968	Number of Maneuver Lanes (N_{WL}), ln	2
Weaving Configuration	One-Sided	Ramp-to-Freeway Lane Changes (LC_{RF}), lc	1
Terrain Type	Specific Grade	Freeway-to-Ramp Lane Changes (LC_{FR}), lc	0
Percent Grade, %	-2.00	Ramp-to-Ramp Lane Changes (LC_{RR}), lc	0
Interchange Density (ID), int/mi	0.33	Cross Weaving Managed Lane	No

Adjustment Factors

Driver Population	Mostly Familiar	Final Speed Adjustment Factor (SAF)	0.975
Weather Type	Non-Severe Weather	Final Capacity Adjustment Factor (CAF)	0.968
Incident Type	No Incident	Demand Adjustment Factor (DAF)	1.000

Demand and Capacity

	FF	RF	RR	FR
Demand Volume (V_i), veh/h	332	1253	234	200
Peak Hour Factor (PHF)	0.94	0.94	0.94	0.94
Total Trucks, %	5.00	5.00	5.00	5.00
Heavy Vehicle Adjustment Factor (f_{HV})	0.939	0.939	0.939	0.869
Flow Rate (v_i), pc/h	376	1420	265	245

Weaving Flow Rate (v_w), pc/h	1665	Freeway Max Capacity (c_{IFL}), pc/h/ln	2200
Non-Weaving Flow Rate (v_{NW}), pc/h	641	Density-Based Capacity (c_{IWL}), pc/h/ln	1468
Total Flow Rate (v), pc/h	2306	Demand Flow-Based Capacity (c_{IW}), pc/h	3324
Volume Ratio (VR)	0.722	Weaving Segment Capacity (cw), veh/h	2757
Minimum Lane Change Rate (LC_{MIN}), lc/h	1420	Adjusted Weaving Area Capacity, pc/h	2865
Maximum Weaving Length (L_{MAX}), ft	10534	Volume-to-Capacity Ratio (v/c)	0.80

Speed and Density

Non-Weaving Vehicle Index (I_{NW})	21	Average Weaving Speed (S_W), mi/h	39.7
Non-Weaving Lane Change Rate (LC_{NW}), lc/h	272	Average Non-Weaving Speed (S_{NW}), mi/h	32.7
Weaving Lane Change Rate (LC_W), lc/h	1471	Average Speed (S), mi/h	37.5
Total Lane Change Rate (LC_{All}), lc/h	1743	Density (D), pc/mi/ln	30.7
Weaving Intensity Factor (W)	0.359	Level of Service (LOS)	C

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