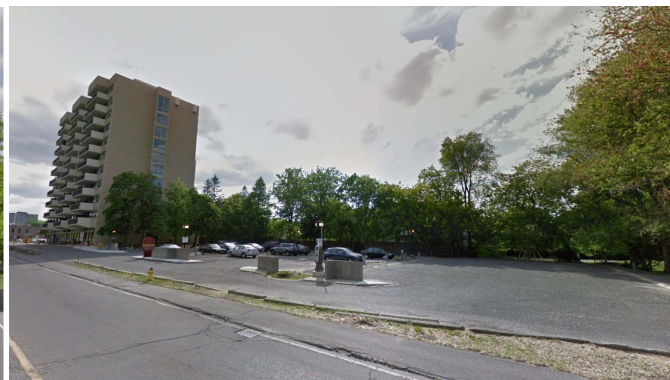




851 Richmond Road Transportation Brief



851 Richmond Road

Transportation Brief

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Transportation Brief

1. INTRODUCTION

This study has been prepared in support of Site Plan Application (SPA) for the redevelopment of Homestead Land Holdings Limited's 851 Richmond Road. The proposed development will consist of two 11 storey towers, one existing and one new tower. The new tower, the primary subject of this application, is anticipated to include 132 residential units. For the purposes of this study it has been assumed that the site will be occupied and operational in 2019.

The subject site, displayed in **Figure 1**, is located on Richmond Road, between the intersections of Woodroffe Road / Richmond Road and Cleary Avenue / Richmond Road. A two-way access to the underground parking is provided directly on Richmond Road. This will replace one of the existing access driveways. In addition, a one-way service access will be provided adjacent to the garage access. This will force the existing traffic to solely use the western existing access. This study will focus on the underground access to the proposed new building, as well as the adjacent road network and signalized intersections.

1.1. CONTEXT

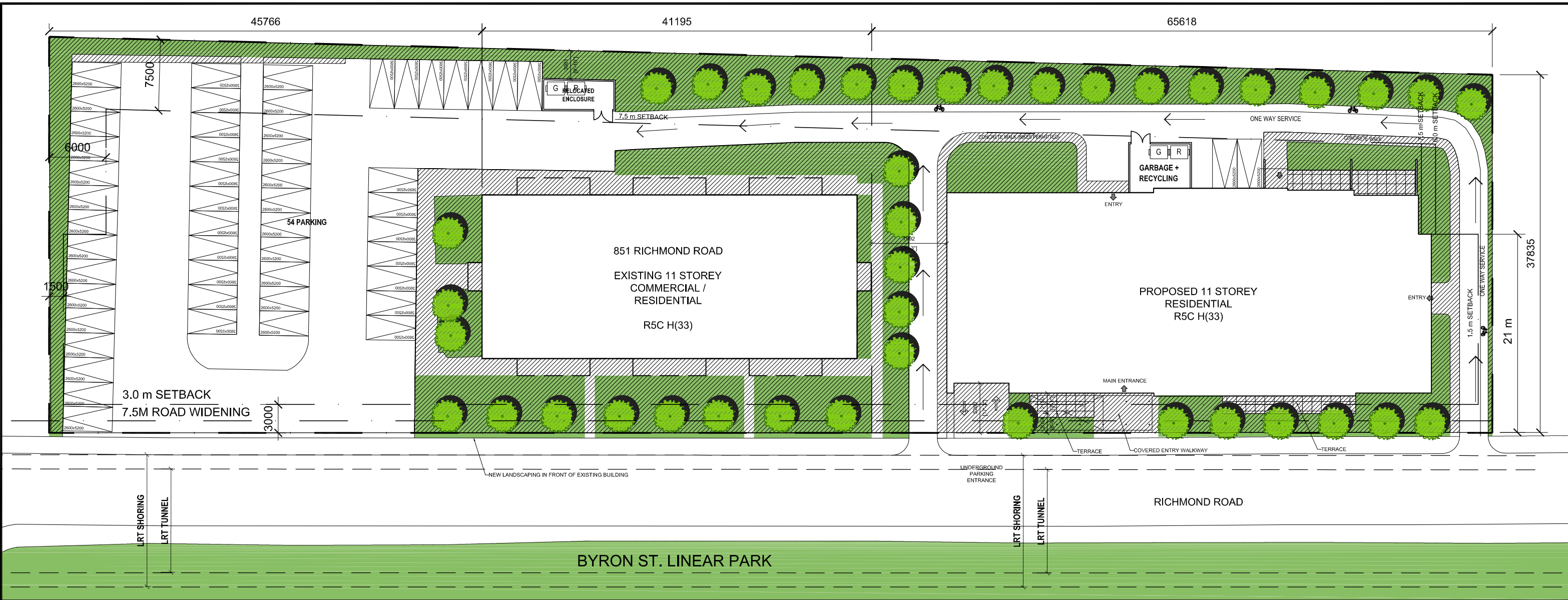
The proposed development is located at the municipal address 851 Richmond Road. The site is located within 300m walking distance of the future Cleary Avenue LRT station and therefore the development needs to be consistent with the Transit-Oriented Development (TOD) guidelines that the City approved in 2007. According to the guidelines, a TOD is "a mix of moderate to high-density transit-supportive land uses located within an easy walk of a rapid transit stop or station that is oriented and designed to facilitate transit use" (City of Ottawa, 2007). In addition, the site should be developed in conjunction with the policies of the Official Plan and all other applicable regulations (i.e. Zoning By-law, Private Approach By-law, Signs By-Law).

The proposed development, shown in **Figure 2** below, includes one new and one existing 11 storey tower, with associated vehicle and bicycle parking. These elements are considered transit-supportive land uses according to City of Ottawa TOD guidelines (2007).

Adjacent land uses along Richmond Road include an autobody shop, restaurants, commercial/retail space and south of the site is the Byron Avenue linear park. Neighbouring residential areas have a variety of dwelling types including apartment buildings, semi-detached homes, and single family homes.

Figure 1: Site Context





BUILDING INFORMATION

OPEN SPACE	
FULL SITE AREA:	65,474 sf
OPEN SPACE:	
TOTAL	21,906 sf 33.5%
NEW PROPOSED BUILDING SITE AREA: 27,351 sf	
OPEN SPACE:	
TOTAL	10,352 sf 37.85%

- OPEN SPACE
- OPEN GREEN SPACE

BLDG FOOTPRINT (LOT COVERAGE)
BOTH NEW/EXISTING: 19,172 sf
NEW PROPOSED BUILDING: 11,692 sf

UNIT TOTALS	
GROUND FLOOR :	(2 UNITS, 3.5 m height)
1 BEDROOM	1
2 BEDROOM	1
LEVELS 2 - 11:	
1 BEDROOM	7
2 BEDROOM	6
TOTAL:	132 UNITS

CONSTRUCTION AREA	
LEVEL 1	11,693 sf
LEVELS 2 -11	12,265 sf per floor (122,650)
TOTAL:	134,343 sf

BLDG PARKING TOTALS	
LEVEL P2:	67
LEVEL P1:	63
TOTAL:	130

STORAGE SPACE & BIKE TOTALS	
3x6 STORAGE LOCKERS (CAN BE USED FOR BIKES):	90
3X4 STORAGE LOCKERS:	66
BIKE PARKING (ground floor):	38
TOTAL BIKE STG CAPACITY:	128
TOTAL STORAGE LOCKERS:	156

AMENITY SPACE	
AMENITY SMALL (MAIN FLR):	854sf
AMENITY LARGE (MAIN FLR):	2,504sf
AMENITY BALCONIES: (COMBINED LEVELS 2-11)	10,828sf
AMENITY ROOF: (INCL. VEST.)	8342sf
TOTAL:	14,186sf



2. EXISTING CONDITIONS

2.1. STUDY AREA ROAD NETWORK

Richmond Road is a two lane east-west arterial road in the City of Ottawa. The posted speed limit for Richmond Road within the Study Area is 50km/h.

Woodroffe Avenue is a north-south arterial road in the City of Ottawa. The posted speed limit for Woodroffe Avenue at the intersection with Richmond Road is 50km/h.

Cleary Avenue is a dead end local road that connects Richmond Road with several buildings including a church, a children's center, and a senior's assisted living facility. The posted speed limit is 25km/h.

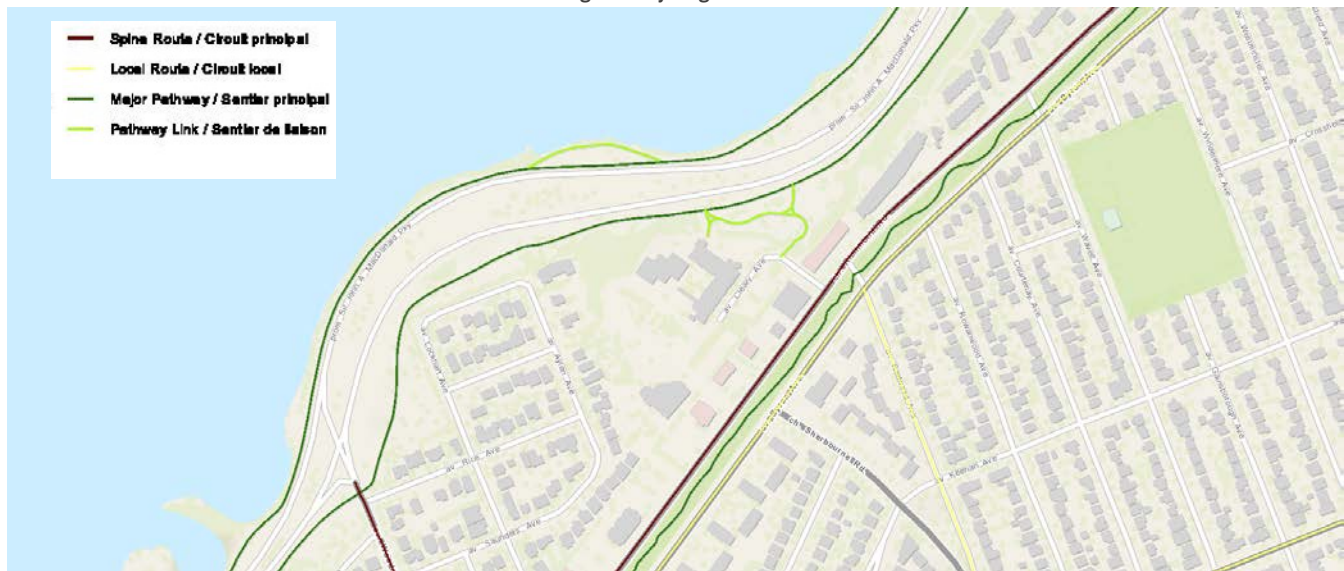
2.2. PEDESTRIAN/CYCLING NETWORK

Paved shoulders for cycling are provided on Richmond Road. The City of Ottawa's 2013 Cycling Plan identifies Richmond Road and Woodroffe Road as Spine or City-Wide cycling routes. There are no existing cycling facilities on Woodroffe Avenue. Cleary Avenue does not have any existing or future planned cycling infrastructure.

Sidewalks are located on the north side of Richmond Road. A multi-use pathway runs east-west along the Byron Avenue linear park. The NCC's Ottawa River multi-use pathway network connects to Cleary Avenue. Woodroffe and Cleary Avenues have sidewalks located on both sides of the street.

Figure 3 illustrates the Study Area, and surrounding area, cycling network.

Figure 3: Cycling Network



2.3. TRANSIT NETWORK

Local OC Transpo Route 2 runs along Richmond Road. Local routes run seven days/week in most time periods. Richmond Road is an existing Rapid Transit Corridor.

Woodroffe Avenue is serviced by OC Transpo local routes 2, 87, and 153 in the vicinity of the Study Area. Transit stops are located only southbound within the Study Area. Woodroffe Avenue has no designation within the Rapid Transit Network. **Figure 4** shows the transit routes through the Study Area.

Figure 4: Existing Transit Network

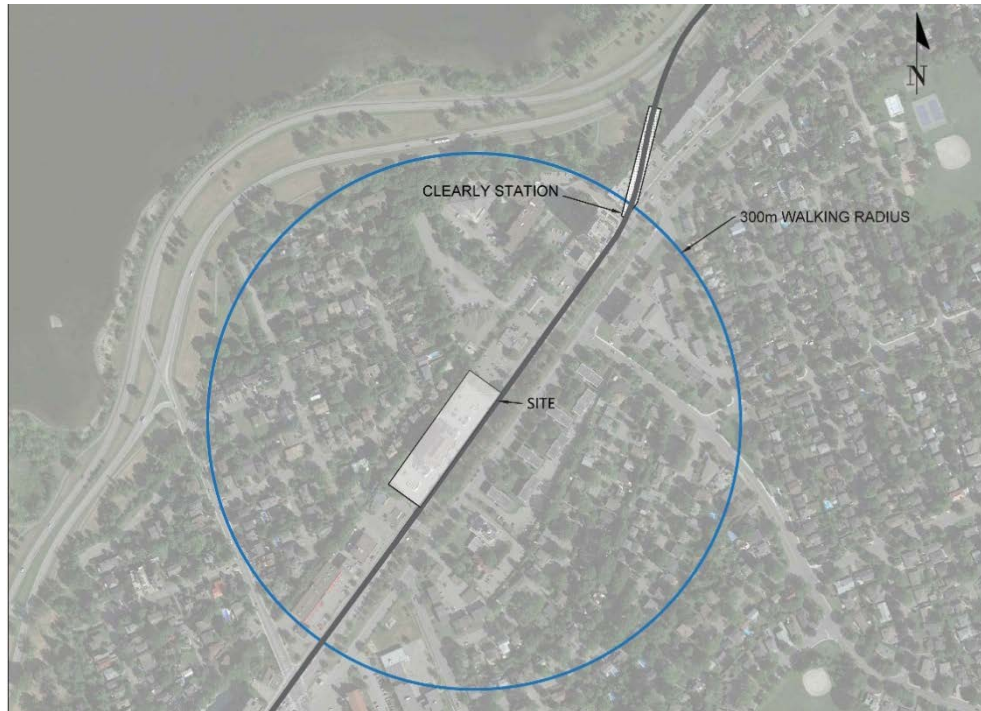


Accessed July 18, 2017. <http://www.octranspo1.com/images/files/systemmap/systemmap.pdf>

The 2013 Transportation Master Plan identifies that Richmond Road will become a part of the Phase 2 Future Light Rail Transit (LRT) network in the City of Ottawa within the Transportation Master Plan's (TMP's) ultimate horizon (2031). A new LRT station is proposed at Cleary Avenue, approximately 300m northeast of the site. Both the station and the LRT line will be located underground in this area.

Figure 5 shows the LRT route through the Study Area and the proximity of the Cleary Station to the subject development.

Figure 5: Phase 2 Light Rail Transit Stations



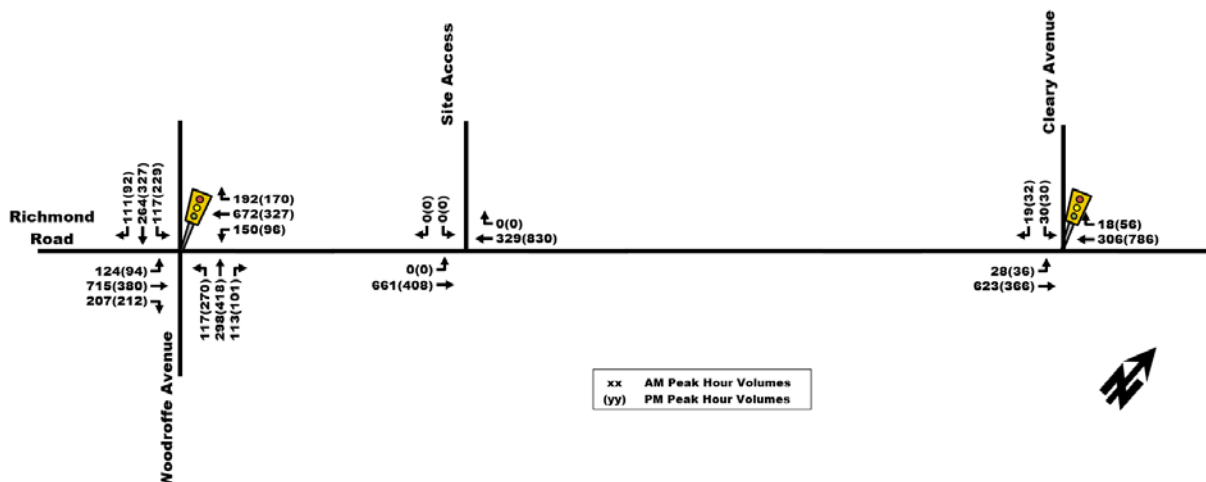
2.4. EXISTING INTERSECTION OPERATIONS

To establish the baseline intersection operations an operational analysis of the existing traffic conditions has been undertaken for the Study Area intersections. Recent turning movement counts have been obtained from the City of Ottawa. The counts were undertaken on the following dates:

- Cleary Avenue @ Richmond Road – Friday, June 12, 2015
- Woodroffe Avenue @ Richmond Road – Friday, May 23, 2014

The counts were adjusted to reflect 2017 conditions using a 1.5% annual background growth rate. **Figure 6** shows the resultant traffic volumes at the Study Area intersections.

Figure 6: 2017 Traffic Volumes



Appendix A contains the detailed traffic data sheets.

To assess the peak hour traffic conditions a level of service analysis has been completed using Trafficware Synchro 9.1, which implements the methods of the 2000 Highway Capacity Manual. The key parameters used in the analysis include:

- A saturation flow rate of 1800 (as per the City of Ottawa TIA Guidelines)
- Existing lane arrangements
- Existing signal timing (provided by the City of Ottawa)
- Peak hour factor (derived from the traffic count provided by the City of Ottawa)
- Heavy vehicle percentages (derived from the traffic count provided by the City of Ottawa)
- Heavy vehicle equivalent factor of 1.70 (as per the City of Ottawa TIA Guidelines)
- Default values for all other inputs (as defined by Synchro 9.1)

The results of the operational analysis are summarized in **Table 1**. The existing signal timing information is included in **Appendix A**. The Synchro analysis outputs are provided in **Appendix B**.

Table 1: Capacity Analysis

Intersection	Weekday AM Peak (PM Peak)					
	Critical Movement			Intersection 'as a Whole'		
	LOS	max. v/c or avg. delay (s)	Movement	Delay (s)	LOS	v/c
Woodroffe Avenue / Richmond Road (Signalized)	D(E)	0.90(0.98)	WBL(SBL)	32.6(37.1)	B(C)	0.67(0.72)
Cleary Avenue / Richmond Road (Signalized)	C(D)	0.77(0.87)	EBT(WBT)	14.3(19.4)	C(C)	0.73(0.75)
Notes: Analysis of signalized intersections assumes a PHF of 0.95 and a saturation flow rate of 1800 veh/h/lane.						

As shown in **Table 1**, the signalized Woodroffe Avenue/Richmond Road critical movements are currently operating at a LOS 'D' for the westbound left turn during the AM peak period and a LOS 'E' for the southbound left movement during the PM peak.

The Cleary Avenue/Richmond Road 'critical movements' are identified as the eastbound through during the AM peak (LOS 'C') and the westbound through during the PM peak (LOS 'D').

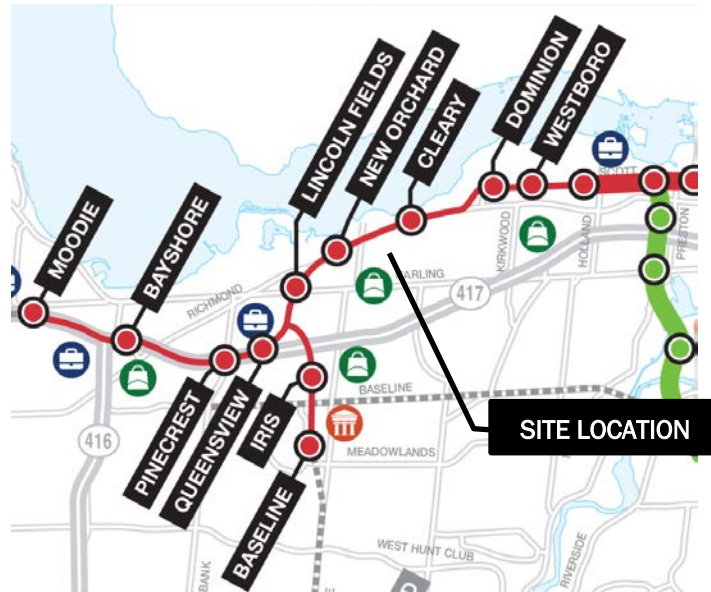
The overall intersection LOS at these locations is within the permissible operational thresholds.

3. DEMAND FORECASTING

3.1. PLANNED STUDY AREA TRANSPORTATION NETWORK CHANGES

The City of Ottawa is planning to expand the nearly completed Stage 1 LRT to include additional stops east and west of Stage 1. Stage 2 will extend westward along the existing Transitway. At Dominion Station the Transitway ends and the Stage 2 LRT West will diverge towards Richmond Road. In the Study Area, the Stage 2 LRT West will run beneath Richmond Road. The Cleary Station will be within 300m walking distance of the subject development. **Figure 7** illustrates the general Stage 2 LRT West alignment and the future stations, as well as the proposed site location relative to the Cleary Station. To account for this change in the transportation network an updated mode share estimate has been created for the post LRT scenario (2024). This will be further documented in **Section 3.4**.

Figure 7: Planned Transitway Map



3.2. OTHER AREA DEVELOPMENT

Adjacent to the subject development is the former Kristy's Restaurant, located at 809 Richmond Road. 809 Richmond Road has recently been the subject of a development application. The development would consist of two 16 storey towers with 11,000 sq. ft. of retail space, and 252 residential units. The traffic impacts of 809 Richmond Road have been documented in the 809 Richmond Road Transportation Impact Study, Parsons, 2016. The results of that study have been used herein to account for traffic growth within the Study Area. **Figure 8** illustrates the 809 Richmond Road Site Plan. **Figure 9** illustrates the site generated traffic from 809 Richmond Road.

Figure 8: 809 Richmond Road Site Plan

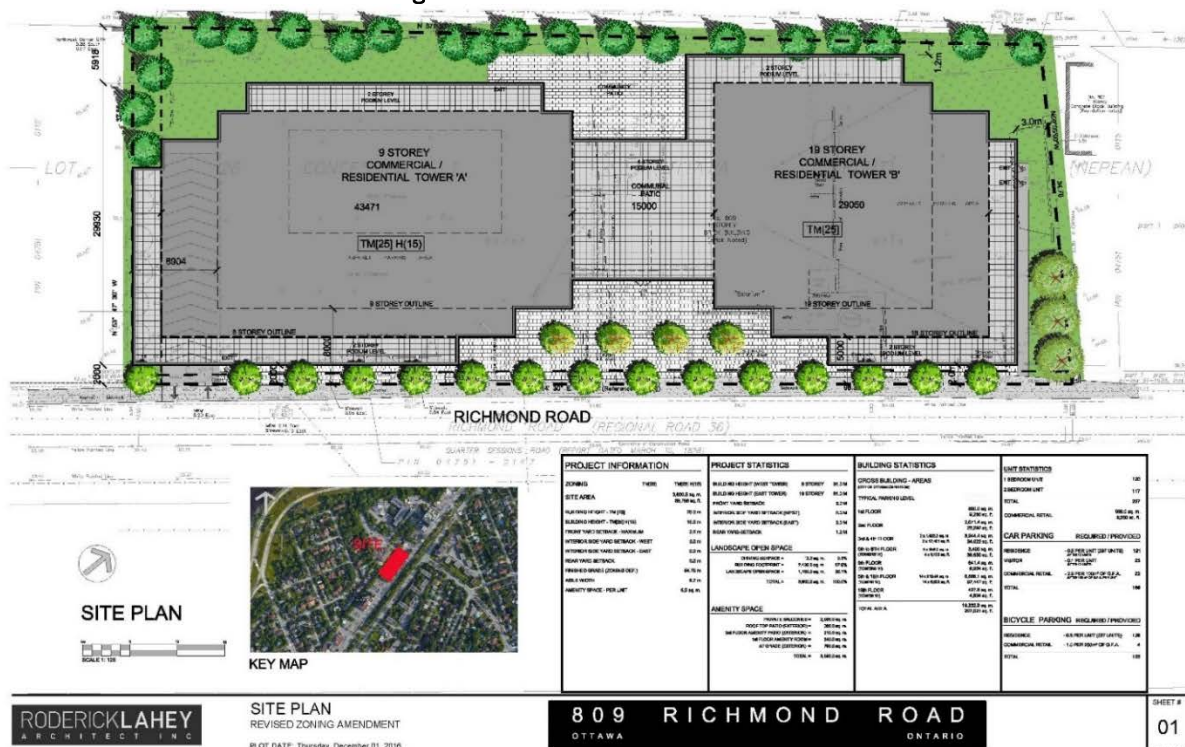
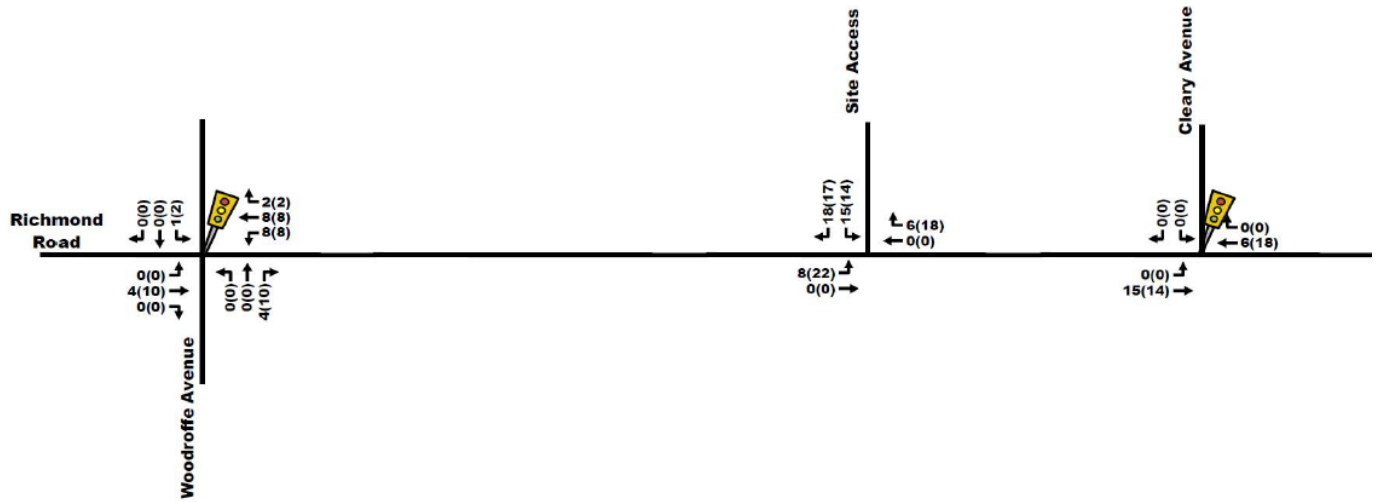


Figure 9: 809 Richmond Road Site Generated Traffic



3.3. BACKGROUND TRAFFIC GROWTH

To estimate traffic growth beyond the Study Area a background growth rate of 1.5% has been applied to the turning movement counts along both Richmond Road and Woodroffe Road. **Figure 10** and **Figure 11** show the future background traffic volumes for the 2019 and 2024 future background traffic volumes, respectively.

Figure 10: 2019 Future Background Traffic

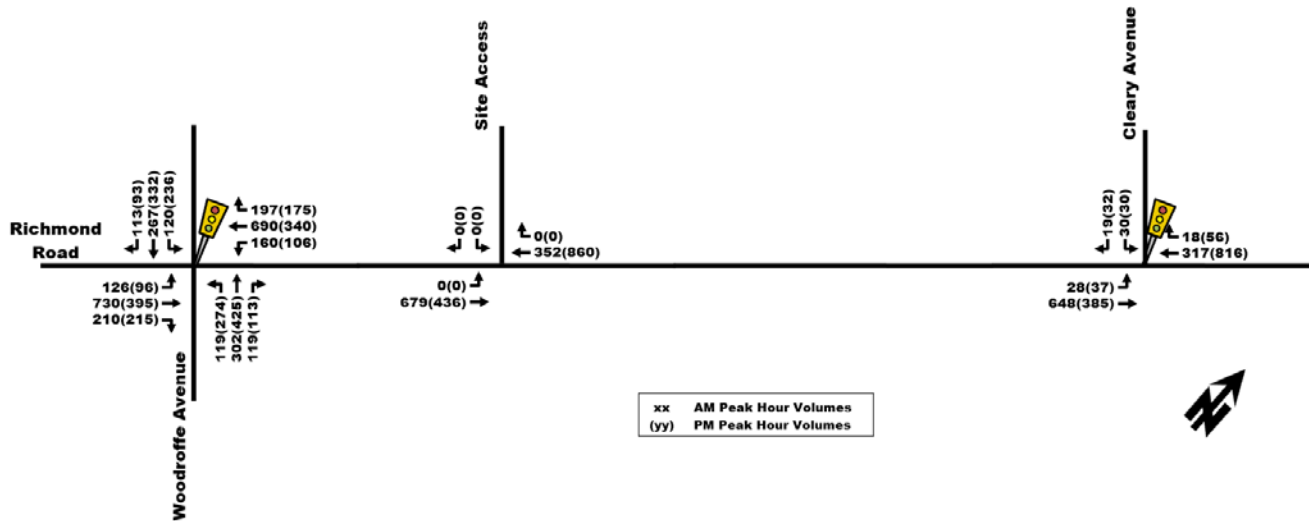
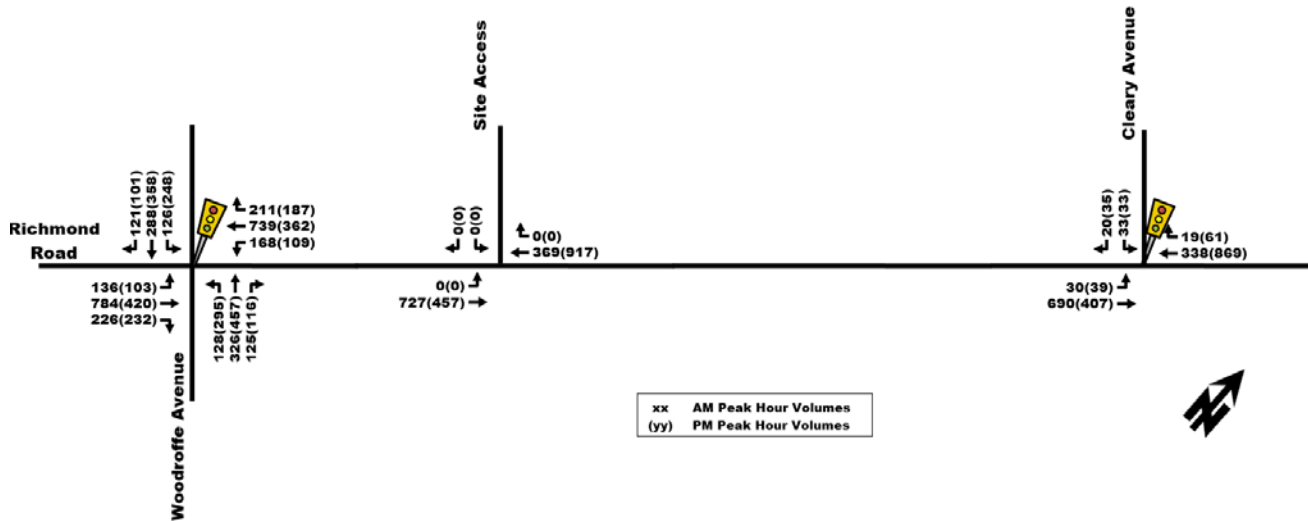


Figure 11: 2024 Future Background Traffic



3.4. SITE TRIP GENERATION

An appropriate trip generation rate equations for the proposed development was obtained from the 9th Edition of the Institute of Transportation Engineers (ITE) Trip Generation Manual, which are summarized in **Table 2**.

Table 2: ITE Vehicle Trip Generation Rates

Land Use	Data Source	Trip Rates	
		AM Peak	PM Peak
High-Rise Apartment	ITE 233	$\ln(T) = 0.80(x) + 0.26$	$\ln(T) = 0.82(x) + 0.32$
Notes: T = Average Vehicle Trip Ends X = Residential units			

As ITE trip generation surveys only record vehicle trips and typically reflect highly suburban locations (with little to no access by travel modes other than private automobiles), adjustment factors appropriate to the more connected suburban study area context were applied to attain estimates of person trips for the proposed development. This approach is considered appropriate within the industry for urban developments.

To convert ITE vehicle trip rates to person trips, an auto occupancy factor and a non-auto trip factor were applied to the ITE vehicle trip rates. Our review of available literature suggests that a combined factor of approximately 1.3 is considered reasonable to account for typical North American auto occupancy values of approximately 1.15 and combined transit and non-motorized modal shares of less than 10%. As such, the person trip generation for the proposed site is summarized in **Table 3**.

Table 3: Modified Person Trip Generation Rates

Land Use	Units	AM Peak (Person Trips/h)			PM Peak (Person Trips/h)		
		In	Out	Total	In	Out	Total
High-Rise Apartment	233	13	39	52	43	28	71
Total Person Trips		13	39	52	43	28	71
Note: 1.3 factor to account for typical North American auto occupancy values of approximately 1.15 and combined transit and non-motorized modal shares of less than 10%							

The person trips shown in **Table 3** for the proposed site were then reduced by modal share values for the pre-OLRT (2019) scenario, with the total site-generated vehicle traffic summarized in **Table 4**.

Table 4: Total Site Trip Generation (Pre-OLRT)

Travel Mode	Mode Share	AM Peak (Person Trips/hr)			PM Peak (Person Trips/hr)		
		In	Out	Total	In	Out	Total
Auto Driver	40%	6	16	22	18	12	30
Auto Passenger	15%	2	6	8	7	4	11
Transit	25%	3	10	13	10	7	17
Non-motorized	20%	2	7	9	8	5	13
Total Person Trips	100%	13	39	52	43	28	71
Total 'New' Auto Trips		6	16	22	18	12	30

As shown in **Table 4**, the resulting number of potential 'new' two-way vehicle trips for the proposed development is approximately 22 and 30 veh/h during the weekday morning and afternoon peak hours, respectively.

The person trips shown in **Table 3** for the proposed site were then reduced by modal share values for the post-OLRT (2024) scenario, with the total site-generated vehicle traffic summarized in **Table 5**.

Table 5: Total Site Trip Generation (Post-OLRT)

Travel Mode	Mode Share	AM Peak (Person Trips/hr)			PM Peak (Person Trips/hr)		
		In	Out	Total	In	Out	Total
Auto Driver	20%	3	8	11	9	6	15
Auto Passenger	15%	2	6	8	7	5	12
Transit	45%	6	18	24	19	12	31
Non-motorized	20%	2	7	9	8	5	13
Total Person Trips	100%	13	39	52	43	28	71
Total 'New' Auto Trips		3	8	11	9	6	15

As shown in **Table 5**, the resulting number of potential 'new' two-way vehicle trips for the proposed development is approximately 11 and 15 veh/h during the weekday morning and afternoon peak hours, respectively. The future vehicle trip generation is expected to decrease over time as a result of access to the Stage 2 LRT at Cleary Station.

3.5. VEHICLE DISTRIBUTION AND ASSIGNMENT

The vehicle traffic distribution and assignment was developed using the 2011 NCR Household Origin – Destination Survey. The resultant distribution is outlined in **Table 6**.

Table 6: Traffic Distribution

To/From	AM Peak Hour
North	5%
South	5%
East	65%
West	25%
Total	100%

New site generated trips were assigned to the Study Area intersections using the above distribution, turning movement splits, proximity / connectivity to major transportation infrastructure (i.e. Highway 417), and the proposed access configuration. **Figure 12** and **Figure 13** show the 2019 and 2024 site generated traffic volumes, respectively.

Figure 12: 2019 Site Generated Traffic Volumes

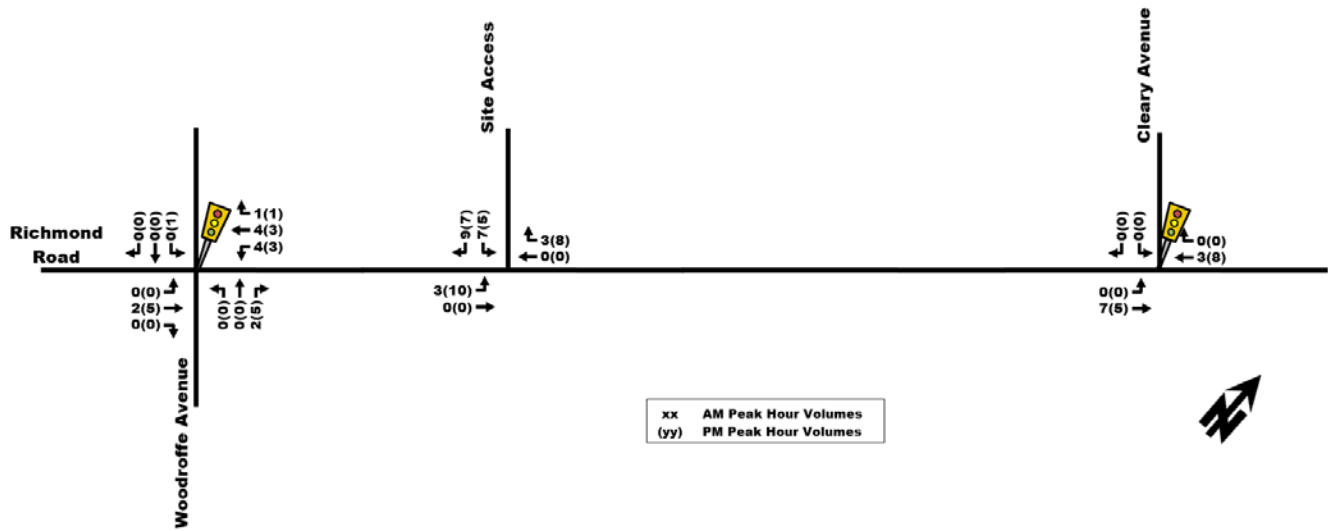
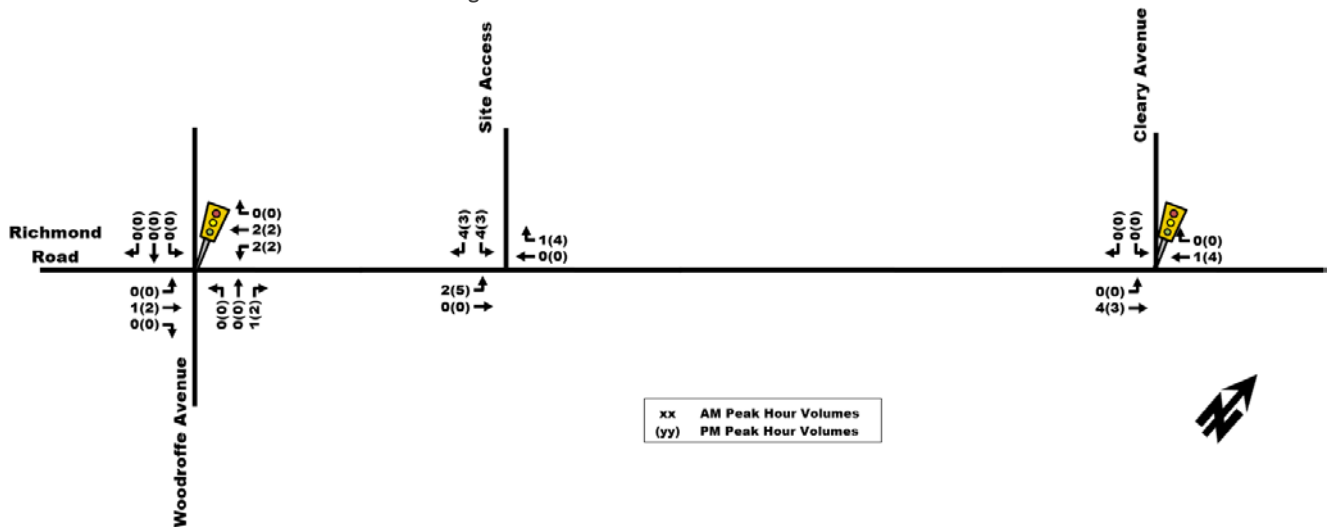


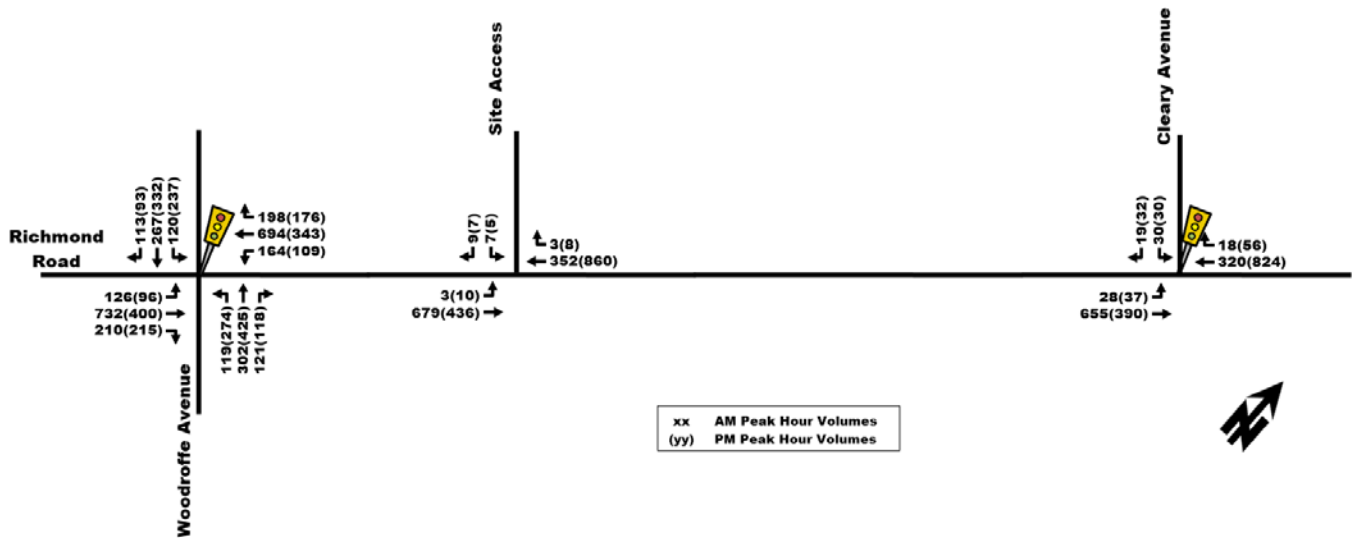
Figure 13: 2024 Site Generated Traffic Volumes



3.6. PROJECTED 2019 CONDITIONS AT FULL SITE DEVELOPMENT

The total projected 2019 volumes associated with the proposed development were derived by superimposing 'new' site-generated traffic volumes (Figure 12) onto projected 2019 background traffic volumes (Figure 10). The resulting total projected 2019 volumes are illustrated as Figure 14.

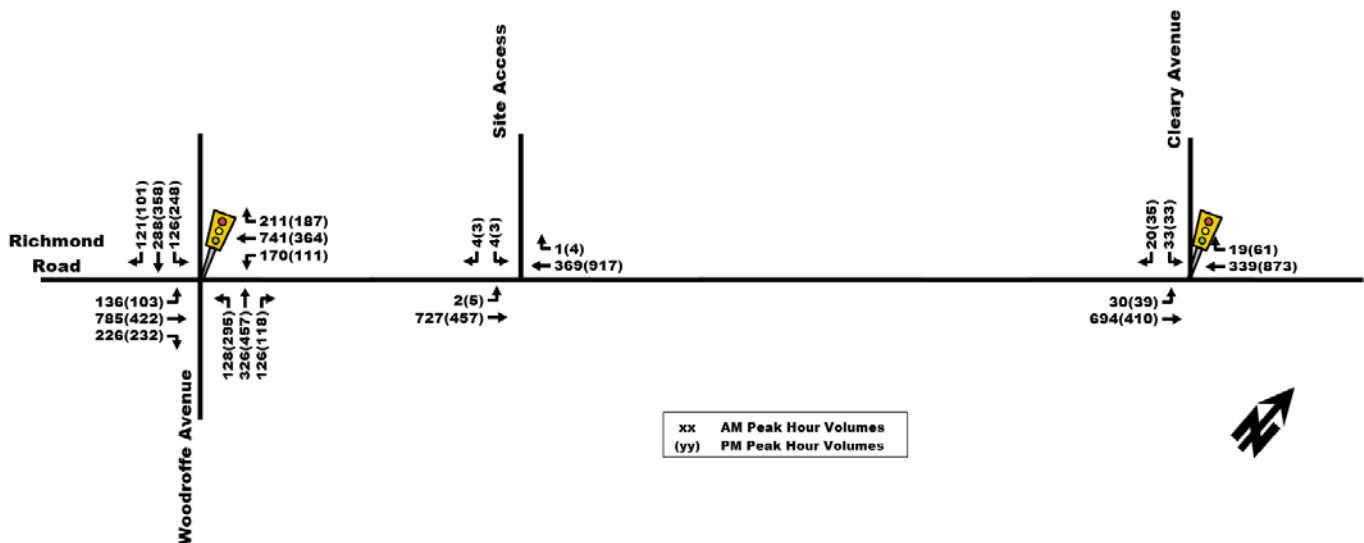
Figure 14: 2019 Total Future Traffic Volumes



3.7. PROJECTED 2024 CONDITIONS AT FULL SITE DEVELOPMENT PLUS FIVE YEARS

The total projected 2024 volumes associated with the proposed development were derived by superimposing 'new' site-generated traffic volumes (Figure 13) onto projected 2024 background traffic volumes (Figure 11). The resulting total projected 2024 volumes are illustrated as Figure 15.

Figure 15: 2024 Total Future Traffic Volumes



4. FUTURE TRAFFIC OPERATIONS

4.1. 2019 FUTURE BACKGROUND CONDITIONS

The operational analysis of the 2019 background conditions is summarized in **Table 7** below. The detailed Synchro analysis sheets are provided as **Appendix C**.

Table 7: 2019 Future Background Capacity Analysis

Intersection	Weekday AM Peak (PM Peak)					
	Critical Movement			Intersection 'as a Whole'		
	LOS	max. v/c or avg. delay (s)	Movement	Delay (s)	LOS	v/c
Woodroffe Avenue / Richmond Road (Signalized)	D(E)	0.90(0.98)	WBL(SBL)	32.6(37.1)	B(C)	0.67(0.72)
Cleary Avenue / Richmond Road (Signalized)	C(D)	0.77(0.87)	EBT(WBT)	14.3(19.4)	C(C)	0.73(0.75)
Notes: Analysis of signalized intersections assumes a PHF of 0.95 and a saturation flow rate of 1800 veh/h/lane.						

As shown in **Table 7**, the signalized Woodroffe Avenue/Richmond Road critical movements are projected to operate at a LOS 'D' for the westbound left turn during the AM peak period and a LOS 'E' for the southbound left movement during the PM peak.

For the intersection at the signalized intersection at Cleary Avenue/Richmond Road, the critical movements are projected to operate at LOS 'C' for the eastbound through movement during the AM peak period and LOS 'D' for the westbound through movement during the PM peak.

The overall intersection LOS at these locations is within the permissible operational thresholds.

4.2. 2019 TOTAL FUTURE CONDITIONS

The operational analysis of the 2019 background conditions is summarized in **Table 8** below. The detailed Synchro analysis sheets are provided as **Appendix D**.

Table 8: 2019 Total Future Capacity Analysis

Intersection	Weekday AM Peak (PM Peak)					
	Critical Movement			Intersection 'as a Whole'		
	LOS	max. v/c or avg. delay (s)	Movement	Delay (s)	LOS	v/c
Woodroffe Avenue / Richmond Road (Signalized)	E(E)	0.93(1.00)	WBL(SBL)	33.0(37.8)	B(C)	0.68(0.73)
Cleary Avenue / Richmond Road (Signalized)	C(D)	0.78(0.88)	EBT(WBT)	14.5(20.0)	C(C)	0.74(0.77)
Richmond Road / West Site Access (Unsignalized)	C(C)	0.3(0.4)	SB(SB)	15.2(22.7)	-	-
Notes: Analysis of signalized intersections assumes a PHF of 0.95 and a saturation flow rate of 1800 veh/h/lane.						

As shown in **Table 8**, the signalized Woodroffe Avenue/Richmond Road critical movements are projected to operate at a LOS 'E' for the westbound left turn during the AM peak period and a LOS 'E' for the southbound left movement during the PM peak.

For the intersection at the signalized intersection at Cleary Avenue/Richmond Road, the critical movements are projected to operate at LOS 'C' for the eastbound through movement during the AM peak period and LOS 'D' for the westbound through movement during the PM peak.

The proposed unsignalized access at Richmond Road/West Site Access has projected critical movements operating at LOS 'C' for both AM and PM peaks.

The overall intersection LOS at these locations is within the permissible operational thresholds.

4.3. 2024 FUTURE BACKGROUND CONDITIONS

The operational analysis of the 2019 background conditions is summarized in **Table 9** below. The detailed Synchro analysis sheets are provided as **Appendix E**.

Table 9: 2024 Future Background Capacity Analysis

Intersection	Weekday AM Peak (PM Peak)					
	Critical Movement			Intersection 'as a Whole'		
	LOS	max. v/c or avg. delay (s)	Movement	Delay (s)	LOS	v/c
Woodroffe Avenue / Richmond Road (Signalized)	F(F)	1.09(1.16)	WBL(SBL)	38.0(46.5)	C(C)	0.74(0.79)
Cleary Avenue / Richmond Road (Signalized)	D(E)	0.83(0.93)	EBT(WBT)	16.4(26.3)	C(D)	0.78(0.84)
Notes: Analysis of signalized intersections assumes a PHF of 0.95 and a saturation flow rate of 1800 veh/h/lane.						

As shown in **Table 9**, the signalized Woodroffe Avenue/Richmond Road critical movements are projected to operate at a LOS 'F' for the westbound left turn during the AM peak period and a LOS 'F' for the southbound left movement during the PM peak.

For the intersection at the signalized intersection at Cleary Avenue/Richmond Road, the critical movements are projected to operate at LOS 'D' for the eastbound through movement during the AM peak period and LOS 'E' for the westbound through movement during the PM peak.

4.4. 2024 TOTAL FUTURE CONDITIONS

The operational analysis of the 2019 background conditions is summarized in **Table 10** below. The detailed Synchro analysis sheets are provided as **Appendix F**.

Table 10: 2024 Total Future Capacity Analysis

Intersection	Weekday AM Peak (PM Peak)					
	Critical Movement			Intersection 'as a Whole'		
	LOS	max. v/c or avg. delay (s)	Movement	Delay (s)	LOS	v/c
Woodroffe Avenue / Richmond Road (Signalized)	F(F)	1.09(1.16)	WBL(SBL)	38.0(46.5)	C(C)	0.74(0.79)
Cleary Avenue / Richmond Road (Signalized)	D(E)	0.83(0.93)	EBT(WBT)	16.4(26.3)	C(D)	0.78(0.84)
Richmond Road / West Site Access (Unsignalized)	C(D)	0.1(0.2)	SB(SB)	16.3(26.5)	-	-
Notes: Analysis of signalized intersections assumes a PHF of 0.95 and a saturation flow rate of 1800 veh/h/lane.						

As shown in **Table 10**, the signalized Woodroffe Avenue/Richmond Road critical movements are projected to operate at a LOS 'F' for the westbound left turn during the AM peak period and a LOS 'F' for the southbound left movement during the PM peak.

For the intersection at the signalized intersection at Cleary Avenue/Richmond Road, the critical movements are projected to operate at LOS 'D' for the eastbound through movement during the AM peak period and LOS 'E' for the westbound through movement during the PM peak.

The proposed unsignalized access at Richmond Road/West Site Access has projected critical movements operating at LOS 'C' for the AM peak and LOS 'D' for the PM peak period.

5. FINDINGS AND RECOMMENDATIONS

851 Richmond Road, located on Richmond Road, between the intersections of Woodroffe Road / Richmond Road and Cleary Avenue / Richmond Road, is a residential development that will consist of 132 new High-Rise Apartment units.

Based on the foregoing analysis of the proposed development, the following transportation-related conclusions are offered:

EXISTING CONDITIONS

- The intersection north of the site within the study area at Cleary Avenue / Richmond Road is currently operating 'as a whole' with an overall LOS 'C' or better during the weekday morning and afternoon peak hours.
- The intersection south of the site within the study area at Woodroffe Avenue / Richmond Road is currently operating 'as a whole' with an overall LOS 'C' or better during the weekday morning and afternoon peak hours.
- No safety issues were noted at the signalized study area intersections adjacent to the proposed site.

PROJECTED CONDITIONS

- To account for background growth beyond that Study Area, a 1.5% traffic growth rate per annum was assumed for the 2019 and 2024 horizon years.
- It is projected that the proposed development, for the 2019 horizon, would generate 'new' two-way vehicle volumes of approximately 22 and 30 veh/h during the weekday morning and afternoon peak hours, respectively.
- As a result of the anticipated shift in mode share, it is projected that the proposed development, for the 2024 horizon, would generate 'new' two-way vehicle volumes of approximately 11 and 15 veh/h during the weekday morning and afternoon peak hours, respectively.
- At full occupancy (year 2019), study area intersections 'as a whole' are projected to operate at an acceptable LOS 'C' or better and the 'critical movements' are projected to operate at acceptable levels of service during both peak hours.
- At 5-years beyond site build-out, study area intersections 'as a whole' are projected to operate at an acceptable LOS 'D' or better;

Based on the foregoing, the proposed development fits well into the context of the surrounding area, and its location and design serves to promote use of walking, cycling, and transit modes, thus supporting City of Ottawa policies, goals and objectives with respect to redevelopment, intensification and modal share.

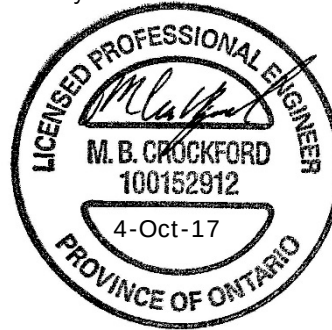
Therefore, Homestead's proposed development at 851 Richmond Road is recommended from a transportation perspective.

Prepared By:



Matthew Mantle, E.I.T
Engineering Associate, Transportation

Reviewed By:



Mark Crockford, P.Eng.
Transportation Engineer

Appendix A

Traffic Data

Public Works - Traffic Services

Turning Movement Count - Peak Hour Diagram

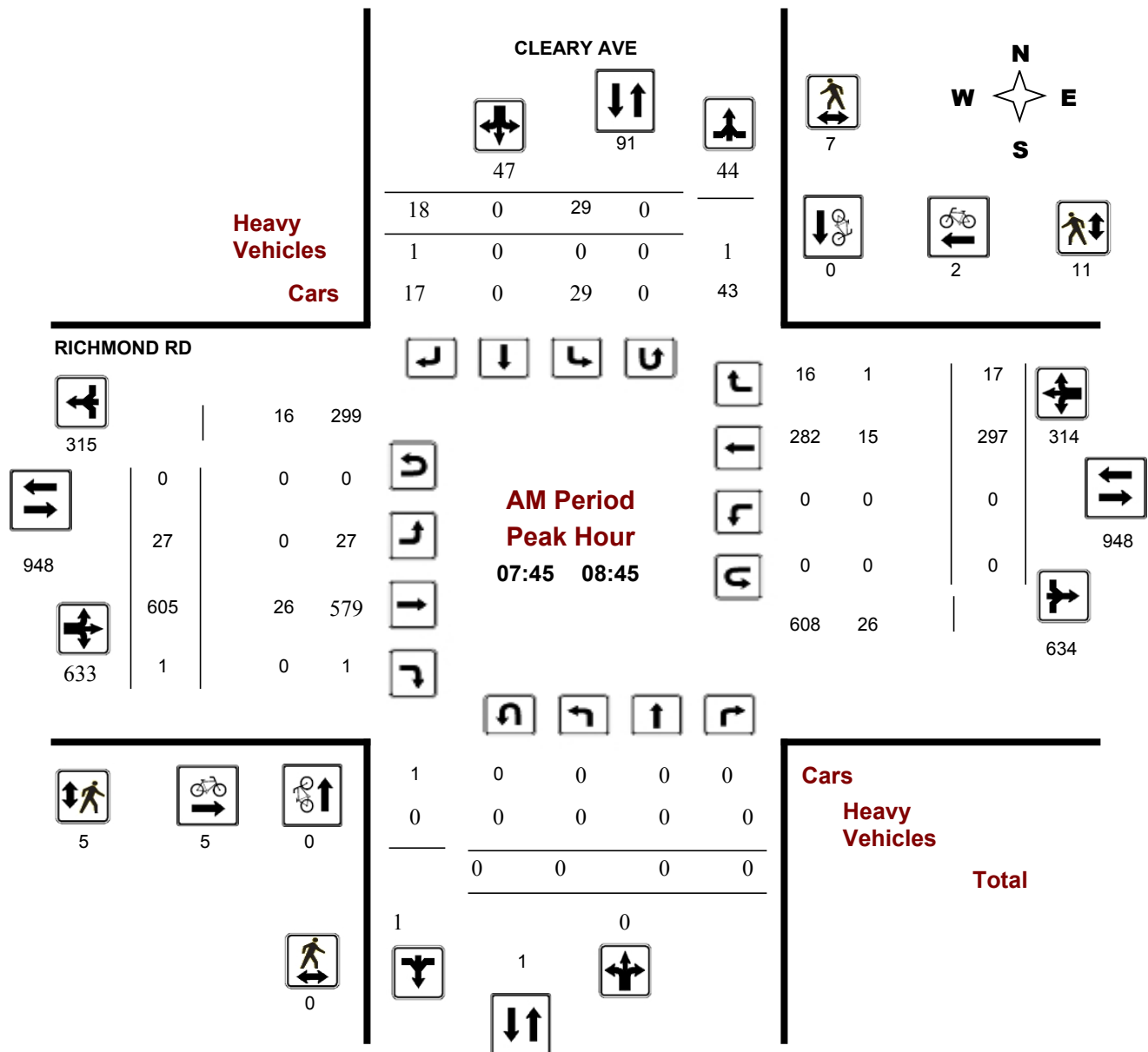
CLEARY AVE @ RICHMOND RD

Survey Date: Friday, June 12, 2015

Start Time: 07:00

WO No: 34681

Device: Jamar Technologies, Inc



Comments

Turning Movement Count - Peak Hour Diagram

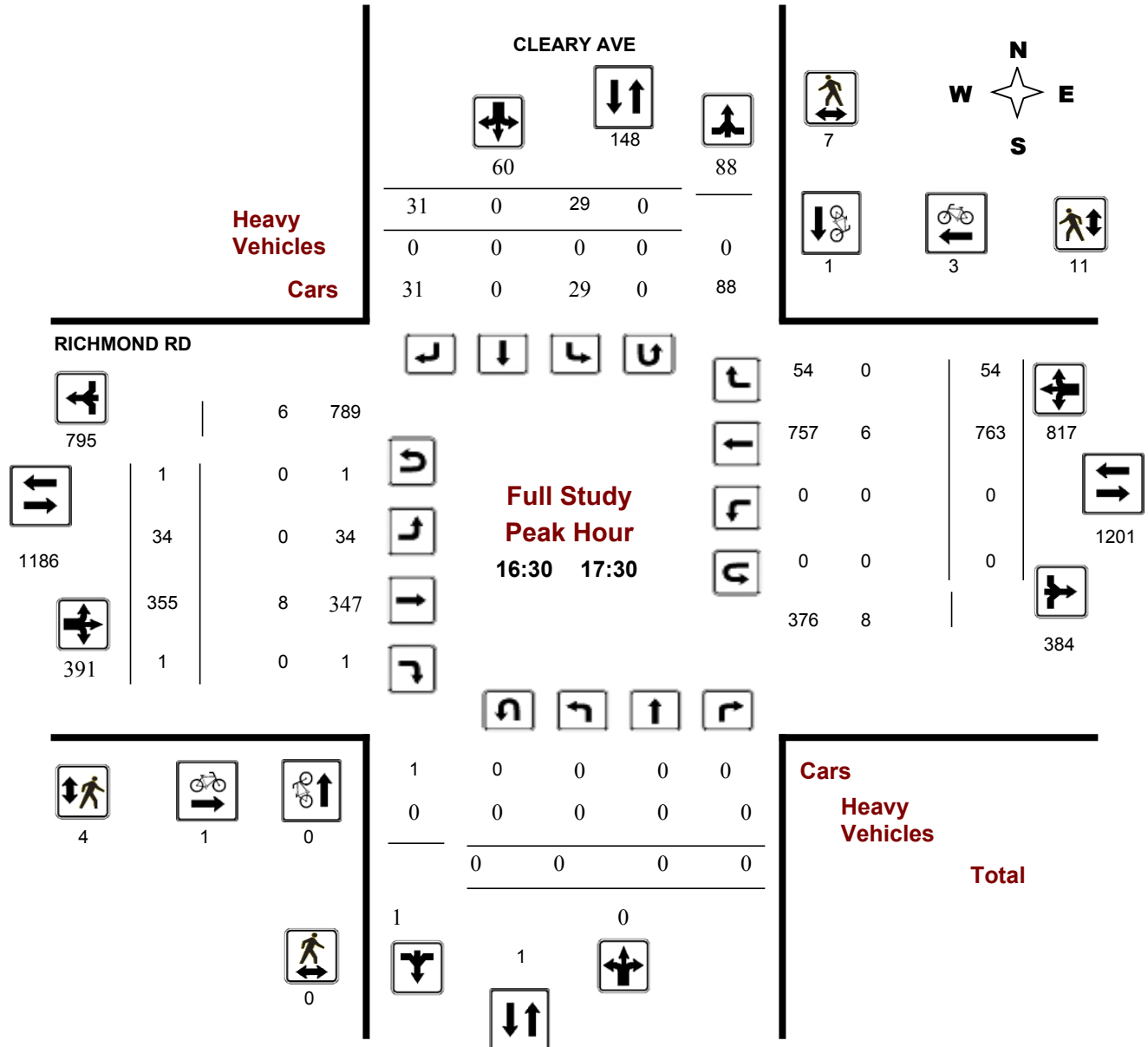
CLEARY AVE @ RICHMOND RD

Survey Date: Friday, June 12, 2015

Start Time: 07:00

WO No: 34681

Device: Jamar Technologies, Inc



Turning Movement Count - Peak Hour Diagram

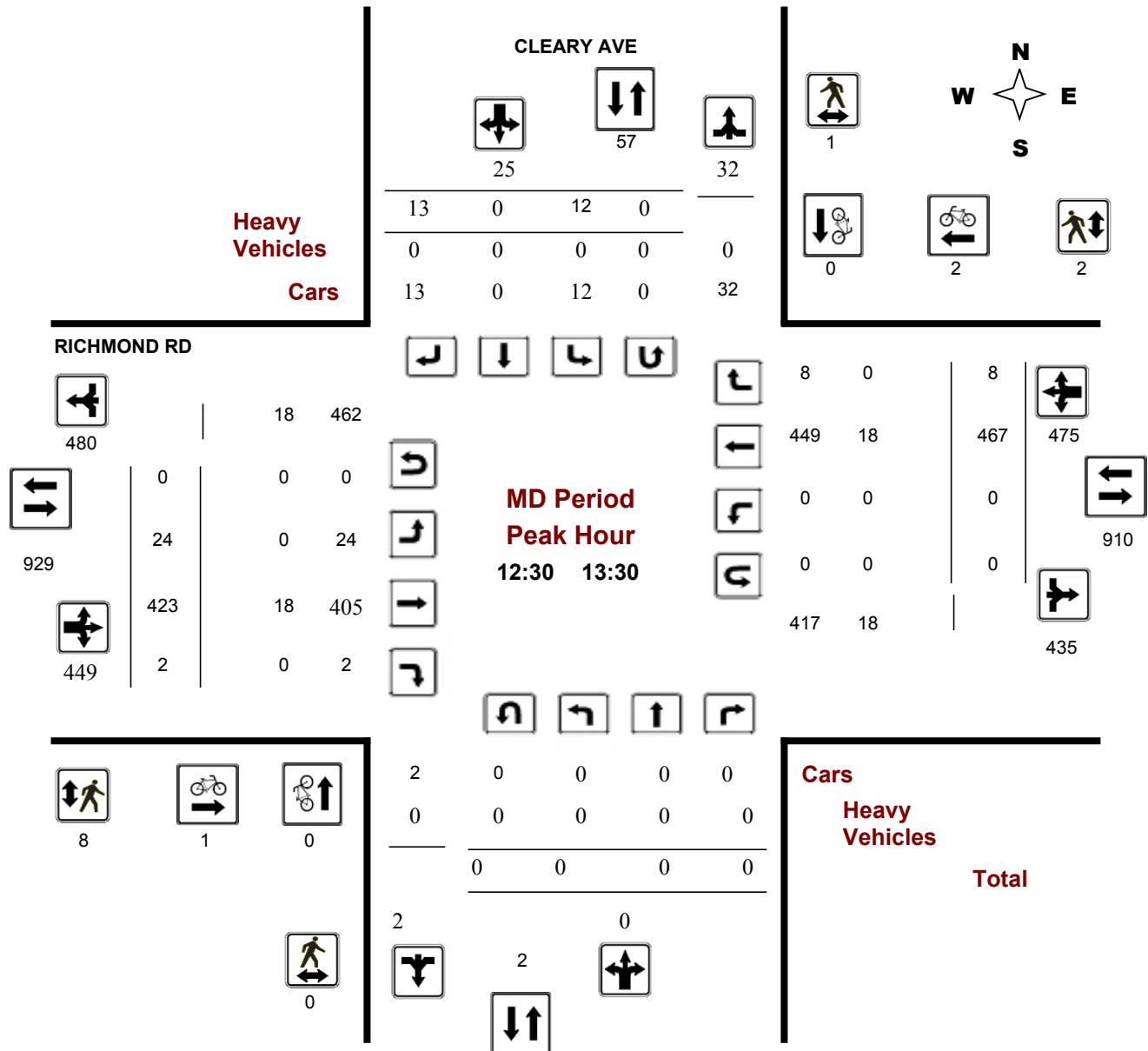
CLEARY AVE @ RICHMOND RD

Survey Date: Friday, June 12, 2015

Start Time: 07:00

WO No: 34681

Device: Jamar Technologies, Inc



Turning Movement Count - Peak Hour Diagram

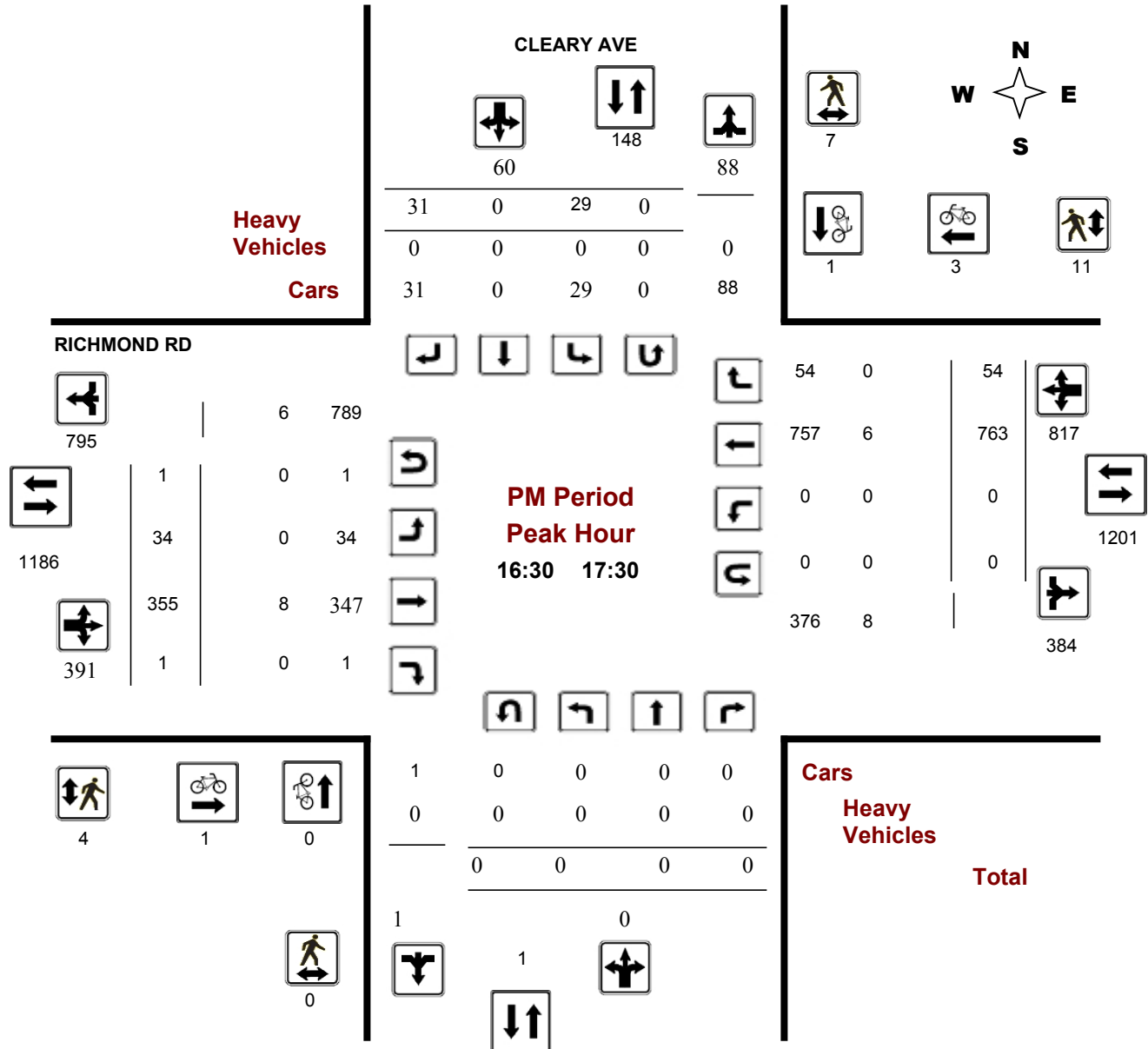
CLEARY AVE @ RICHMOND RD

Survey Date: Friday, June 12, 2015

Start Time: 07:00

WO No: 34681

Device: Jamar Technologies, Inc



Turning Movement Count - Full Study Summary Report

CLEARY AVE @ RICHMOND RD

Survey Date: Friday, June 12, 2015

Total Observed U-Turns

Northbound: 0 Southbound: 0
Eastbound: 1 Westbound: 0

AADT Factor

.80

Full Study

CLEARY AVE										RICHMOND RD											
Northbound					Southbound					Eastbound					Westbound						
Period	LT	ST	RT	NB TOT	LT	ST	RT	SB TOT	STR TOT	LT	ST	RT	EB TOT	LT	ST	RT	WB TOT	STR TOT	Grand Total		
07:00 08:00	0	0	0	0	12	0	10	22	22	14	549	0	563	0	204	12	216	779	801		
08:00 09:00	0	0	0	0	28	0	18	46	46	28	568	1	597	0	322	13	335	932	978		
09:00 10:00	0	0	0	0	17	0	14	31	31	11	404	0	415	0	340	11	351	766	797		
11:30 12:30	0	0	0	0	23	0	15	38	38	16	374	0	390	0	430	20	450	840	878		
12:30 13:30	0	0	0	0	12	0	13	25	25	24	423	2	449	0	467	8	475	924	949		
15:00 16:00	0	0	0	0	10	0	23	33	33	16	326	0	342	0	693	12	705	1047	1080		
16:00 17:00	0	0	0	0	27	1	30	58	58	36	364	2	402	0	748	46	794	1196	1254		
17:00 18:00	0	0	0	0	23	0	24	47	47	23	378	1	402	0	750	22	772	1174	1221		
Sub Total	0	0	0	0	152	1	147	300	300	168	3386	6	3560	0	3954	144	4098	7658	7958		
U Turns				0				0	0				1				0	1	1		
Total	0	0	0	0	152	1	147	300	300	168	3386	6	3561	0	3954	144	4098	7659	7959		
EQ 12Hr	0	0	0	0	211	1	204	417	417	234	4707	8	4950	0	5496	200	5696	10646	11063		
Note: These values are calculated by multiplying the totals by the appropriate expansion factor.													1.39								
AVG 12Hr	0	0	0	0	169	1	163	334	334	187	3765	7	3960	0	4397	160	4557	8517	8851		
Note: These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor.													.80								
AVG 24Hr	0	0	0	0	221	1	214	437	437	245	4932	9	5187	0	5760	210	5970	11157	11594		
Note: These volumes are calculated by multiplying the Average Daily 12 hr. totals by 12 to 24 expansion factor.													1.31								

Comments:

Note: U-Turns provided for approach totals. Refer to 'U-Turn' Report for specific breakdown.



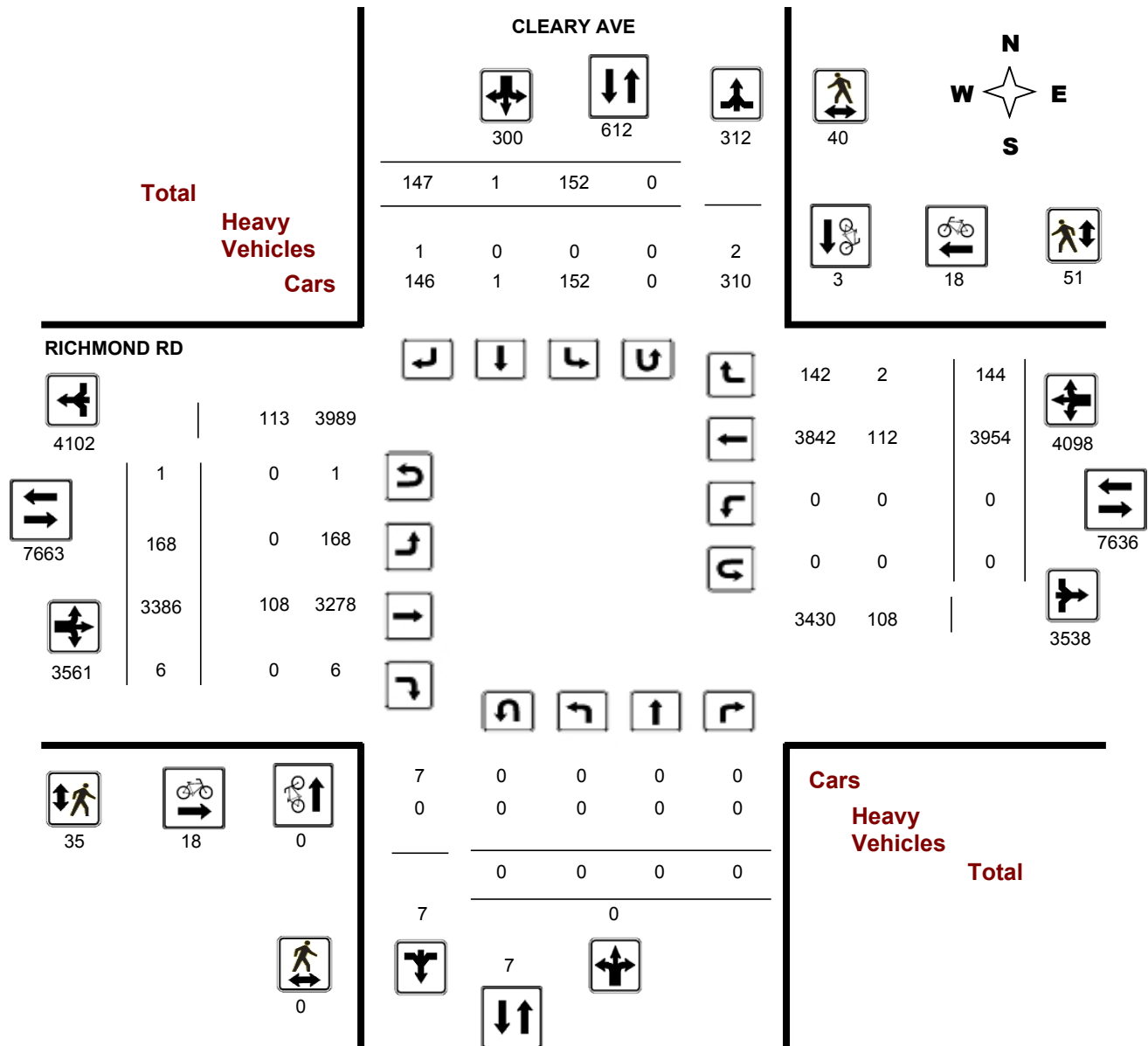
Public Works - Traffic Services

Turning Movement Count - Full Study Diagram

CLEARY AVE @ RICHMOND RD

Survey Date: Friday, June 12, 2015

WO#: 34681
Device: Jamar Technologies, Inc



Turning Movement Count - 15 Minute Summary Report

CLEARY AVE @ RICHMOND RD

Survey Date: Friday, June 12, 2015

Total Observed U-Turns

Northbound: 0 Southbound: 0
Eastbound: 1 Westbound: 0

CLEARY AVE

RICHMOND RD

Time Period	Northbound			N TOT	Southbound			S TOT	STR TOT	Eastbound			E TOT	Westbound			W TOT	STR TOT	Grand Total
	LT	ST	RT		LT	ST	RT			LT	ST	RT		LT	ST	RT			
07:00 07:15	0	0	0	0	1	0	4	5	5	4	106	0	110	0	40	1	41	151	156
07:15 07:30	0	0	0	0	2	0	1	3	3	3	144	0	147	0	52	3	55	202	205
07:30 07:45	0	0	0	0	5	0	2	7	7	3	133	0	136	0	54	4	58	194	201
07:45 08:00	0	0	0	0	4	0	3	7	7	4	166	0	170	0	58	4	62	232	239
08:00 08:15	0	0	0	0	10	0	1	11	11	6	136	0	142	0	79	7	86	228	239
08:15 08:30	0	0	0	0	9	0	8	17	17	12	154	1	167	0	94	4	98	265	282
08:30 08:45	0	0	0	0	6	0	6	12	12	5	149	0	154	0	66	2	68	222	234
08:45 09:00	0	0	0	0	3	0	3	6	6	5	129	0	134	0	83	0	83	217	223
09:00 09:15	0	0	0	0	5	0	4	9	9	4	97	0	101	0	107	4	111	212	221
09:15 09:30	0	0	0	0	7	0	5	12	12	2	109	0	111	0	68	2	70	181	193
09:30 09:45	0	0	0	0	1	0	1	2	2	1	78	0	79	0	83	1	84	163	165
09:45 10:00	0	0	0	0	4	0	4	8	8	4	120	0	124	0	82	4	86	210	218
11:30 11:45	0	0	0	0	8	0	3	11	11	4	99	0	103	0	109	3	112	215	226
11:45 12:00	0	0	0	0	7	0	1	8	8	3	113	0	116	0	100	8	108	224	232
12:00 12:15	0	0	0	0	2	0	4	6	6	4	73	0	77	0	117	3	120	197	203
12:15 12:30	0	0	0	0	6	0	7	13	13	5	89	0	94	0	104	6	110	204	217
12:30 12:45	0	0	0	0	2	0	2	4	4	3	116	0	119	0	104	2	106	225	229
12:45 13:00	0	0	0	0	6	0	3	9	9	6	114	0	120	0	124	3	127	247	256
13:00 13:15	0	0	0	0	0	0	7	7	7	5	97	1	103	0	119	1	120	223	230
13:15 13:30	0	0	0	0	4	0	1	5	5	10	96	1	107	0	120	2	122	229	234
15:00 15:15	0	0	0	0	3	0	1	4	4	2	75	0	77	0	120	4	124	201	205
15:15 15:30	0	0	0	0	2	0	3	5	5	2	82	0	84	0	163	3	166	250	255
15:30 15:45	0	0	0	0	3	0	8	11	11	4	89	0	93	0	205	4	209	302	313
15:45 16:00	0	0	0	0	2	0	11	13	13	8	80	0	88	0	205	1	206	294	307
16:00 16:15	0	0	0	0	7	0	3	10	10	9	106	0	115	0	190	4	194	309	319
16:15 16:30	0	0	0	0	5	1	7	13	13	8	87	1	96	0	187	5	192	288	301
16:30 16:45	0	0	0	0	9	0	11	20	20	9	93	0	103	0	198	8	206	309	329
16:45 17:00	0	0	0	0	6	0	9	15	15	10	78	1	89	0	173	29	202	291	306
17:00 17:15	0	0	0	0	7	0	10	17	17	11	82	0	93	0	193	11	204	297	314
17:15 17:30	0	0	0	0	7	0	1	8	8	4	102	0	106	0	199	6	205	311	319
17:30 17:45	0	0	0	0	3	0	10	13	13	6	97	0	103	0	183	1	184	287	300
17:45 18:00	0	0	0	0	6	0	3	9	9	2	97	1	100	0	175	4	179	279	288
TOTAL:	0	0	0	0	152	1	147	300	300	168	3386	6	3561	0	3954	144	4098	7659	7959

Note: U-Turns are included in Totals.

Comment:



Public Works - Traffic Services

Turning Movement Count - Cyclist Volume Report

Work Order
34681

CLEARY AVE @ RICHMOND RD

Count Date: Friday, June 12, 2015

Start Time: 07:00

Time Period	CLEARY AVE			RICHMOND RD			Grand Total
	Northbound	Southbound	Street Total	Eastbound	Westbound	Street Total	
07:00 08:00	0	0	0	6	1	7	7
08:00 09:00	0	0	0	6	2	8	8
09:00 10:00	0	0	0	0	3	3	3
11:30 12:30	0	1	1	2	0	2	3
12:30 13:30	0	0	0	1	2	3	3
15:00 16:00	0	0	0	1	3	4	4
16:00 17:00	0	2	2	2	1	3	5
17:00 18:00	0	0	0	0	6	6	6
Total	0	3	3	18	18	36	39

Comment:

Note: These volumes consists of bicycles only (no mopeds or motorcycles) and ARE NOT included in the Turning Movement Count Summary.

Turning Movement Count - Heavy Vehicle Report

CLEARY AVE @ RICHMOND RD

Survey Date: Friday, June 12, 2015

CLEARY AVE											RICHMOND RD									
Time Period		Northbound			N TOT	Southbound			S TOT	STR TOT	Eastbound			E TOT	Westbound			W TOT	STR TOT	Grand Total
		LT	ST	RT		LT	ST	RT			LT	ST	RT		LT	ST	RT			
07:00	08:00	0	0	0	0	0	0	0	0	0	0	17	0	17	0	17	0	17	34	34
08:00	09:00	0	0	0	0	0	0	1	1	1	0	21	0	21	0	16	1	17	38	39
09:00	10:00	0	0	0	0	0	0	0	0	0	0	19	0	19	0	16	1	17	36	36
11:30	12:30	0	0	0	0	0	0	0	0	0	0	13	0	13	0	20	0	20	33	33
12:30	13:30	0	0	0	0	0	0	0	0	0	0	18	0	18	0	18	0	18	36	36
15:00	16:00	0	0	0	0	0	0	0	0	0	0	8	0	8	0	11	0	11	19	19
16:00	17:00	0	0	0	0	0	0	0	0	0	0	8	0	8	0	7	0	7	15	15
17:00	18:00	0	0	0	0	0	0	0	0	0	0	4	0	4	0	7	0	7	11	11
Sub Total		0	0	0	0	0	0	1	1	1	0	108	0	108	0	112	2	114	222	223
U-Turns (Heavy Vehicles)					0				0	0				0				0	0	0
Total		0	0	0	0	0	0	1	1	1	0	108	0	108	0	112	2	114	222	223

Heavy Vehicles are vehicles having one rear axle with four or more wheels, or having two or more rear axles. These vehicles include most O.C. Transpo, school and inter-city buses. Further, they ARE included in the Turning Movement Count Summary.



Public Works - Traffic Services

Work Order

34681

Turning Movement Count - Pedestrian Volume Report

CLEARY AVE @ RICHMOND RD

Count Date: Friday, June 12, 2015

Start Time: 07:00

Time Period	NB Approach (E or W Crossing)	SB Approach (E or W Crossing)	Total	EB Approach (N or S Crossing)	WB Approach (N or S Crossing)	Total	Grand Total
07:00 07:15	0	0	0	1	0	1	1
07:15 07:30	0	1	1	0	2	2	3
07:30 07:45	0	3	3	0	2	2	5
07:45 08:00	0	2	2	1	1	2	4
07:00 08:00	0	6	6	2	5	7	13
08:00 08:15	0	3	3	1	2	3	6
08:15 08:30	0	2	2	2	5	7	9
08:30 08:45	0	0	0	1	3	4	4
08:45 09:00	0	0	0	0	3	3	3
08:00 09:00	0	5	5	4	13	17	22
09:00 09:15	0	3	3	0	0	0	3
09:15 09:30	0	6	6	0	5	5	11
09:30 09:45	0	2	2	1	0	1	3
09:45 10:00	0	0	0	0	1	1	1
09:00 10:00	0	11	11	1	6	7	18
11:30 11:45	0	0	0	3	1	4	4
11:45 12:00	0	0	0	1	1	2	2
12:00 12:15	0	0	0	1	7	8	8
12:15 12:30	0	1	1	0	0	0	1
11:30 12:30	0	1	1	5	9	14	15
12:30 12:45	0	1	1	2	1	3	4
12:45 13:00	0	0	0	2	0	2	2
13:00 13:15	0	0	0	2	0	2	2
13:15 13:30	0	0	0	2	1	3	3
12:30 13:30	0	1	1	8	2	10	11
15:00 15:15	0	3	3	1	0	1	4
15:15 15:30	0	2	2	1	0	1	3
15:30 15:45	0	0	0	2	2	4	4
15:45 16:00	0	1	1	0	0	0	1
15:00 16:00	0	6	6	4	2	6	12
16:00 16:15	0	2	2	4	2	6	8
16:15 16:30	0	0	0	0	0	0	0
16:30 16:45	0	1	1	1	3	4	5
16:45 17:00	0	2	2	1	1	2	4
16:00 17:00	0	5	5	6	6	12	17
17:00 17:15	0	1	1	0	5	5	6
17:15 17:30	0	3	3	2	2	4	7
17:30 17:45	0	1	1	0	0	0	1
17:45 18:00	0	0	0	3	1	4	4
17:00 18:00	0	5	5	5	8	13	18
Total	0	40	40	35	51	86	126

Comment:

Turning Movement Count - 15 Min U-Turn Total Report

CLEARY AVE @ RICHMOND RD

Survey Date: Friday, June 12, 2015

Time Period		Northbound U-Turn Total	Southbound U-Turn Total	Eastbound U-Turn Total	Westbound U-Turn Total	Total
07:00	07:15	0	0	0	0	0
07:15	07:30	0	0	0	0	0
07:30	07:45	0	0	0	0	0
07:45	08:00	0	0	0	0	0
08:00	08:15	0	0	0	0	0
08:15	08:30	0	0	0	0	0
08:30	08:45	0	0	0	0	0
08:45	09:00	0	0	0	0	0
09:00	09:15	0	0	0	0	0
09:15	09:30	0	0	0	0	0
09:30	09:45	0	0	0	0	0
09:45	10:00	0	0	0	0	0
11:30	11:45	0	0	0	0	0
11:45	12:00	0	0	0	0	0
12:00	12:15	0	0	0	0	0
12:15	12:30	0	0	0	0	0
12:30	12:45	0	0	0	0	0
12:45	13:00	0	0	0	0	0
13:00	13:15	0	0	0	0	0
13:15	13:30	0	0	0	0	0
15:00	15:15	0	0	0	0	0
15:15	15:30	0	0	0	0	0
15:30	15:45	0	0	0	0	0
15:45	16:00	0	0	0	0	0
16:00	16:15	0	0	0	0	0
16:15	16:30	0	0	0	0	0
16:30	16:45	0	0	1	0	1
16:45	17:00	0	0	0	0	0
17:00	17:15	0	0	0	0	0
17:15	17:30	0	0	0	0	0
17:30	17:45	0	0	0	0	0
17:45	18:00	0	0	0	0	0
Total		0	0	1	0	1

Turning Movement Count - Peak Hour Diagram

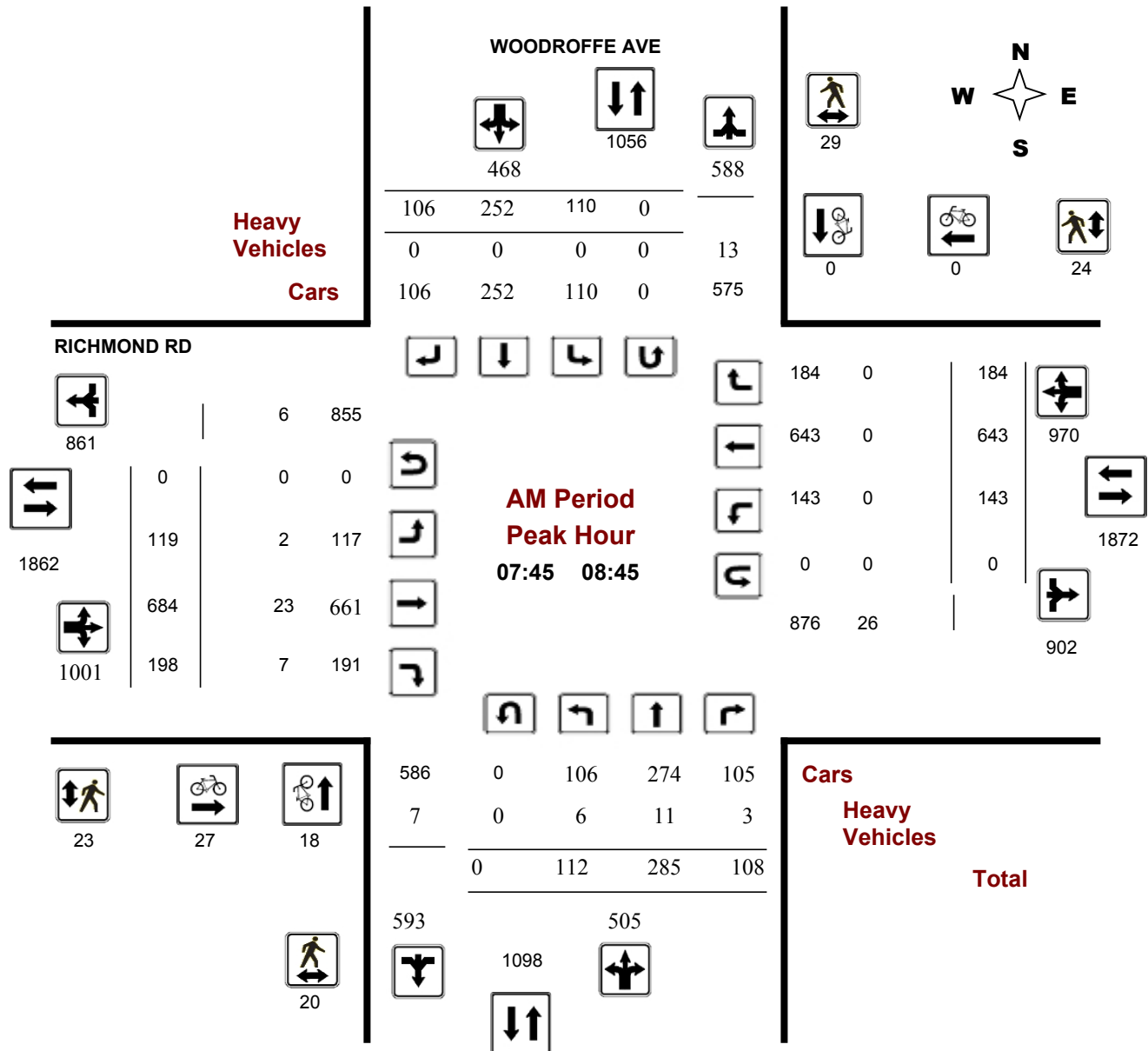
RICHMOND RD @ WOODROFFE AVE

Survey Date: Friday, May 23, 2014

Start Time: 07:00

WO No: 1044

Device: Jamar Technologies, Inc



Turning Movement Count - Peak Hour Diagram

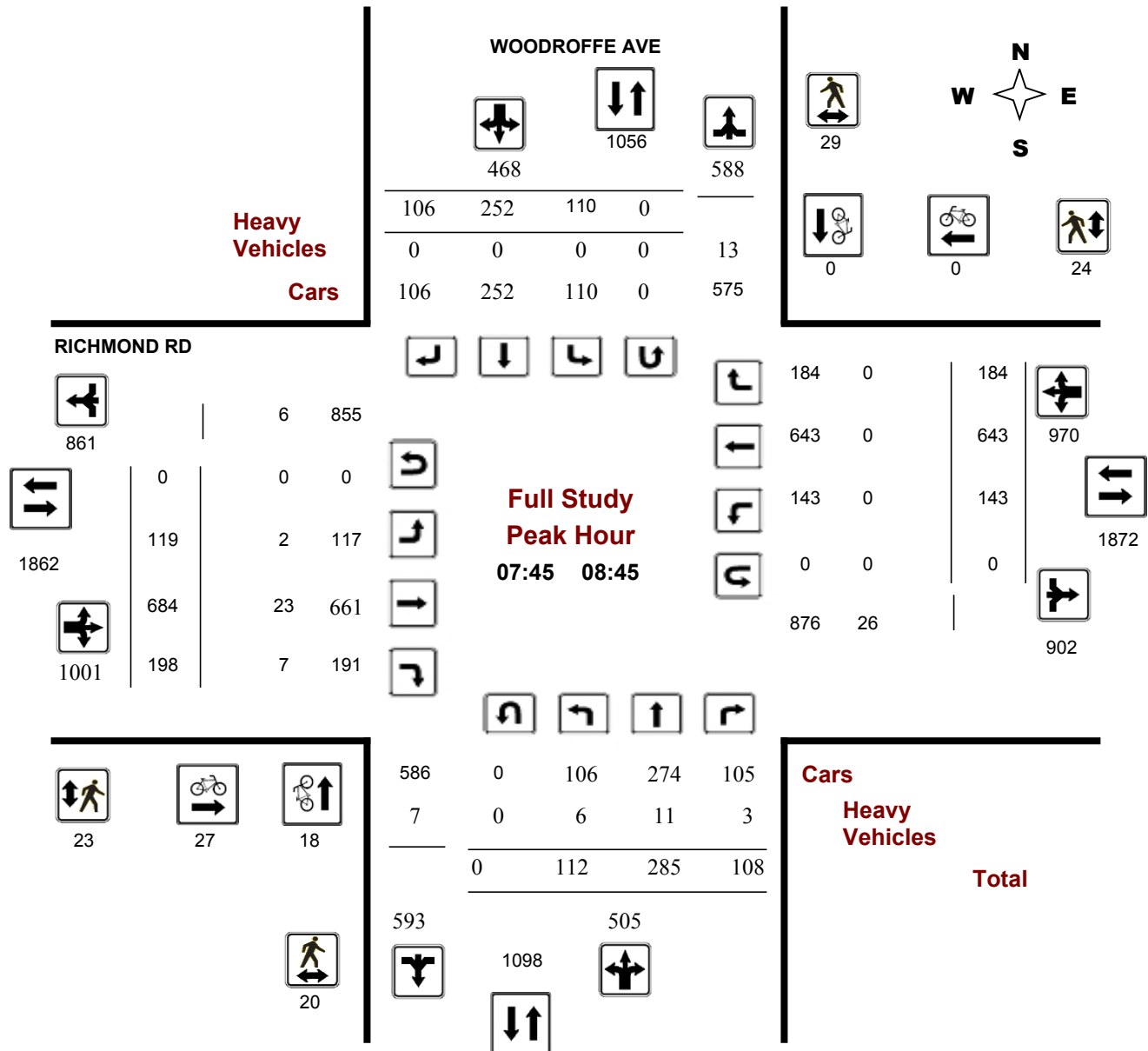
RICHMOND RD @ WOODROFFE AVE

Survey Date: Friday, May 23, 2014

Start Time: 07:00

WO No: 1044

Device: Jamar Technologies, Inc



Turning Movement Count - Peak Hour Diagram

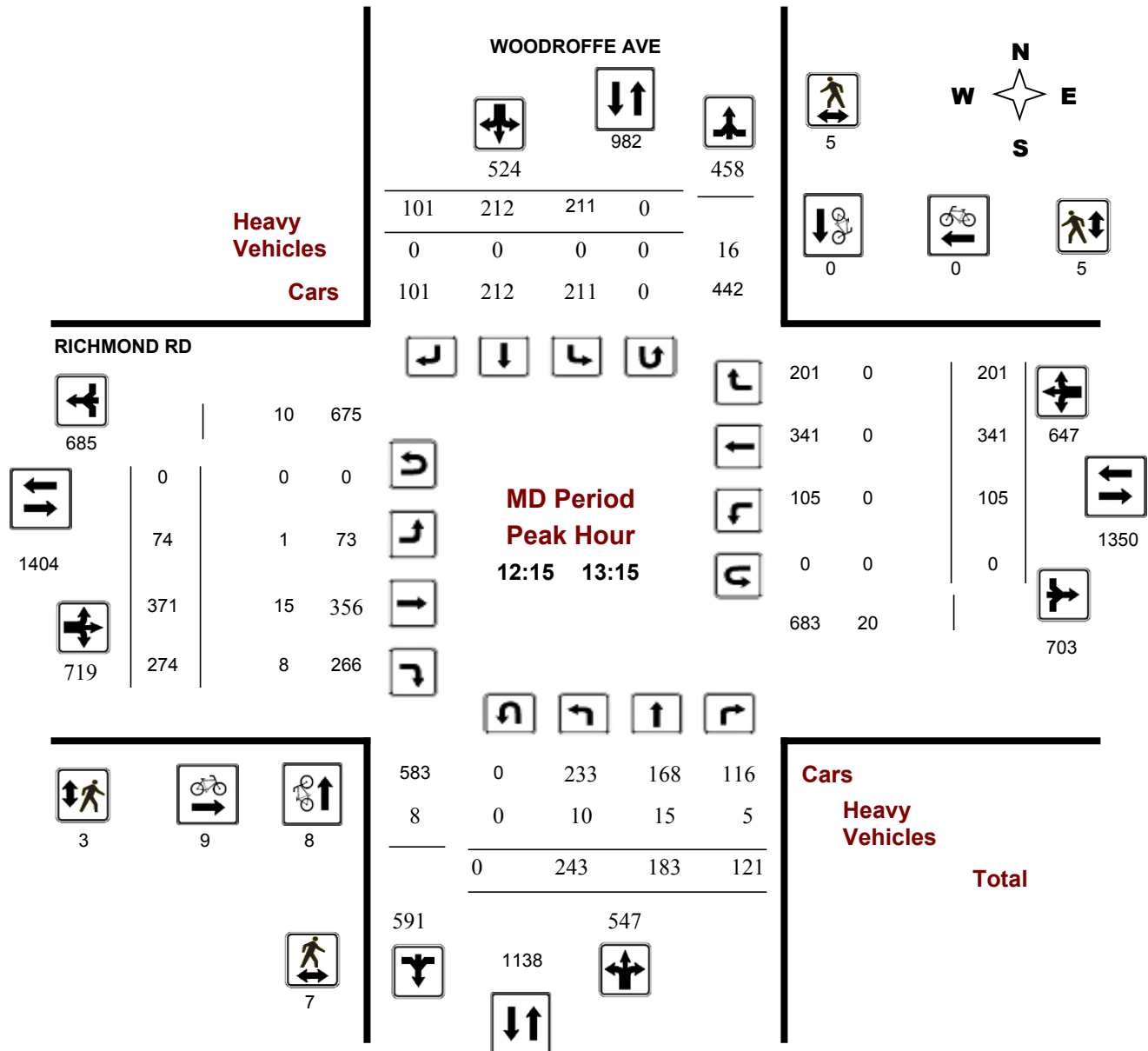
RICHMOND RD @ WOODROFFE AVE

Survey Date: Friday, May 23, 2014

Start Time: 07:00

WO No: 1044

Device: Jamar Technologies, Inc



Turning Movement Count - Peak Hour Diagram

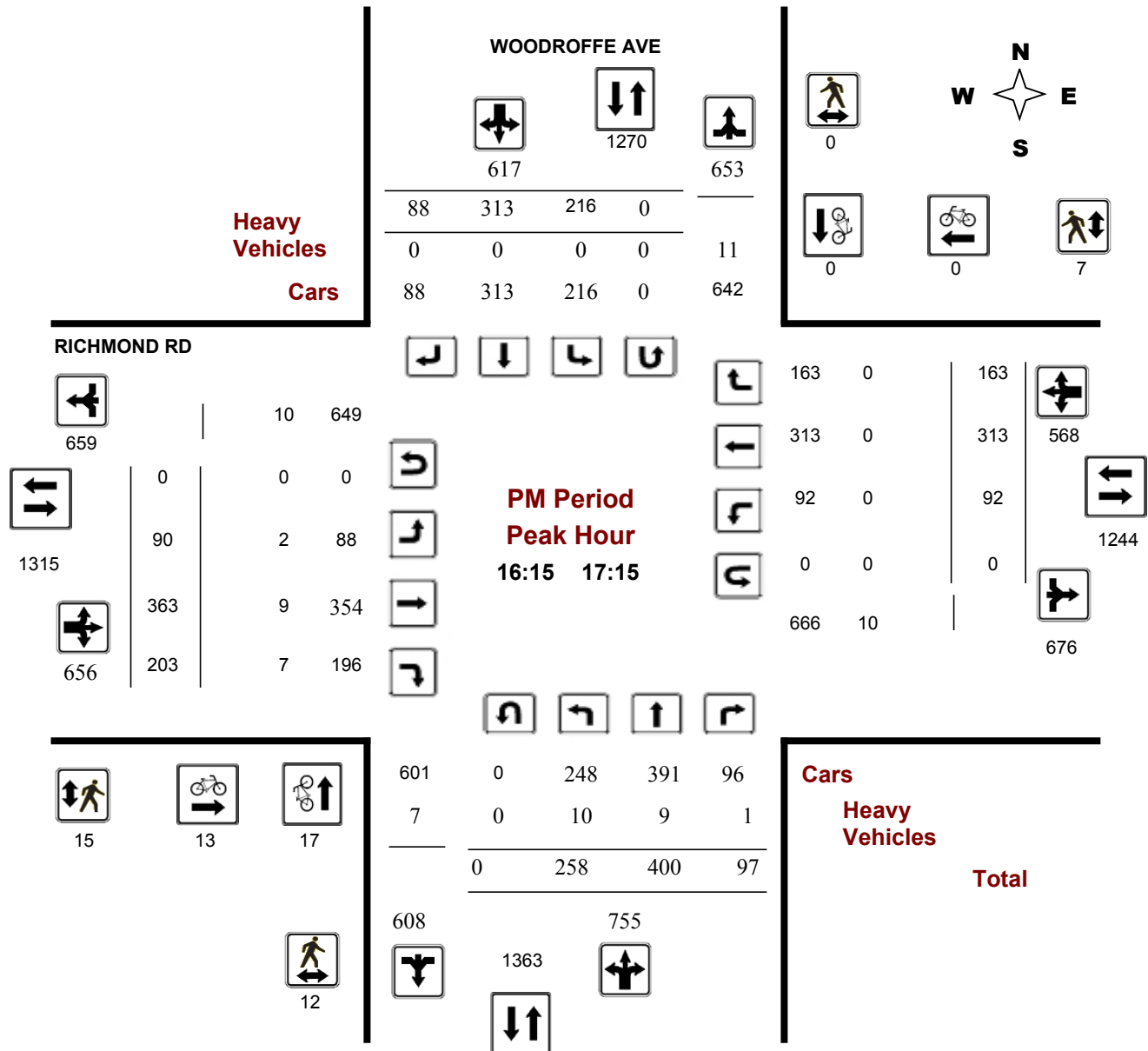
RICHMOND RD @ WOODROFFE AVE

Survey Date: Friday, May 23, 2014

Start Time: 07:00

WO No: 1044

Device: Jamar Technologies, Inc





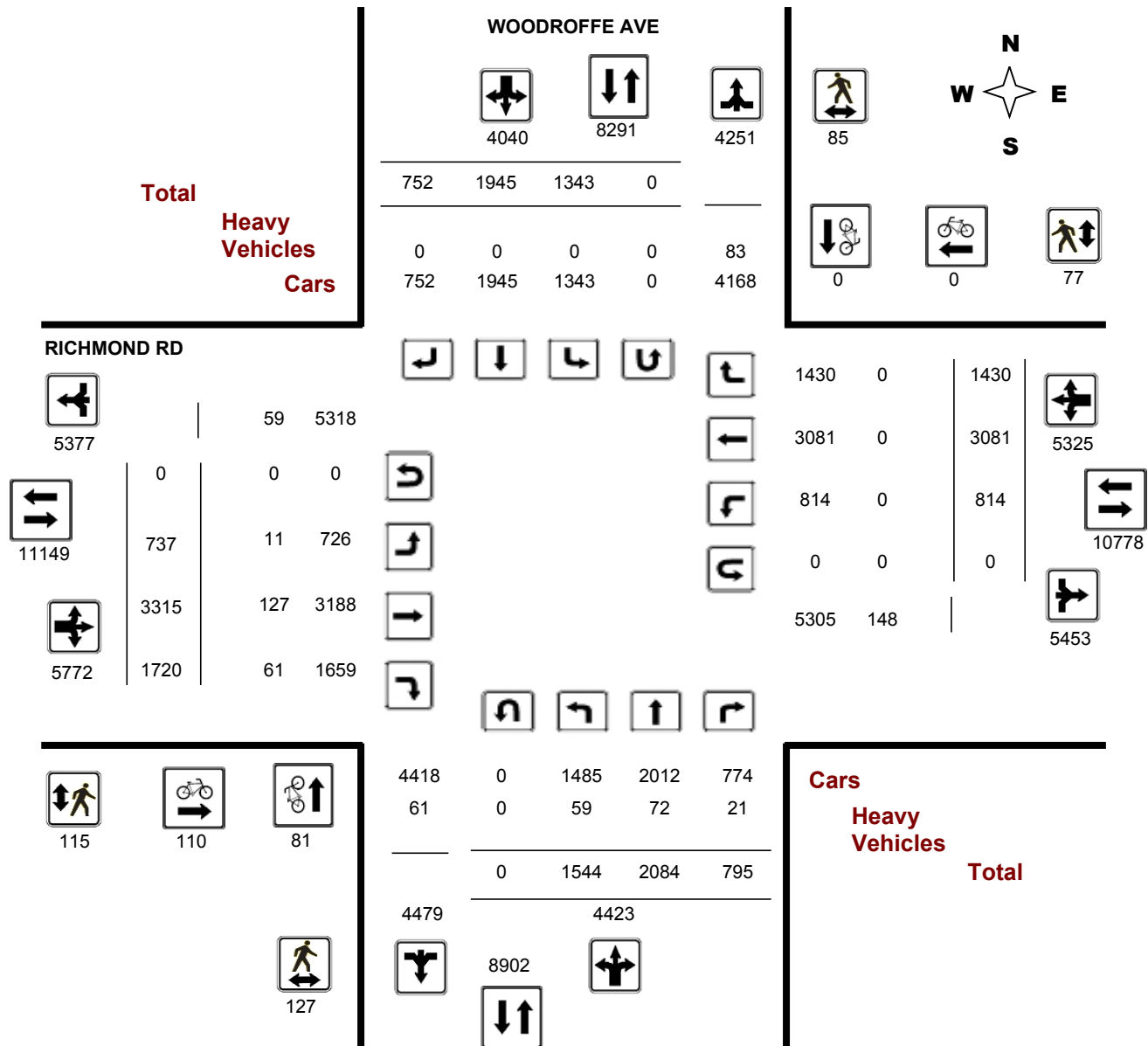
Public Works - Traffic Services

Turning Movement Count - Full Study Diagram

RICHMOND RD @ WOODROFFE AVE

Survey Date: Friday, May 23, 2014

WO#: 1044
Device: Jamar Technologies, Inc



Turning Movement Count - Full Study Summary Report

RICHMOND RD @ WOODROFFE AVE

Survey Date: Friday, May 23, 2014

Total Observed U-Turns

Northbound: 0 Southbound: 0
Eastbound: 0 Westbound: 0

AADT Factor

.80

Full Study

WOODROFFE AVE										RICHMOND RD									
Northbound					Southbound					Eastbound					Westbound				
Period	LT	ST	RT	NB TOT	LT	ST	RT	SB TOT	STR TOT	LT	ST	RT	EB TOT	LT	ST	RT	WB TOT	STR TOT	Grand Total
07:00 08:00	62	237	85	384	83	200	85	368	752	111	533	158	802	127	524	153	804	1606	2358
08:00 09:00	121	282	108	511	116	242	101	459	970	117	647	212	976	124	630	195	949	1925	2895
09:00 10:00	154	191	93	438	104	157	86	347	785	68	392	216	676	86	351	182	619	1295	2080
11:30 12:30	240	202	112	554	204	196	127	527	1081	63	371	240	674	89	353	208	650	1324	2405
12:30 13:30	228	184	123	535	202	217	89	508	1043	77	351	278	706	99	335	225	659	1365	2408
15:00 16:00	247	309	86	642	205	311	84	600	1242	119	355	215	689	97	251	146	494	1183	2425
16:00 17:00	255	382	91	728	217	329	86	632	1360	84	323	203	610	91	330	165	586	1196	2556
17:00 18:00	237	297	97	631	212	293	94	599	1230	98	343	198	639	101	307	156	564	1203	2433
Sub Total	1544	2084	795	4423	1343	1945	752	4040	8463	737	3315	1720	5772	814	3081	1430	5325	11097	19560
U Turns				0				0	0				0				0	0	0
Total	1544	2084	795	4423	1343	1945	752	4040	8463	737	3315	1720	5772	814	3081	1430	5325	11097	19560
EQ 12Hr	2146	2897	1105	6148	1867	2704	1045	5616	11764	1024	4608	2391	8023	1131	4283	1988	7402	15425	27189
Note: These values are calculated by multiplying the totals by the appropriate expansion factor.										1.39									
AVG 12Hr	1717	2317	884	4918	1493	2163	836	4492	9410	820	3686	1913	6418	905	3426	1590	5921	12339	21749
Note: These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor.										.80									
AVG 24Hr	2249	3036	1158	6443	1956	2833	1095	5885	12328	1074	4829	2506	8408	1186	4488	2083	7757	16165	28493
Note: These volumes are calculated by multiplying the Average Daily 12 hr. totals by 12 to 24 expansion factor.										1.31									

Comments:

Note: U-Turns provided for approach totals. Refer to 'U-Turn' Report for specific breakdown.

Turning Movement Count - 15 Minute Summary Report

RICHMOND RD @ WOODROFFE AVE

Survey Date: Friday, May 23, 2014

Total Observed U-Turns

Northbound: 0 Southbound: 0
Eastbound: 0 Westbound: 0

WOODROFFE AVE

RICHMOND RD

Time Period	Northbound			N TOT	Southbound			S TOT	STR TOT	Eastbound			E TOT	Westbound			W TOT	STR TOT	Grand Total
	LT	ST	RT		LT	ST	RT			LT	ST	RT		LT	ST	RT			
07:00 07:15	17	42	12	71	12	36	14	62	133	18	94	33	145	23	98	37	158	303	436
07:15 07:30	10	73	27	110	17	56	22	95	205	36	124	39	199	30	127	30	187	386	591
07:30 07:45	12	57	19	88	25	50	21	96	184	29	132	40	201	35	140	43	218	419	603
07:45 08:00	23	65	27	115	29	58	28	115	230	28	183	46	257	39	159	43	241	498	728
08:00 08:15	25	70	23	118	24	64	16	104	222	31	164	51	246	42	161	51	254	500	722
08:15 08:30	22	75	28	125	33	57	31	121	246	30	168	46	244	33	171	47	251	495	741
08:30 08:45	42	75	30	147	24	73	31	128	275	30	169	55	254	29	152	43	224	478	753
08:45 09:00	32	62	27	121	35	48	23	106	227	26	146	60	232	20	146	54	220	452	679
09:00 09:15	31	59	25	115	31	51	24	106	221	19	101	65	185	26	98	41	165	350	571
09:15 09:30	33	51	26	110	20	42	26	88	198	17	106	50	173	16	92	51	159	332	530
09:30 09:45	49	46	17	112	37	36	16	89	201	13	89	48	150	24	83	43	150	300	501
09:45 10:00	41	35	25	101	16	28	20	64	165	19	96	53	168	20	78	47	145	313	478
11:30 11:45	70	59	26	155	54	47	34	135	290	17	81	40	138	20	97	64	181	319	609
11:45 12:00	58	43	29	130	47	41	35	123	253	17	110	62	189	19	90	50	159	348	601
12:00 12:15	48	55	32	135	43	55	31	129	264	16	76	74	166	23	77	50	150	316	580
12:15 12:30	64	45	25	134	60	53	27	140	274	13	104	64	181	27	89	44	160	341	615
12:30 12:45	54	45	31	130	40	48	24	112	242	20	86	67	173	27	90	58	175	348	590
12:45 13:00	63	42	42	147	45	52	33	130	277	22	94	63	179	26	95	49	170	349	626
13:00 13:15	62	51	23	136	66	59	17	142	278	19	87	80	186	25	67	50	142	328	606
13:15 13:30	49	46	27	122	51	58	15	124	246	16	84	68	168	21	83	68	172	340	586
15:00 15:15	58	76	23	157	57	77	27	161	318	28	97	59	184	32	64	47	143	327	645
15:15 15:30	63	93	15	171	46	83	23	152	323	25	93	48	166	21	48	39	108	274	597
15:30 15:45	60	69	28	157	50	69	19	138	295	27	76	54	157	22	69	29	120	277	572
15:45 16:00	66	71	20	157	52	82	15	149	306	39	89	54	182	22	70	31	123	305	611
16:00 16:15	61	71	16	148	58	97	20	175	323	23	63	48	134	30	88	45	163	297	620
16:15 16:30	61	125	12	198	52	92	20	164	362	27	80	52	159	13	70	33	116	275	637
16:30 16:45	67	85	35	187	52	68	23	143	330	15	87	55	157	27	84	41	152	309	639
16:45 17:00	66	101	28	195	55	72	23	150	345	19	93	48	160	21	88	46	155	315	660
17:00 17:15	64	89	22	175	57	81	22	160	335	29	103	48	180	31	71	43	145	325	660
17:15 17:30	64	68	27	159	65	79	35	179	338	26	75	50	151	26	78	38	142	293	631
17:30 17:45	57	73	27	157	51	75	18	144	301	24	83	52	159	24	87	31	142	301	602
17:45 18:00	52	67	21	140	39	58	19	116	256	19	82	48	149	20	71	44	135	284	540
TOTAL:	1544	2084	795	4423	1343	1945	752	4040	8463	737	3315	1720	5772	814	3081	1430	5325	11097	19560

Note: U-Turns are included in Totals.

Comment:



Public Works - Traffic Services

Turning Movement Count - Cyclist Volume Report

Work Order
1044

RICHMOND RD @ WOODROFFE AVE

Count Date: Friday, May 23, 2014

Start Time: 07:00

Time Period	WOODROFFE AVE			RICHMOND RD			Grand Total
	Northbound	Southbound	Street Total	Eastbound	Westbound	Street Total	
07:00 08:00	6	0	6	18	0	18	24
08:00 09:00	20	0	20	27	0	27	47
09:00 10:00	8	0	8	2	0	2	10
11:30 12:30	9	0	9	8	0	8	17
12:30 13:30	4	0	4	9	0	9	13
15:00 16:00	11	0	11	10	0	10	21
16:00 17:00	14	0	14	10	0	10	24
17:00 18:00	9	0	9	26	0	26	35
Total	81	0	81	110	0	110	191

Comment:

Note: These volumes consists of bicycles only (no mopeds or motorcycles) and ARE NOT included in the Turning Movement Count Summary.

Turning Movement Count - Heavy Vehicle Report

RICHMOND RD @ WOODROFFE AVE

Survey Date: Friday, May 23, 2014

WOODROFFE AVE										RICHMOND RD										Grand Total
Time Period		Northbound			Southbound			S TOT	STR TOT	Eastbound			Westbound			W TOT	STR TOT			
		LT	ST	RT	N TOT	LT	ST			RT	LT	ST	RT	E TOT	LT			ST	RT	
07:00	08:00	4	6	0	10	0	0	0	0	10	2	12	3	17	0	0	0	0	17	27
08:00	09:00	5	11	5	21	0	0	0	0	21	3	22	12	37	0	0	0	0	37	58
09:00	10:00	7	9	2	18	0	0	0	0	18	1	13	4	18	0	0	0	0	18	36
11:30	12:30	12	10	5	27	0	0	0	0	27	0	25	16	41	0	0	0	0	41	68
12:30	13:30	8	14	4	26	0	0	0	0	26	1	18	8	27	0	0	0	0	27	53
15:00	16:00	10	5	3	18	0	0	0	0	18	2	17	6	25	0	0	0	0	25	43
16:00	17:00	11	11	2	24	0	0	0	0	24	2	13	9	24	0	0	0	0	24	48
17:00	18:00	2	6	0	8	0	0	0	0	8	0	7	3	10	0	0	0	0	10	18
Sub Total		59	72	21	152	0	0	0	0	152	11	127	61	199	0	0	0	0	199	351
U-Turns (Heavy Vehicles)					0				0	0				0				0	0	0
Total		59	72	21	0	0	0	0	0	152	11	127	61	199	0	0	0	0	199	351

Heavy Vehicles are vehicles having one rear axle with four or more wheels, or having two or more rear axles. These vehicles include most O.C. Transpo, school and inter-city buses. Further, they ARE included in the Turning Movement Count Summary.



Public Works - Traffic Services

Work Order

1044

Turning Movement Count - Pedestrian Volume Report

RICHMOND RD @ WOODROFFE AVE

Count Date: Friday, May 23, 2014

Start Time: 07:00

Time Period	NB Approach (E or W Crossing)	SB Approach (E or W Crossing)	Total	EB Approach (N or S Crossing)	WB Approach (N or S Crossing)	Total	Grand Total
07:00 07:15	0	0	0	2	0	2	2
07:15 07:30	0	5	5	1	4	5	10
07:30 07:45	1	7	8	4	2	6	14
07:45 08:00	5	4	9	2	3	5	14
07:00 08:00	6	16	22	9	9	18	40
08:00 08:15	3	8	11	3	7	10	21
08:15 08:30	5	10	15	7	12	19	34
08:30 08:45	7	7	14	11	2	13	27
08:45 09:00	6	6	12	2	5	7	19
08:00 09:00	21	31	52	23	26	49	101
09:00 09:15	2	2	4	1	0	1	5
09:15 09:30	4	3	7	5	3	8	15
09:30 09:45	13	14	27	8	1	9	36
09:45 10:00	5	2	7	2	1	3	10
09:00 10:00	24	21	45	16	5	21	66
11:30 11:45	4	0	4	3	1	4	8
11:45 12:00	4	3	7	2	4	6	13
12:00 12:15	5	1	6	2	0	2	8
12:15 12:30	3	1	4	2	1	3	7
11:30 12:30	16	5	21	9	6	15	36
12:30 12:45	3	0	3	0	1	1	4
12:45 13:00	0	3	3	0	2	2	5
13:00 13:15	1	1	2	1	1	2	4
13:15 13:30	3	2	5	1	0	1	6
12:30 13:30	7	6	13	2	4	6	19
15:00 15:15	5	2	7	5	3	8	15
15:15 15:30	4	2	6	7	1	8	14
15:30 15:45	1	0	1	0	2	2	3
15:45 16:00	3	0	3	4	2	6	9
15:00 16:00	13	4	17	16	8	24	41
16:00 16:15	7	1	8	5	3	8	16
16:15 16:30	1	0	1	2	0	2	3
16:30 16:45	4	0	4	3	2	5	9
16:45 17:00	0	0	0	3	4	7	7
16:00 17:00	12	1	13	13	9	22	35
17:00 17:15	7	0	7	7	1	8	15
17:15 17:30	5	0	5	3	3	6	11
17:30 17:45	15	0	15	12	4	16	31
17:45 18:00	1	1	2	5	2	7	9
17:00 18:00	28	1	29	27	10	37	66
Total	127	85	212	115	77	192	404

Comment:

Turning Movement Count - 15 Min U-Turn Total Report

RICHMOND RD @ WOODROFFE AVE

Survey Date: Friday, May 23, 2014

Time Period		Northbound U-Turn Total	Southbound U-Turn Total	Eastbound U-Turn Total	Westbound U-Turn Total	Total
07:00	07:15	0	0	0	0	0
07:15	07:30	0	0	0	0	0
07:30	07:45	0	0	0	0	0
07:45	08:00	0	0	0	0	0
08:00	08:15	0	0	0	0	0
08:15	08:30	0	0	0	0	0
08:30	08:45	0	0	0	0	0
08:45	09:00	0	0	0	0	0
09:00	09:15	0	0	0	0	0
09:15	09:30	0	0	0	0	0
09:30	09:45	0	0	0	0	0
09:45	10:00	0	0	0	0	0
11:30	11:45	0	0	0	0	0
11:45	12:00	0	0	0	0	0
12:00	12:15	0	0	0	0	0
12:15	12:30	0	0	0	0	0
12:30	12:45	0	0	0	0	0
12:45	13:00	0	0	0	0	0
13:00	13:15	0	0	0	0	0
13:15	13:30	0	0	0	0	0
15:00	15:15	0	0	0	0	0
15:15	15:30	0	0	0	0	0
15:30	15:45	0	0	0	0	0
15:45	16:00	0	0	0	0	0
16:00	16:15	0	0	0	0	0
16:15	16:30	0	0	0	0	0
16:30	16:45	0	0	0	0	0
16:45	17:00	0	0	0	0	0
17:00	17:15	0	0	0	0	0
17:15	17:30	0	0	0	0	0
17:30	17:45	0	0	0	0	0
17:45	18:00	0	0	0	0	0
Total		0	0	0	0	0

Traffic Signal Timing

City of Ottawa, Public Works Department

Traffic Operations Unit

Intersection:	Main: Richmond	Side: Woodroffe
Controller:	MS-3200	TSD: 5230
Author:	Basel Ansari	Date: 24-Mar-2016

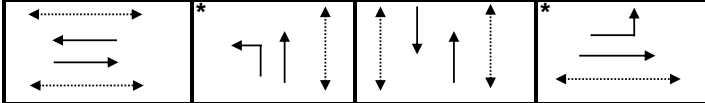
Existing Timing Plans†

	Plan					Ped Minimum Time		
	AM Peak 1	Off Peak 2	PM Peak 3	Night 4	Weekend 5	Walk	DW	A+R
Cycle	100	95	100	70	95			
Offset	35	50	35	3	50			
EB Thru	54	34	33	36	34	7	11	3.3+2.9
WB Thru	39	34	33	36	34	7	11	3.3+2.9
NB Left	12	15	16	-	15	-	-	3.3+1.6
SB Thru	34	34	37	34	34	7	20	3.3+3.3
NB Thru	46	49	53	34	49	7	20	3.3+3.3
EB Left	15	12	14	-	12	-	-	3.3+2.9
WB Left	-	12	14	-	12	-	-	3.3+2.9

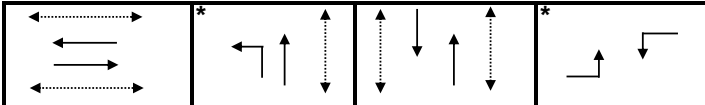
Notes: 1) For Plan 3, all unused time throughout the cycle is given to the EB and WB Thru movements

Phasing Sequence†

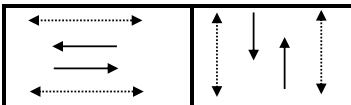
Plan: 1



Plans: 2, 3, 5



Plan: 4



Schedule

Weekday

Time	Plan
0:15	4
6:30	1
9:30	2
15:00	3
18:30	2
23:00	4

Saturday

Time	Plan
0:15	4
9:10	5
18:30	2
23:30	4

Sunday

Time	Plan
0:15	4
9:10	2
22:30	4

Notes

†: Time for each direction includes amber and all red intervals
 ‡: Start of first phase should be used as reference point for offset
 Asterisk (*) Indicates actuated phase
 (fp): Fully Protected Left Turn
 ◀.....▶ Pedestrian signal

Cost is \$56.50 (\$50 + HST)

Traffic Signal Timing

City of Ottawa, Public Works Department

Traffic Operations Unit

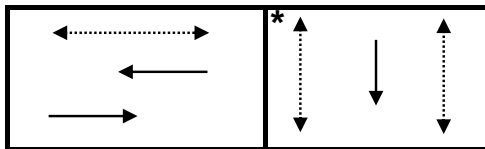
Intersection:	Main: Richmond	Side: Cleary
Controller:	MS-3200	TSD: 5845
Author:	Basel Ansari	Date: 24-Mar-2016

Existing Timing Plans[†]

	Plan					Ped Minimum Time		
	AM Peak 1	Off Peak 2	PM Peak 3	Night 4	Weekend 5	Walk	DW	A+R
Cycle	65	55	65	50	55			
Offset	53	X	13	X	X			
EB Thru	43	33	43	28	33	13	5	3.3+1.8
WB Thru	43	33	43	28	33	13	5	3.3+1.8
SB Thru	22	22	22	22	22	7	9	3.3+2.0

Phasing Sequence[‡]

Plan: All



Schedule

Weekday

Time	Plan
0:15	4
6:30	1
9:30	2
15:00	3
18:30	2
23:00	4

Saturday

Time	Plan
0:10	4
9:10	5
18:30	2
23:30	4

Sunday

Time	Plan
0:15	4
9:10	2
22:30	4

Notes

†: Time for each direction includes amber and all red intervals

‡: Start of first phase should be used as reference point for offset

Asterisk (*) Indicates actuated phase

(fp): Fully Protected Left Turn

←.....→ Pedestrian signal

Cost is \$56.50 (\$50 + HST)

Appendix B

Existing Conditions Synchro Analysis Sheets

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2017 Existing AM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	124	715	207	150	672	192	117	298	113	117	264	111
Future Volume (vph)	124	715	207	150	672	192	117	298	113	117	264	111
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	65.0		0.0	65.0		0.0	60.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	85.0			60.0			15.0			45.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.966			0.967			0.959			0.956	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1695	3236	0	1729	3344	0	1647	1683	0	1729	1740	0
Flt Permitted	0.133			0.304			0.241			0.517		
Satd. Flow (perm)	237	3236	0	553	3344	0	418	1683	0	941	1740	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		51			39			22			21	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		143.1			207.3			173.3			231.8	
Travel Time (s)		10.3			14.9			12.5			16.7	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	2%	3%	4%	0%	0%	0%	5%	4%	3%	0%	0%	0%
Adj. Flow (vph)	127	730	211	153	686	196	119	304	115	119	269	113
Shared Lane Traffic (%)												
Lane Group Flow (vph)	127	941	0	153	882	0	119	419	0	119	382	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2017 Existing AM
851 Richmond Road TIS



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2			6			8			4		
Detector Phase	5	2		6	6		3	8		4	4	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	10.2	24.2		24.2	24.2		8.9	33.6		33.6	33.6	
Total Split (s)	15.0	54.0		39.0	39.0		12.0	46.0		34.0	34.0	
Total Split (%)	15.0%	54.0%		39.0%	39.0%		12.0%	46.0%		34.0%	34.0%	
Maximum Green (s)	8.8	47.8		32.8	32.8		7.1	39.4		27.4	27.4	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	3.3		3.3	3.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.2	6.2		6.2	6.2		4.9	6.6		6.6	6.6	
Lead/Lag	Lead			Lag	Lag		Lead			Lag	Lag	
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		C-Max	C-Max		None	Max		Max	Max	
Walk Time (s)		7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)		11.0		11.0	11.0			20.0		20.0	20.0	
Pedestrian Calls (#/hr)		0		0	0			0		0	0	
Act Effect Green (s)	47.8	47.8		33.3	33.3		41.1	39.4		27.5	27.5	
Actuated g/C Ratio	0.48	0.48		0.33	0.33		0.41	0.39		0.28	0.28	
v/c Ratio	0.54	0.60		0.83	0.77		0.46	0.62		0.46	0.77	
Control Delay	23.8	19.9		68.0	34.3		25.0	27.8		37.1	43.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	23.8	19.9		68.0	34.3		25.0	27.8		37.1	43.8	
LOS	C	B		E	C		C	C		D	D	
Approach Delay		20.3			39.3			27.2			42.2	
Approach LOS		C			D			C			D	
Queue Length 50th (m)	13.4	64.0		27.3	77.5		14.3	60.6		19.2	64.6	
Queue Length 95th (m)	23.9	83.4		#63.8	101.0		26.0	92.2		36.6	#107.3	
Internal Link Dist (m)		119.1			183.3			149.3			207.8	
Turn Bay Length (m)	65.0			65.0			60.0			30.0		
Base Capacity (vph)	241	1573		184	1139		259	676		258	493	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.53	0.60		0.83	0.77		0.46	0.62		0.46	0.77	

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 35 (35%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.83

Intersection Signal Delay: 31.2

Intersection LOS: C

Intersection Capacity Utilization 88.6%

ICU Level of Service E

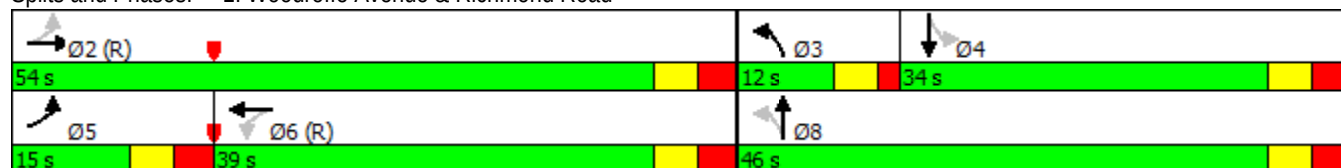
Analysis Period (min) 15

Lanes, Volumes, Timings 1: Woodroffe Avenue & Richmond Road

2017 Existing AM
851 Richmond Road TIS

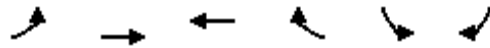
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Woodroffe Avenue & Richmond Road



Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

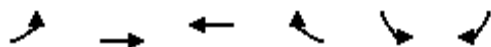
2017 Existing AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	28	623	306	18	30	19
Future Volume (vph)	28	623	306	18	30	19
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.993		0.947	
Flt Protected		0.998			0.971	
Satd. Flow (prot)	0	1749	1720	0	1641	0
Flt Permitted		0.975			0.971	
Satd. Flow (perm)	0	1709	1720	0	1641	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			8		22	
Link Speed (k/h)		50	50		50	
Link Distance (m)		160.2	91.9		133.2	
Travel Time (s)		11.5	6.6		9.6	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	4%	5%	6%	0%	5%
Adj. Flow (vph)	32	708	348	20	34	22
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	740	368	0	56	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2		1	
Detector Template	Left	Thru	Thru		Left	
Leading Detector (m)	6.1	30.5	30.5		6.1	
Trailing Detector (m)	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	6.1	1.8	1.8		6.1	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	
Protected Phases		2	6		4	
Permitted Phases	2					
Detector Phase	2	2	6		4	
Switch Phase						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2017 Existing AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Minimum Initial (s)	4.0	4.0	4.0		4.0	
Minimum Split (s)	29.1	29.1	29.1		21.3	
Total Split (s)	43.0	43.0	43.0		22.0	
Total Split (%)	66.2%	66.2%	66.2%		33.8%	
Maximum Green (s)	37.9	37.9	37.9		16.7	
Yellow Time (s)	3.3	3.3	3.3		3.3	
All-Red Time (s)	1.8	1.8	1.8		2.0	
Lost Time Adjust (s)		0.0	0.0		0.0	
Total Lost Time (s)		5.1	5.1		5.3	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	C-Max	C-Max	C-Max		Max	
Walk Time (s)	13.0	13.0	13.0		4.0	
Flash Dont Walk (s)	5.0	5.0	5.0		9.0	
Pedestrian Calls (#/hr)	0	0	0		0	
Act Effect Green (s)		37.9	37.9		16.7	
Actuated g/C Ratio		0.58	0.58		0.26	
v/c Ratio		0.74	0.37		0.13	
Control Delay		15.8	8.3		13.8	
Queue Delay		0.0	0.0		0.0	
Total Delay		15.8	8.3		13.8	
LOS		B	A		B	
Approach Delay		15.8	8.3		13.8	
Approach LOS		B	A		B	
Queue Length 50th (m)		58.1	20.3		3.1	
Queue Length 95th (m)		94.0	33.7		10.3	
Internal Link Dist (m)		136.2	67.9		109.2	
Turn Bay Length (m)						
Base Capacity (vph)		996	1006		437	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		0.74	0.37		0.13	

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Offset: 53 (82%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.74
Intersection Signal Delay: 13.3
Intersection Capacity Utilization 70.6%
Analysis Period (min) 15

Intersection LOS: B
ICU Level of Service C

Splits and Phases: 4: Richmond Road & Cleary Avenue



Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2017 Existing PM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	94	380	212	96	327	170	270	418	101	229	327	92
Future Volume (vph)	94	380	212	96	327	170	270	418	101	229	327	92
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	65.0		0.0	65.0		0.0	60.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	85.0			60.0			15.0			45.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.946			0.949			0.971			0.967	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1712	3156	0	1729	3282	0	1662	1648	0	1729	1760	0
Flt Permitted	0.363			0.287			0.222			0.467		
Satd. Flow (perm)	654	3156	0	522	3282	0	388	1648	0	850	1760	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		104			91			16			15	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		143.1			207.3			173.3			231.8	
Travel Time (s)		10.3			14.9			12.5			16.7	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	1%	4%	3%	0%	0%	0%	4%	8%	4%	0%	0%	0%
Adj. Flow (vph)	96	388	216	98	334	173	276	427	103	234	334	94
Shared Lane Traffic (%)												
Lane Group Flow (vph)	96	604	0	98	507	0	276	530	0	234	428	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2		1	6		3	8			4	

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2017 Existing PM
851 Richmond Road TIS



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		3	8		4	4	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	10.2	24.2		10.2	24.2		8.9	33.6		33.6	33.6	
Total Split (s)	14.0	33.0		14.0	33.0		16.0	53.0		37.0	37.0	
Total Split (%)	14.0%	33.0%		14.0%	33.0%		16.0%	53.0%		37.0%	37.0%	
Maximum Green (s)	7.8	26.8		7.8	26.8		11.1	46.4		30.4	30.4	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	3.3		3.3	3.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.2	6.2		6.2	6.2		4.9	6.6		6.6	6.6	
Lead/Lag	Lead	Lag		Lead	Lag		Lead			Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		None	C-Max		None	Max		Max	Max	
Walk Time (s)		7.0			7.0			7.0		7.0	7.0	
Flash Dont Walk (s)		11.0			11.0			20.0		20.0	20.0	
Pedestrian Calls (#/hr)		0			0			0		0	0	
Act Effect Green (s)	35.8	29.6		35.8	29.6		48.1	46.4		30.4	30.4	
Actuated g/C Ratio	0.36	0.30		0.36	0.30		0.48	0.46		0.30	0.30	
v/c Ratio	0.31	0.60		0.35	0.49		0.84	0.69		0.91	0.79	
Control Delay	21.6	28.5		22.7	26.3		41.4	26.0		72.2	42.5	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	21.6	28.5		22.7	26.3		41.4	26.0		72.2	42.5	
LOS	C	C		C	C		D	C		E	D	
Approach Delay		27.6			25.7			31.3			53.0	
Approach LOS		C			C			C			D	
Queue Length 50th (m)	11.5	45.3		11.7	36.0		32.1	75.9		43.4	73.0	
Queue Length 95th (m)	21.7	63.8		22.0	52.0		#67.1	113.6		#88.3	#118.2	
Internal Link Dist (m)		119.1			183.3			149.3			207.8	
Turn Bay Length (m)	65.0			65.0			60.0			30.0		
Base Capacity (vph)	316	1007		281	1035		328	773		258	545	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.30	0.60		0.35	0.49		0.84	0.69		0.91	0.79	

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 35 (35%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.91

Intersection Signal Delay: 34.3

Intersection LOS: C

Intersection Capacity Utilization 88.3%

ICU Level of Service E

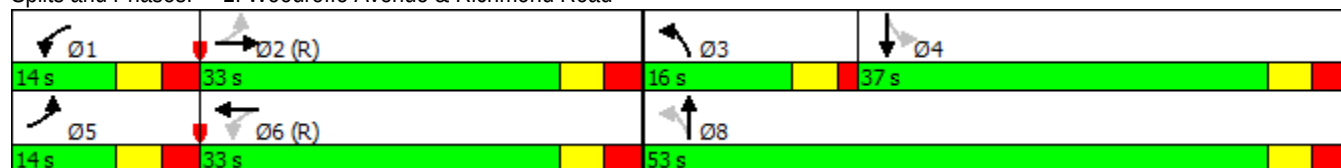
Analysis Period (min) 15

Lanes, Volumes, Timings 1: Woodroffe Avenue & Richmond Road

2017 Existing PM
851 Richmond Road TIS

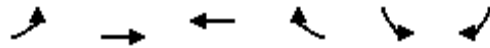
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Woodroffe Avenue & Richmond Road



Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

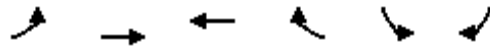
2017 Existing PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	36	366	786	56	30	32
Future Volume (vph)	36	366	786	56	30	32
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.991		0.930	
Flt Protected		0.995			0.976	
Satd. Flow (prot)	0	1779	1787	0	1652	0
Flt Permitted		0.749			0.976	
Satd. Flow (perm)	0	1339	1787	0	1652	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			9		33	
Link Speed (k/h)		50	50		50	
Link Distance (m)		160.2	91.9		133.2	
Travel Time (s)		11.5	6.6		9.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	2%	1%	0%	0%	0%
Adj. Flow (vph)	38	381	819	58	31	33
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	419	877	0	64	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2		1	
Detector Template	Left	Thru	Thru		Left	
Leading Detector (m)	6.1	30.5	30.5		6.1	
Trailing Detector (m)	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	6.1	1.8	1.8		6.1	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	
Protected Phases		2	6		4	
Permitted Phases	2					
Detector Phase	2	2	6		4	
Switch Phase						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2017 Existing PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Minimum Initial (s)	4.0	4.0	4.0		4.0	
Minimum Split (s)	29.1	29.1	29.1		21.3	
Total Split (s)	43.0	43.0	43.0		22.0	
Total Split (%)	66.2%	66.2%	66.2%		33.8%	
Maximum Green (s)	37.9	37.9	37.9		16.7	
Yellow Time (s)	3.3	3.3	3.3		3.3	
All-Red Time (s)	1.8	1.8	1.8		2.0	
Lost Time Adjust (s)		0.0	0.0		0.0	
Total Lost Time (s)		5.1	5.1		5.3	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	C-Max	C-Max	C-Max		Max	
Walk Time (s)	13.0	13.0	13.0		4.0	
Flash Dont Walk (s)	5.0	5.0	5.0		9.0	
Pedestrian Calls (#/hr)	0	0	0		0	
Act Effect Green (s)		37.9	37.9		16.7	
Actuated g/C Ratio		0.58	0.58		0.26	
v/c Ratio		0.54	0.84		0.14	
Control Delay		11.4	20.7		12.0	
Queue Delay		0.0	0.0		0.0	
Total Delay		11.4	20.7		12.0	
LOS		B	C		B	
Approach Delay		11.4	20.7		12.0	
Approach LOS		B	C		B	
Queue Length 50th (m)		27.2	75.9		2.8	
Queue Length 95th (m)		49.0	#153.0		10.9	
Internal Link Dist (m)		136.2	67.9		109.2	
Turn Bay Length (m)						
Base Capacity (vph)		780	1045		448	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		0.54	0.84		0.14	

Intersection Summary

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 65

Offset: 53 (82%), Referenced to phase 2:EBTL and 6:WBT, Start of Green

Natural Cycle: 60

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 17.4

Intersection LOS: B

Intersection Capacity Utilization 64.4%

ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 4: Richmond Road & Cleary Avenue



Appendix C

2019 Future Background Synchro Analysis Sheets

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2019 Future Background AM

851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	126	730	210	160	690	197	119	302	119	120	267	113
Future Volume (vph)	126	730	210	160	690	197	119	302	119	120	267	113
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	65.0		0.0	65.0		0.0	60.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	85.0			60.0			15.0			45.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.967			0.967			0.958			0.955	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1695	3239	0	1729	3344	0	1647	1681	0	1729	1738	0
Flt Permitted	0.124			0.299			0.234			0.504		
Satd. Flow (perm)	221	3239	0	544	3344	0	406	1681	0	917	1738	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		51			39			23			21	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		143.1			207.3			173.3			231.8	
Travel Time (s)		10.3			14.9			12.5			16.7	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	2%	3%	4%	0%	0%	0%	5%	4%	3%	0%	0%	0%
Adj. Flow (vph)	129	745	214	163	704	201	121	308	121	122	272	115
Shared Lane Traffic (%)												
Lane Group Flow (vph)	129	959	0	163	905	0	121	429	0	122	387	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2019 Future Background AM
851 Richmond Road TIS



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2			6			8			4		
Detector Phase	5	2		6	6		3	8		4	4	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	10.2	24.2		24.2	24.2		8.9	33.6		33.6	33.6	
Total Split (s)	15.0	54.0		39.0	39.0		12.0	46.0		34.0	34.0	
Total Split (%)	15.0%	54.0%		39.0%	39.0%		12.0%	46.0%		34.0%	34.0%	
Maximum Green (s)	8.8	47.8		32.8	32.8		7.1	39.4		27.4	27.4	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	3.3		3.3	3.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.2	6.2		6.2	6.2		4.9	6.6		6.6	6.6	
Lead/Lag	Lead			Lag	Lag		Lead			Lag	Lag	
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		C-Max	C-Max		None	Max		Max	Max	
Walk Time (s)		7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)		11.0		11.0	11.0			20.0		20.0	20.0	
Pedestrian Calls (#/hr)		0		0	0			0		0	0	
Act Effect Green (s)	47.8	47.8		33.3	33.3		41.1	39.4		27.5	27.5	
Actuated g/C Ratio	0.48	0.48		0.33	0.33		0.41	0.39		0.28	0.28	
v/c Ratio	0.57	0.61		0.90	0.80		0.48	0.63		0.48	0.79	
Control Delay	24.8	20.1		80.7	35.3		25.5	28.2		38.1	44.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	24.8	20.1		80.7	35.3		25.5	28.2		38.1	44.7	
LOS	C	C		F	D		C	C		D	D	
Approach Delay		20.7			42.2			27.6			43.1	
Approach LOS		C			D			C			D	
Queue Length 50th (m)	13.6	65.7		30.1	80.4		14.6	62.5		19.8	65.9	
Queue Length 95th (m)	24.3	85.6		#69.3	104.5		26.5	95.0		37.8	#109.5	
Internal Link Dist (m)		119.1			183.3			149.3			207.8	
Turn Bay Length (m)	65.0			65.0			60.0			30.0		
Base Capacity (vph)	235	1574		181	1138		254	676		252	492	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.55	0.61		0.90	0.80		0.48	0.63		0.48	0.79	

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 35 (35%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.90

Intersection Signal Delay: 32.6

Intersection LOS: C

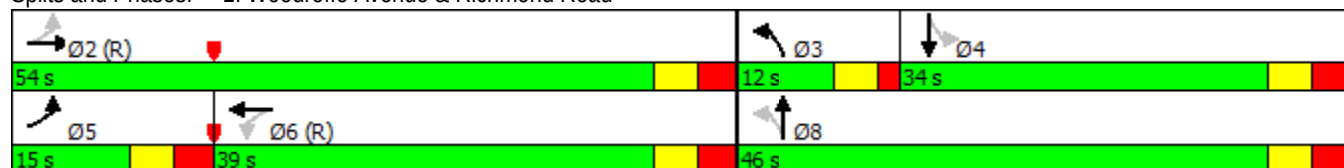
Intersection Capacity Utilization 90.5%

ICU Level of Service E

Analysis Period (min) 15

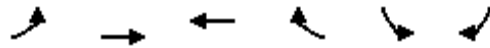
95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Woodroffe Avenue & Richmond Road



Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

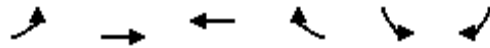
2019 Future Background AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	28	648	317	18	30	19
Future Volume (vph)	28	648	317	18	30	19
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.993		0.947	
Flt Protected		0.998			0.971	
Satd. Flow (prot)	0	1749	1720	0	1641	0
Flt Permitted		0.975			0.971	
Satd. Flow (perm)	0	1709	1720	0	1641	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			7		22	
Link Speed (k/h)		50	50		50	
Link Distance (m)		160.2	91.9		133.2	
Travel Time (s)		11.5	6.6		9.6	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	4%	5%	6%	0%	5%
Adj. Flow (vph)	32	736	360	20	34	22
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	768	380	0	56	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2		1	
Detector Template	Left	Thru	Thru		Left	
Leading Detector (m)	6.1	30.5	30.5		6.1	
Trailing Detector (m)	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	6.1	1.8	1.8		6.1	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	
Protected Phases		2	6		4	
Permitted Phases	2					
Detector Phase	2	2	6		4	
Switch Phase						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2019 Future Background AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Minimum Initial (s)	4.0	4.0	4.0		4.0	
Minimum Split (s)	29.1	29.1	29.1		21.3	
Total Split (s)	43.0	43.0	43.0		22.0	
Total Split (%)	66.2%	66.2%	66.2%		33.8%	
Maximum Green (s)	37.9	37.9	37.9		16.7	
Yellow Time (s)	3.3	3.3	3.3		3.3	
All-Red Time (s)	1.8	1.8	1.8		2.0	
Lost Time Adjust (s)		0.0	0.0		0.0	
Total Lost Time (s)		5.1	5.1		5.3	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	C-Max	C-Max	C-Max		Max	
Walk Time (s)	13.0	13.0	13.0		4.0	
Flash Dont Walk (s)	5.0	5.0	5.0		9.0	
Pedestrian Calls (#/hr)	0	0	0		0	
Act Effect Green (s)		37.9	37.9		16.7	
Actuated g/C Ratio		0.58	0.58		0.26	
v/c Ratio		0.77	0.38		0.13	
Control Delay		17.2	8.5		13.8	
Queue Delay		0.0	0.0		0.0	
Total Delay		17.2	8.5		13.8	
LOS		B	A		B	
Approach Delay		17.2	8.5		13.8	
Approach LOS		B	A		B	
Queue Length 50th (m)		62.2	21.2		3.1	
Queue Length 95th (m)		101.3	35.0		10.3	
Internal Link Dist (m)		136.2	67.9		109.2	
Turn Bay Length (m)						
Base Capacity (vph)		996	1005		437	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		0.77	0.38		0.13	

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Offset: 53 (82%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 14.3
Intersection Capacity Utilization 72.0%
Analysis Period (min) 15

Intersection LOS: B
ICU Level of Service C

Splits and Phases: 4: Richmond Road & Cleary Avenue



Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2019 Future Background PM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	96	395	215	106	340	175	274	425	113	236	332	93
Future Volume (vph)	96	395	215	106	340	175	274	425	113	236	332	93
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	65.0		0.0	65.0		0.0	60.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	85.0			60.0			15.0			45.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.947			0.949			0.969			0.967	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1712	3159	0	1729	3282	0	1662	1646	0	1729	1760	0
Flt Permitted	0.364			0.250			0.215			0.445		
Satd. Flow (perm)	656	3159	0	455	3282	0	376	1646	0	810	1760	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		100			90			18			14	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		143.1			207.3			173.3			231.8	
Travel Time (s)		10.3			14.9			12.5			16.7	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	1%	4%	3%	0%	0%	0%	4%	8%	4%	0%	0%	0%
Adj. Flow (vph)	98	403	219	108	347	179	280	434	115	241	339	95
Shared Lane Traffic (%)												
Lane Group Flow (vph)	98	622	0	108	526	0	280	549	0	241	434	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2		1	6		3	8			4	

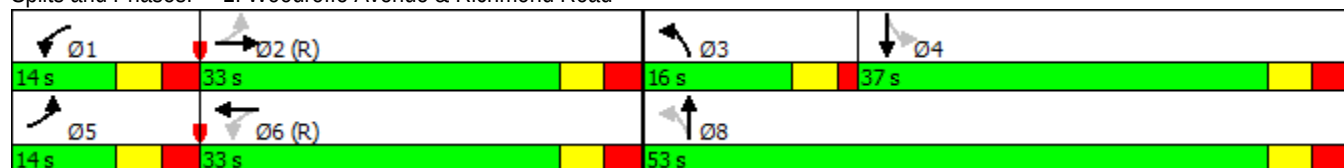
Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2019 Future Background PM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		3	8		4	4	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	10.2	24.2		10.2	24.2		8.9	33.6		33.6	33.6	
Total Split (s)	14.0	33.0		14.0	33.0		16.0	53.0		37.0	37.0	
Total Split (%)	14.0%	33.0%		14.0%	33.0%		16.0%	53.0%		37.0%	37.0%	
Maximum Green (s)	7.8	26.8		7.8	26.8		11.1	46.4		30.4	30.4	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	3.3		3.3	3.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.2	6.2		6.2	6.2		4.9	6.6		6.6	6.6	
Lead/Lag	Lead	Lag		Lead	Lag		Lead			Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		None	C-Max		None	Max		Max	Max	
Walk Time (s)		7.0			7.0			7.0		7.0	7.0	
Flash Dont Walk (s)		11.0			11.0			20.0		20.0	20.0	
Pedestrian Calls (#/hr)		0			0			0		0	0	
Act Effct Green (s)	34.6	27.1		35.8	29.6		48.1	46.4		30.4	30.4	
Actuated g/C Ratio	0.35	0.27		0.36	0.30		0.48	0.46		0.30	0.30	
v/c Ratio	0.32	0.67		0.42	0.51		0.87	0.71		0.98	0.80	
Control Delay	21.9	31.2		24.2	26.9		45.1	26.9		89.3	43.5	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	21.9	31.2		24.2	26.9		45.1	26.9		89.3	43.5	
LOS	C	C		C	C		D	C		F	D	
Approach Delay		30.0			26.4			33.1			59.9	
Approach LOS		C			C			C			E	
Queue Length 50th (m)	11.7	47.6		12.9	38.0		32.7	79.7		46.1	74.6	
Queue Length 95th (m)	22.0	66.6		24.0	54.4		#68.3	119.6		#94.0	#121.3	
Internal Link Dist (m)		119.1			183.3			149.3			207.8	
Turn Bay Length (m)	65.0			65.0			60.0			30.0		
Base Capacity (vph)	311	928		262	1034		323	773		246	544	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.32	0.67		0.41	0.51		0.87	0.71		0.98	0.80	
Intersection Summary												
Area Type:	Other											
Cycle Length: 100												
Actuated Cycle Length: 100												
Offset: 35 (35%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green												
Natural Cycle: 80												
Control Type: Actuated-Coordinated												
Maximum v/c Ratio: 0.98												
Intersection Signal Delay: 37.1							Intersection LOS: D					
Intersection Capacity Utilization 91.0%							ICU Level of Service E					
Analysis Period (min) 15												

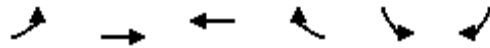
95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Woodroffe Avenue & Richmond Road



Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

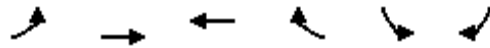
2019 Future Background PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	37	385	816	56	30	32
Future Volume (vph)	37	385	816	56	30	32
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.991		0.930	
Flt Protected		0.996			0.976	
Satd. Flow (prot)	0	1780	1787	0	1652	0
Flt Permitted		0.702			0.976	
Satd. Flow (perm)	0	1255	1787	0	1652	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			9		33	
Link Speed (k/h)		50	50		50	
Link Distance (m)		160.2	91.9		133.2	
Travel Time (s)		11.5	6.6		9.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	2%	1%	0%	0%	0%
Adj. Flow (vph)	39	401	850	58	31	33
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	440	908	0	64	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2		1	
Detector Template	Left	Thru	Thru		Left	
Leading Detector (m)	6.1	30.5	30.5		6.1	
Trailing Detector (m)	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	6.1	1.8	1.8		6.1	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	
Protected Phases		2	6		4	
Permitted Phases	2					
Detector Phase	2	2	6		4	
Switch Phase						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2019 Future Background PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Minimum Initial (s)	4.0	4.0	4.0		4.0	
Minimum Split (s)	29.1	29.1	29.1		21.3	
Total Split (s)	43.0	43.0	43.0		22.0	
Total Split (%)	66.2%	66.2%	66.2%		33.8%	
Maximum Green (s)	37.9	37.9	37.9		16.7	
Yellow Time (s)	3.3	3.3	3.3		3.3	
All-Red Time (s)	1.8	1.8	1.8		2.0	
Lost Time Adjust (s)		0.0	0.0		0.0	
Total Lost Time (s)		5.1	5.1		5.3	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	C-Max	C-Max	C-Max		Max	
Walk Time (s)	13.0	13.0	13.0		4.0	
Flash Dont Walk (s)	5.0	5.0	5.0		9.0	
Pedestrian Calls (#/hr)	0	0	0		0	
Act Effect Green (s)		37.9	37.9		16.7	
Actuated g/C Ratio		0.58	0.58		0.26	
v/c Ratio		0.60	0.87		0.14	
Control Delay		13.1	23.0		12.0	
Queue Delay		0.0	0.0		0.0	
Total Delay		13.1	23.0		12.0	
LOS		B	C		B	
Approach Delay		13.1	23.0		12.0	
Approach LOS		B	C		B	
Queue Length 50th (m)		30.2	81.2		2.8	
Queue Length 95th (m)		55.9	#161.8		10.9	
Internal Link Dist (m)		136.2	67.9		109.2	
Turn Bay Length (m)						
Base Capacity (vph)		731	1045		448	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		0.60	0.87		0.14	

Intersection Summary

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 65

Offset: 53 (82%), Referenced to phase 2:EBTL and 6:WBT, Start of Green

Natural Cycle: 65

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.87

Intersection Signal Delay: 19.4

Intersection LOS: B

Intersection Capacity Utilization 66.3%

ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 4: Richmond Road & Cleary Avenue



Appendix D

2019 Total Future Synchro Analysis Sheets

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2019 Total Future AM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	126	732	210	164	694	198	119	302	121	120	267	113
Future Volume (vph)	126	732	210	164	694	198	119	302	121	120	267	113
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	65.0		0.0	65.0		0.0	60.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	85.0			60.0			15.0			45.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.967			0.967			0.957			0.955	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1695	3239	0	1729	3344	0	1647	1679	0	1729	1738	0
Flt Permitted	0.122			0.298			0.234			0.501		
Satd. Flow (perm)	218	3239	0	542	3344	0	406	1679	0	912	1738	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		51			39			24			21	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		143.1			207.3			173.3			231.8	
Travel Time (s)		10.3			14.9			12.5			16.7	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	2%	3%	4%	0%	0%	0%	5%	4%	3%	0%	0%	0%
Adj. Flow (vph)	129	747	214	167	708	202	121	308	123	122	272	115
Shared Lane Traffic (%)												
Lane Group Flow (vph)	129	961	0	167	910	0	121	431	0	122	387	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2019 Total Future AM
851 Richmond Road TIS



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2			6			8			4		
Detector Phase	5	2		6	6		3	8		4	4	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	10.2	24.2		24.2	24.2		8.9	33.6		33.6	33.6	
Total Split (s)	15.0	54.0		39.0	39.0		12.0	46.0		34.0	34.0	
Total Split (%)	15.0%	54.0%		39.0%	39.0%		12.0%	46.0%		34.0%	34.0%	
Maximum Green (s)	8.8	47.8		32.8	32.8		7.1	39.4		27.4	27.4	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	3.3		3.3	3.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.2	6.2		6.2	6.2		4.9	6.6		6.6	6.6	
Lead/Lag	Lead			Lag	Lag		Lead			Lag	Lag	
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		C-Max	C-Max		None	Max		Max	Max	
Walk Time (s)		7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)		11.0		11.0	11.0			20.0		20.0	20.0	
Pedestrian Calls (#/hr)		0		0	0			0		0	0	
Act Effect Green (s)	47.8	47.8		33.3	33.3		41.1	39.4		27.5	27.5	
Actuated g/C Ratio	0.48	0.48		0.33	0.33		0.41	0.39		0.28	0.28	
v/c Ratio	0.57	0.61		0.93	0.80		0.48	0.64		0.49	0.79	
Control Delay	25.0	20.1		86.6	35.5		25.5	28.3		38.3	44.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	25.0	20.1		86.6	35.5		25.5	28.3		38.3	44.7	
LOS	C	C		F	D		C	C		D	D	
Approach Delay		20.7			43.4			27.7			43.2	
Approach LOS		C			D			C			D	
Queue Length 50th (m)	13.6	65.9		31.2	81.0		14.6	62.8		19.8	65.9	
Queue Length 95th (m)	24.3	85.7		#71.8	105.2		26.5	95.3		37.9	#109.5	
Internal Link Dist (m)		119.1			183.3			149.3			207.8	
Turn Bay Length (m)	65.0			65.0			60.0			30.0		
Base Capacity (vph)	234	1574		180	1138		254	676		250	492	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.55	0.61		0.93	0.80		0.48	0.64		0.49	0.79	

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 35 (35%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 33.0

Intersection LOS: C

Intersection Capacity Utilization 90.9%

ICU Level of Service E

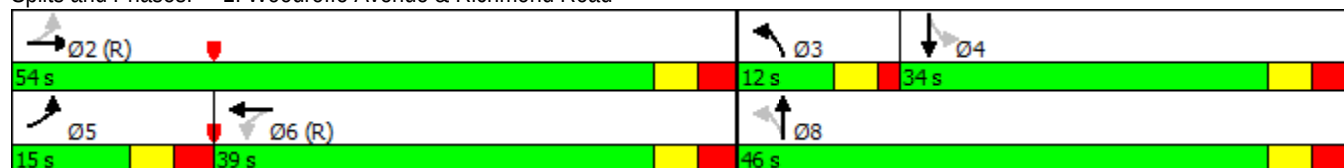
Analysis Period (min) 15

Lanes, Volumes, Timings 1: Woodroffe Avenue & Richmond Road

2019 Total Future AM
851 Richmond Road TIS

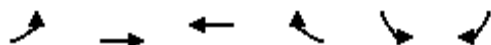
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Woodroffe Avenue & Richmond Road



Lanes, Volumes, Timings
2: Richmond Road & West Site Access

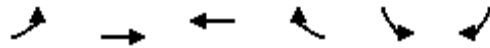
2019 Total Future AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	3	679	352	3	7	9
Future Volume (vph)	3	679	352	3	7	9
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.999		0.925	
Flt Protected					0.978	
Satd. Flow (prot)	0	1784	1783	0	1614	0
Flt Permitted					0.978	
Satd. Flow (perm)	0	1784	1783	0	1614	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		132.7	143.7		44.1	
Travel Time (s)		9.6	10.3		3.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	738	383	3	8	10
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	741	386	0	18	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type: Unsignalized						
Intersection Capacity Utilization 50.2%				ICU Level of Service A		
Analysis Period (min) 15						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

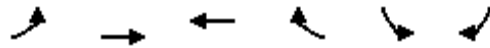
2019 Total Future AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	28	655	320	18	30	19
Future Volume (vph)	28	655	320	18	30	19
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.993		0.947	
Flt Protected		0.998			0.971	
Satd. Flow (prot)	0	1749	1720	0	1641	0
Flt Permitted		0.976			0.971	
Satd. Flow (perm)	0	1711	1720	0	1641	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			7		22	
Link Speed (k/h)		50	50		50	
Link Distance (m)		160.2	91.9		133.2	
Travel Time (s)		11.5	6.6		9.6	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	4%	5%	6%	0%	5%
Adj. Flow (vph)	32	744	364	20	34	22
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	776	384	0	56	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2		1	
Detector Template	Left	Thru	Thru		Left	
Leading Detector (m)	6.1	30.5	30.5		6.1	
Trailing Detector (m)	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	6.1	1.8	1.8		6.1	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	
Protected Phases		2	6		4	
Permitted Phases	2					
Detector Phase	2	2	6		4	
Switch Phase						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2019 Total Future AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Minimum Initial (s)	4.0	4.0	4.0		4.0	
Minimum Split (s)	29.1	29.1	29.1		21.3	
Total Split (s)	43.0	43.0	43.0		22.0	
Total Split (%)	66.2%	66.2%	66.2%		33.8%	
Maximum Green (s)	37.9	37.9	37.9		16.7	
Yellow Time (s)	3.3	3.3	3.3		3.3	
All-Red Time (s)	1.8	1.8	1.8		2.0	
Lost Time Adjust (s)		0.0	0.0		0.0	
Total Lost Time (s)		5.1	5.1		5.3	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	C-Max	C-Max	C-Max		Max	
Walk Time (s)	13.0	13.0	13.0		4.0	
Flash Dont Walk (s)	5.0	5.0	5.0		9.0	
Pedestrian Calls (#/hr)	0	0	0		0	
Act Effect Green (s)		37.9	37.9		16.7	
Actuated g/C Ratio		0.58	0.58		0.26	
v/c Ratio		0.78	0.38		0.13	
Control Delay		17.5	8.5		13.8	
Queue Delay		0.0	0.0		0.0	
Total Delay		17.5	8.5		13.8	
LOS		B	A		B	
Approach Delay		17.5	8.5		13.8	
Approach LOS		B	A		B	
Queue Length 50th (m)		63.3	21.5		3.1	
Queue Length 95th (m)		102.8	35.4		10.3	
Internal Link Dist (m)		136.2	67.9		109.2	
Turn Bay Length (m)						
Base Capacity (vph)		997	1005		437	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		0.78	0.38		0.13	

Intersection Summary

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 65

Offset: 53 (82%), Referenced to phase 2:EBTL and 6:WBT, Start of Green

Natural Cycle: 60

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.78

Intersection Signal Delay: 14.5

Intersection LOS: B

Intersection Capacity Utilization 72.4%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 4: Richmond Road & Cleary Avenue



HCM Unsignalized Intersection Capacity Analysis

2: Richmond Road & West Site Access

2019 Total Future AM
851 Richmond Road TIS

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	3	679	352	3	7	9
Future Volume (Veh/h)	3	679	352	3	7	9
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	738	383	3	8	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)		340	304			
pX, platoon unblocked	0.96				0.78	0.96
vC, conflicting volume	386				1128	384
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	341				912	340
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				97	99
cM capacity (veh/h)	1171				237	676
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	741	386	18			
Volume Left	3	0	8			
Volume Right	0	3	10			
cSH	1171	1700	370			
Volume to Capacity	0.00	0.23	0.05			
Queue Length 95th (m)	0.1	0.0	1.2			
Control Delay (s)	0.1	0.0	15.2			
Lane LOS	A		C			
Approach Delay (s)	0.1	0.0	15.2			
Approach LOS			C			
Intersection Summary						
Average Delay			0.3			
Intersection Capacity Utilization			50.2%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2019 Total Future PM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	96	400	215	109	343	176	274	425	118	237	332	93
Future Volume (vph)	96	400	215	109	343	176	274	425	118	237	332	93
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	65.0		0.0	65.0		0.0	60.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	85.0			60.0			15.0			45.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.948			0.949			0.968			0.967	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1712	3163	0	1729	3282	0	1662	1644	0	1729	1760	0
Flt Permitted	0.361			0.247			0.215			0.438		
Satd. Flow (perm)	651	3163	0	450	3282	0	376	1644	0	797	1760	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		97			89			19			14	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		143.1			207.3			173.3			231.8	
Travel Time (s)		10.3			14.9			12.5			16.7	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	1%	4%	3%	0%	0%	0%	4%	8%	4%	0%	0%	0%
Adj. Flow (vph)	98	408	219	111	350	180	280	434	120	242	339	95
Shared Lane Traffic (%)												
Lane Group Flow (vph)	98	627	0	111	530	0	280	554	0	242	434	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2		1	6		3	8			4	

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2019 Total Future PM
851 Richmond Road TIS



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		3	8		4	4	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	10.2	24.2		10.2	24.2		8.9	33.6		33.6	33.6	
Total Split (s)	14.0	33.0		14.0	33.0		16.0	53.0		37.0	37.0	
Total Split (%)	14.0%	33.0%		14.0%	33.0%		16.0%	53.0%		37.0%	37.0%	
Maximum Green (s)	7.8	26.8		7.8	26.8		11.1	46.4		30.4	30.4	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	3.3		3.3	3.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.2	6.2		6.2	6.2		4.9	6.6		6.6	6.6	
Lead/Lag	Lead	Lag		Lead	Lag		Lead			Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		None	C-Max		None	Max		Max	Max	
Walk Time (s)		7.0			7.0			7.0		7.0	7.0	
Flash Dont Walk (s)		11.0			11.0			20.0		20.0	20.0	
Pedestrian Calls (#/hr)		0			0			0		0	0	
Act Effect Green (s)	34.5	27.1		35.8	29.6		48.1	46.4		30.4	30.4	
Actuated g/C Ratio	0.34	0.27		0.36	0.30		0.48	0.46		0.30	0.30	
v/c Ratio	0.32	0.68		0.43	0.51		0.87	0.72		1.00	0.80	
Control Delay	21.9	31.6		24.5	27.0		45.1	27.1		95.1	43.5	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	21.9	31.6		24.5	27.0		45.1	27.1		95.1	43.5	
LOS	C	C		C	C		D	C		F	D	
Approach Delay		30.3			26.6			33.2			62.0	
Approach LOS		C			C			C			E	
Queue Length 50th (m)	11.7	48.5		13.3	38.6		32.7	80.8		46.7	74.6	
Queue Length 95th (m)	22.0	67.7		24.6	55.0		#68.3	120.9		#95.3	#121.3	
Internal Link Dist (m)		119.1			183.3			149.3			207.8	
Turn Bay Length (m)	65.0			65.0			60.0			30.0		
Base Capacity (vph)	310	926		261	1033		323	773		242	544	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.32	0.68		0.43	0.51		0.87	0.72		1.00	0.80	

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 35 (35%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.00

Intersection Signal Delay: 37.8

Intersection LOS: D

Intersection Capacity Utilization 91.7%

ICU Level of Service F

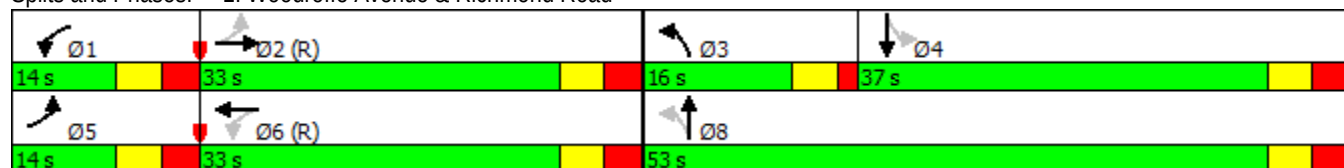
Analysis Period (min) 15

Lanes, Volumes, Timings
 1: Woodroffe Avenue & Richmond Road

2019 Total Future PM
 851 Richmond Road TIS

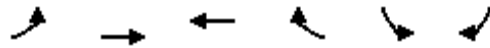
95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Woodroffe Avenue & Richmond Road



Lanes, Volumes, Timings
2: Richmond Road & West Site Access

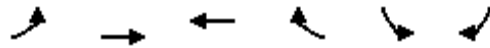
2019 Total Future PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	10	436	860	8	5	7
Future Volume (vph)	10	436	860	8	5	7
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.999		0.917	
Flt Protected		0.999			0.981	
Satd. Flow (prot)	0	1783	1783	0	1605	0
Flt Permitted		0.999			0.981	
Satd. Flow (perm)	0	1783	1783	0	1605	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		133.7	142.8		42.6	
Travel Time (s)		9.6	10.3		3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	474	935	9	5	8
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	485	944	0	13	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type: Other						
Control Type: Unsignalized						
Intersection Capacity Utilization 58.3%						
ICU Level of Service B						
Analysis Period (min) 15						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

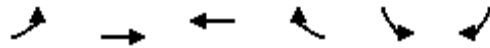
2019 Total Future PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	37	390	824	56	30	32
Future Volume (vph)	37	390	824	56	30	32
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.991		0.930	
Flt Protected		0.996			0.976	
Satd. Flow (prot)	0	1780	1787	0	1652	0
Flt Permitted		0.691			0.976	
Satd. Flow (perm)	0	1235	1787	0	1652	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			9		33	
Link Speed (k/h)		50	50		50	
Link Distance (m)		160.2	91.9		133.2	
Travel Time (s)		11.5	6.6		9.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	2%	1%	0%	0%	0%
Adj. Flow (vph)	39	406	858	58	31	33
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	445	916	0	64	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2		1	
Detector Template	Left	Thru	Thru		Left	
Leading Detector (m)	6.1	30.5	30.5		6.1	
Trailing Detector (m)	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	6.1	1.8	1.8		6.1	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	
Protected Phases		2	6		4	
Permitted Phases	2					
Detector Phase	2	2	6		4	
Switch Phase						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2019 Total Future PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Minimum Initial (s)	4.0	4.0	4.0		4.0	
Minimum Split (s)	29.1	29.1	29.1		21.3	
Total Split (s)	43.0	43.0	43.0		22.0	
Total Split (%)	66.2%	66.2%	66.2%		33.8%	
Maximum Green (s)	37.9	37.9	37.9		16.7	
Yellow Time (s)	3.3	3.3	3.3		3.3	
All-Red Time (s)	1.8	1.8	1.8		2.0	
Lost Time Adjust (s)		0.0	0.0		0.0	
Total Lost Time (s)		5.1	5.1		5.3	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	C-Max	C-Max	C-Max		Max	
Walk Time (s)	13.0	13.0	13.0		4.0	
Flash Dont Walk (s)	5.0	5.0	5.0		9.0	
Pedestrian Calls (#/hr)	0	0	0		0	
Act Effect Green (s)		37.9	37.9		16.7	
Actuated g/C Ratio		0.58	0.58		0.26	
v/c Ratio		0.62	0.88		0.14	
Control Delay		13.6	23.7		12.0	
Queue Delay		0.0	0.0		0.0	
Total Delay		13.6	23.7		12.0	
LOS		B	C		B	
Approach Delay		13.6	23.7		12.0	
Approach LOS		B	C		B	
Queue Length 50th (m)		31.0	82.7		2.8	
Queue Length 95th (m)		57.9	#164.1		10.9	
Internal Link Dist (m)		136.2	67.9		109.2	
Turn Bay Length (m)						
Base Capacity (vph)		720	1045		448	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		0.62	0.88		0.14	

Intersection Summary

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 65

Offset: 53 (82%), Referenced to phase 2:EBTL and 6:WBT, Start of Green

Natural Cycle: 65

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.88

Intersection Signal Delay: 20.0

Intersection LOS: B

Intersection Capacity Utilization 66.6%

ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Lanes, Volumes, Timings
 4: Richmond Road & Cleary Avenue

2019 Total Future PM
 851 Richmond Road TIS

Splits and Phases: 4: Richmond Road & Cleary Avenue



HCM Unsignalized Intersection Capacity Analysis

2: Richmond Road & West Site Access

2019 Total Future PM
851 Richmond Road TIS

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	10	436	860	8	5	7
Future Volume (Veh/h)	10	436	860	8	5	7
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	474	935	9	5	8
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)		341	303			
pX, platoon unblocked	0.51				0.55	0.51
vC, conflicting volume	944				1436	940
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	400				1030	391
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				96	98
cM capacity (veh/h)	586				139	332
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	485	944	13			
Volume Left	11	0	5			
Volume Right	0	9	8			
cSH	586	1700	217			
Volume to Capacity	0.02	0.56	0.06			
Queue Length 95th (m)	0.4	0.0	1.4			
Control Delay (s)	0.5	0.0	22.7			
Lane LOS	A		C			
Approach Delay (s)	0.5	0.0	22.7			
Approach LOS			C			
Intersection Summary						
Average Delay			0.4			
Intersection Capacity Utilization			58.3%	ICU Level of Service		B
Analysis Period (min)			15			

Appendix E

2024 Future Background Synchro Analysis Sheets

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2024 Future Background AM

851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	784	226	168	739	211	128	326	125	126	288	121
Future Volume (vph)	136	784	226	168	739	211	128	326	125	126	288	121
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	65.0		0.0	65.0		0.0	60.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	85.0			60.0			15.0			45.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.966			0.967			0.958			0.956	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1695	3236	0	1729	3344	0	1647	1681	0	1729	1740	0
Flt Permitted	0.102			0.264			0.194			0.457		
Satd. Flow (perm)	182	3236	0	480	3344	0	336	1681	0	832	1740	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		51			39			23			21	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		143.1			207.3			173.3			231.8	
Travel Time (s)		10.3			14.9			12.5			16.7	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	2%	3%	4%	0%	0%	0%	5%	4%	3%	0%	0%	0%
Adj. Flow (vph)	139	800	231	171	754	215	131	333	128	129	294	123
Shared Lane Traffic (%)												
Lane Group Flow (vph)	139	1031	0	171	969	0	131	461	0	129	417	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2024 Future Background AM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2			6			8			4		
Detector Phase	5	2		6	6		3	8		4	4	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	10.2	24.2		24.2	24.2		8.9	33.6		33.6	33.6	
Total Split (s)	15.0	54.0		39.0	39.0		12.0	46.0		34.0	34.0	
Total Split (%)	15.0%	54.0%		39.0%	39.0%		12.0%	46.0%		34.0%	34.0%	
Maximum Green (s)	8.8	47.8		32.8	32.8		7.1	39.4		27.4	27.4	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	3.3		3.3	3.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.2	6.2		6.2	6.2		4.9	6.6		6.6	6.6	
Lead/Lag	Lead			Lag	Lag		Lead			Lag	Lag	
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		C-Max	C-Max		None	Max		Max	Max	
Walk Time (s)		7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)		11.0		11.0	11.0			20.0		20.0	20.0	
Pedestrian Calls (#/hr)		0		0	0			0		0	0	
Act Effct Green (s)	47.8	47.8		33.1	33.1		41.1	39.4		27.4	27.4	
Actuated g/C Ratio	0.48	0.48		0.33	0.33		0.41	0.39		0.27	0.27	
v/c Ratio	0.65	0.66		1.08	0.85		0.57	0.68		0.57	0.85	
Control Delay	31.5	21.2		129.2	38.9		29.4	30.0		42.5	50.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	31.5	21.2		129.2	38.9		29.4	30.0		42.5	50.1	
LOS	C	C		F	D		C	C		D	D	
Approach Delay		22.4			52.4			29.9			48.3	
Approach LOS		C			D			C			D	
Queue Length 50th (m)	14.8	73.3		~37.4	88.7		15.9	69.1		21.5	72.9	
Queue Length 95th (m)	#33.8	94.9		#77.6	#122.3		28.4	104.6		41.3	#123.4	
Internal Link Dist (m)		119.1			183.3			149.3			207.8	
Turn Bay Length (m)	65.0			65.0			60.0			30.0		
Base Capacity (vph)	220	1573		159	1134		231	676		227	492	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.63	0.66		1.08	0.85		0.57	0.68		0.57	0.85	
Intersection Summary												
Area Type:	Other											
Cycle Length: 100												
Actuated Cycle Length: 100												
Offset: 35 (35%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green												
Natural Cycle: 90												
Control Type: Actuated-Coordinated												
Maximum v/c Ratio: 1.08												
Intersection Signal Delay: 37.7						Intersection LOS: D						
Intersection Capacity Utilization 95.2%						ICU Level of Service F						
Analysis Period (min) 15												

Lanes, Volumes, Timings

1: Woodroffe Avenue & Richmond Road

2024 Future Background AM
851 Richmond Road TIS

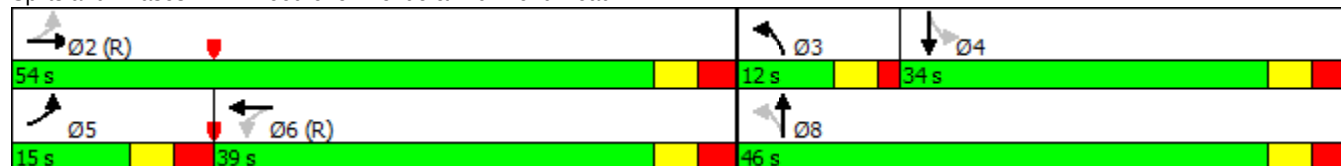
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

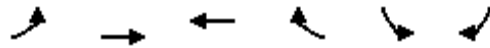
Queue shown is maximum after two cycles.

Splits and Phases: 1: Woodroffe Avenue & Richmond Road



Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

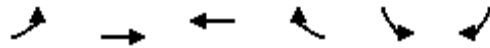
2024 Future Background AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	30	690	338	19	33	20
Future Volume (vph)	30	690	338	19	33	20
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.993		0.949	
Flt Protected		0.998			0.970	
Satd. Flow (prot)	0	1749	1720	0	1644	0
Flt Permitted		0.974			0.970	
Satd. Flow (perm)	0	1707	1720	0	1644	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			8		23	
Link Speed (k/h)		50	50		50	
Link Distance (m)		160.2	91.9		133.2	
Travel Time (s)		11.5	6.6		9.6	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	4%	5%	6%	0%	5%
Adj. Flow (vph)	34	784	384	22	38	23
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	818	406	0	61	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2		1	
Detector Template	Left	Thru	Thru		Left	
Leading Detector (m)	6.1	30.5	30.5		6.1	
Trailing Detector (m)	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	6.1	1.8	1.8		6.1	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	
Protected Phases		2	6		4	
Permitted Phases	2					
Detector Phase	2	2	6		4	
Switch Phase						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2024 Future Background AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Minimum Initial (s)	4.0	4.0	4.0		4.0	
Minimum Split (s)	29.1	29.1	29.1		21.3	
Total Split (s)	43.0	43.0	43.0		22.0	
Total Split (%)	66.2%	66.2%	66.2%		33.8%	
Maximum Green (s)	37.9	37.9	37.9		16.7	
Yellow Time (s)	3.3	3.3	3.3		3.3	
All-Red Time (s)	1.8	1.8	1.8		2.0	
Lost Time Adjust (s)		0.0	0.0		0.0	
Total Lost Time (s)		5.1	5.1		5.3	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	C-Max	C-Max	C-Max		Max	
Walk Time (s)	13.0	13.0	13.0		4.0	
Flash Dont Walk (s)	5.0	5.0	5.0		9.0	
Pedestrian Calls (#/hr)	0	0	0		0	
Act Effect Green (s)		37.9	37.9		16.7	
Actuated g/C Ratio		0.58	0.58		0.26	
v/c Ratio		0.82	0.40		0.14	
Control Delay		20.1	8.7		14.1	
Queue Delay		0.0	0.0		0.0	
Total Delay		20.1	8.7		14.1	
LOS		C	A		B	
Approach Delay		20.1	8.7		14.1	
Approach LOS		C	A		B	
Queue Length 50th (m)		70.2	23.2		3.5	
Queue Length 95th (m)		#136.7	37.9		11.0	
Internal Link Dist (m)		136.2	67.9		109.2	
Turn Bay Length (m)						
Base Capacity (vph)		995	1006		439	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		0.82	0.40		0.14	

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Offset: 53 (82%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 16.2
Intersection Capacity Utilization 76.0%
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Richmond Road & Cleary Avenue



Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2024 Future Background PM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	103	420	232	109	362	187	295	457	116	248	358	101
Future Volume (vph)	103	420	232	109	362	187	295	457	116	248	358	101
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	65.0		0.0	65.0		0.0	60.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	85.0			60.0			15.0			45.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.947			0.949			0.970			0.967	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1712	3160	0	1729	3282	0	1662	1647	0	1729	1760	0
Flt Permitted	0.336			0.220			0.176			0.398		
Satd. Flow (perm)	605	3160	0	400	3282	0	308	1647	0	724	1760	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		102			90			17			15	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		143.1			207.3			173.3			231.8	
Travel Time (s)		10.3			14.9			12.5			16.7	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	1%	4%	3%	0%	0%	0%	4%	8%	4%	0%	0%	0%
Adj. Flow (vph)	105	429	237	111	369	191	301	466	118	253	365	103
Shared Lane Traffic (%)												
Lane Group Flow (vph)	105	666	0	111	560	0	301	584	0	253	468	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2		1	6		3	8			4	

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2024 Future Background PM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		3	8		4	4	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	10.2	24.2		10.2	24.2		8.9	33.6		33.6	33.6	
Total Split (s)	14.0	33.0		14.0	33.0		16.0	53.0		37.0	37.0	
Total Split (%)	14.0%	33.0%		14.0%	33.0%		16.0%	53.0%		37.0%	37.0%	
Maximum Green (s)	7.8	26.8		7.8	26.8		11.1	46.4		30.4	30.4	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	3.3		3.3	3.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.2	6.2		6.2	6.2		4.9	6.6		6.6	6.6	
Lead/Lag	Lead	Lag		Lead	Lag		Lead			Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		None	C-Max		None	Max		Max	Max	
Walk Time (s)		7.0			7.0			7.0		7.0	7.0	
Flash Dont Walk (s)		11.0			11.0			20.0		20.0	20.0	
Pedestrian Calls (#/hr)		0			0			0		0	0	
Act Effct Green (s)	34.6	27.1		35.8	29.6		48.1	46.4		30.4	30.4	
Actuated g/C Ratio	0.35	0.27		0.36	0.30		0.48	0.46		0.30	0.30	
v/c Ratio	0.36	0.72		0.46	0.54		1.01	0.76		1.15	0.86	
Control Delay	22.7	32.9		25.4	27.7		76.5	29.1		141.4	48.9	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	22.7	32.9		25.4	27.7		76.5	29.1		141.4	48.9	
LOS	C	C		C	C		E	C		F	D	
Approach Delay		31.5			27.3			45.2			81.3	
Approach LOS		C			C			D			F	
Queue Length 50th (m)	12.6	52.5		13.3	41.6		~36.2	87.9		~58.0	82.6	
Queue Length 95th (m)	23.3	72.7		24.6	59.0		#88.9	131.9		#105.0	#136.8	
Internal Link Dist (m)		119.1			183.3			149.3			207.8	
Turn Bay Length (m)	65.0			65.0			60.0			30.0		
Base Capacity (vph)	297	929		247	1034		298	773		220	545	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.35	0.72		0.45	0.54		1.01	0.76		1.15	0.86	
Intersection Summary												
Area Type:	Other											
Cycle Length: 100												
Actuated Cycle Length: 100												
Offset: 35 (35%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green												
Natural Cycle: 90												
Control Type: Actuated-Coordinated												
Maximum v/c Ratio: 1.15												
Intersection Signal Delay: 46.3						Intersection LOS: D						
Intersection Capacity Utilization 95.1%						ICU Level of Service F						
Analysis Period (min) 15												

Lanes, Volumes, Timings 1: Woodroffe Avenue & Richmond Road

2024 Future Background PM
851 Richmond Road TIS

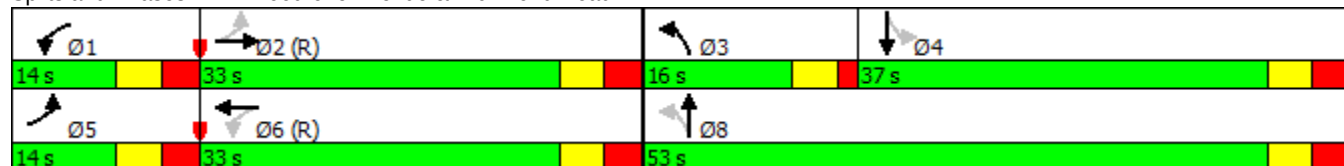
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

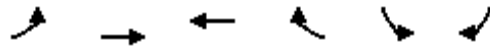
Queue shown is maximum after two cycles.

Splits and Phases: 1: Woodroffe Avenue & Richmond Road



Lanes, Volumes, Timings
2: Richmond Road & West Site Access

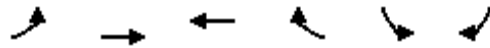
2024 Future Background PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	457	917	0	0	0
Future Volume (vph)	0	457	917	0	0	0
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frts						
Flt Protected						
Satd. Flow (prot)	0	1784	1784	0	1784	0
Flt Permitted						
Satd. Flow (perm)	0	1784	1784	0	1784	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		133.7	142.8		42.6	
Travel Time (s)		9.6	10.3		3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	497	997	0	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	497	997	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type: Other						
Control Type: Unsignalized						
Intersection Capacity Utilization 54.3%						
ICU Level of Service A						
Analysis Period (min) 15						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

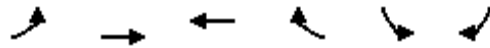
2024 Future Background PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	39	407	869	61	33	35
Future Volume (vph)	39	407	869	61	33	35
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.991		0.931	
Flt Protected		0.996			0.976	
Satd. Flow (prot)	0	1780	1787	0	1654	0
Flt Permitted		0.600			0.976	
Satd. Flow (perm)	0	1072	1787	0	1654	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			9		36	
Link Speed (k/h)		50	50		50	
Link Distance (m)		160.2	91.9		133.2	
Travel Time (s)		11.5	6.6		9.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	2%	1%	0%	0%	0%
Adj. Flow (vph)	41	424	905	64	34	36
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	465	969	0	70	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2		1	
Detector Template	Left	Thru	Thru		Left	
Leading Detector (m)	6.1	30.5	30.5		6.1	
Trailing Detector (m)	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	6.1	1.8	1.8		6.1	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	
Protected Phases		2	6		4	
Permitted Phases	2					
Detector Phase	2	2	6		4	
Switch Phase						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2024 Future Background PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Minimum Initial (s)	4.0	4.0	4.0		4.0	
Minimum Split (s)	29.1	29.1	29.1		21.3	
Total Split (s)	43.0	43.0	43.0		22.0	
Total Split (%)	66.2%	66.2%	66.2%		33.8%	
Maximum Green (s)	37.9	37.9	37.9		16.7	
Yellow Time (s)	3.3	3.3	3.3		3.3	
All-Red Time (s)	1.8	1.8	1.8		2.0	
Lost Time Adjust (s)		0.0	0.0		0.0	
Total Lost Time (s)		5.1	5.1		5.3	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	C-Max	C-Max	C-Max		Max	
Walk Time (s)	13.0	13.0	13.0		4.0	
Flash Dont Walk (s)	5.0	5.0	5.0		9.0	
Pedestrian Calls (#/hr)	0	0	0		0	
Act Effect Green (s)		37.9	37.9		16.7	
Actuated g/C Ratio		0.58	0.58		0.26	
v/c Ratio		0.74	0.93		0.16	
Control Delay		19.7	29.6		12.1	
Queue Delay		0.0	0.0		0.0	
Total Delay		19.7	29.6		12.1	
LOS		B	C		B	
Approach Delay		19.7	29.6		12.1	
Approach LOS		B	C		B	
Queue Length 50th (m)		36.6	93.3		3.1	
Queue Length 95th (m)		#88.5	#179.3		11.5	
Internal Link Dist (m)		136.2	67.9		109.2	
Turn Bay Length (m)						
Base Capacity (vph)		625	1045		451	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		0.74	0.93		0.16	

Intersection Summary

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 65

Offset: 53 (82%), Referenced to phase 2:EBTL and 6:WBT, Start of Green

Natural Cycle: 70

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 25.7

Intersection LOS: C

Intersection Capacity Utilization 69.7%

ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 4: Richmond Road & Cleary Avenue



Appendix F

2024 Total Future Synchro Analysis Sheets

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2024 Total Future AM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	785	226	170	741	211	128	326	126	126	288	121
Future Volume (vph)	136	785	226	170	741	211	128	326	126	126	288	121
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	65.0		0.0	65.0		0.0	60.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	85.0			60.0			15.0			45.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.966			0.967			0.958			0.956	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1695	3236	0	1729	3344	0	1647	1681	0	1729	1740	0
Flt Permitted	0.102			0.264			0.194			0.455		
Satd. Flow (perm)	182	3236	0	480	3344	0	336	1681	0	828	1740	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		51			39			23			21	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		143.1			207.3			173.3			231.8	
Travel Time (s)		10.3			14.9			12.5			16.7	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	2%	3%	4%	0%	0%	0%	5%	4%	3%	0%	0%	0%
Adj. Flow (vph)	139	801	231	173	756	215	131	333	129	129	294	123
Shared Lane Traffic (%)												
Lane Group Flow (vph)	139	1032	0	173	971	0	131	462	0	129	417	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2024 Total Future AM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2			6			8			4		
Detector Phase	5	2		6	6		3	8		4	4	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	10.2	24.2		24.2	24.2		8.9	33.6		33.6	33.6	
Total Split (s)	15.0	54.0		39.0	39.0		12.0	46.0		34.0	34.0	
Total Split (%)	15.0%	54.0%		39.0%	39.0%		12.0%	46.0%		34.0%	34.0%	
Maximum Green (s)	8.8	47.8		32.8	32.8		7.1	39.4		27.4	27.4	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	3.3		3.3	3.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.2	6.2		6.2	6.2		4.9	6.6		6.6	6.6	
Lead/Lag	Lead			Lag	Lag		Lead			Lag	Lag	
Lead-Lag Optimize?	Yes			Yes	Yes		Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		C-Max	C-Max		None	Max		Max	Max	
Walk Time (s)		7.0		7.0	7.0			7.0		7.0	7.0	
Flash Dont Walk (s)		11.0		11.0	11.0			20.0		20.0	20.0	
Pedestrian Calls (#/hr)		0		0	0			0		0	0	
Act Effct Green (s)	47.8	47.8		33.1	33.1		41.1	39.4		27.4	27.4	
Actuated g/C Ratio	0.48	0.48		0.33	0.33		0.41	0.39		0.27	0.27	
v/c Ratio	0.65	0.66		1.09	0.86		0.57	0.68		0.57	0.85	
Control Delay	31.5	21.2		132.9	39.0		29.4	30.0		42.7	50.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	31.5	21.2		132.9	39.0		29.4	30.0		42.7	50.1	
LOS	C	C		F	D		C	C		D	D	
Approach Delay		22.4			53.2			29.9			48.3	
Approach LOS		C			D			C			D	
Queue Length 50th (m)	14.8	73.4		~38.2	88.9		15.9	69.4		21.5	72.9	
Queue Length 95th (m)	#33.8	95.0		#78.8	#123.0		28.4	104.9		41.4	#123.4	
Internal Link Dist (m)		119.1			183.3			149.3			207.8	
Turn Bay Length (m)	65.0			65.0			60.0			30.0		
Base Capacity (vph)	220	1573		159	1134		231	676		226	492	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.63	0.66		1.09	0.86		0.57	0.68		0.57	0.85	
Intersection Summary												
Area Type:	Other											
Cycle Length: 100												
Actuated Cycle Length: 100												
Offset: 35 (35%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green												
Natural Cycle: 90												
Control Type: Actuated-Coordinated												
Maximum v/c Ratio: 1.09												
Intersection Signal Delay: 38.0						Intersection LOS: D						
Intersection Capacity Utilization 95.4%						ICU Level of Service F						
Analysis Period (min) 15												

Lanes, Volumes, Timings

1: Woodroffe Avenue & Richmond Road

2024 Total Future AM
851 Richmond Road TIS

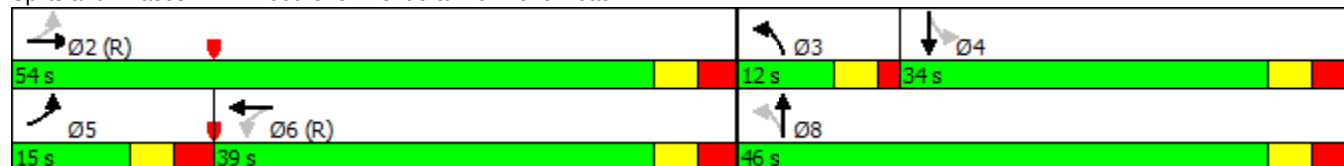
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

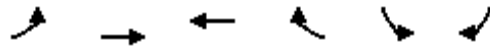
Queue shown is maximum after two cycles.

Splits and Phases: 1: Woodroffe Avenue & Richmond Road



Lanes, Volumes, Timings
2: Richmond Road & West Site Access

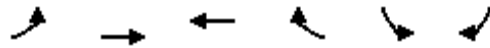
2024 Total Future AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	2	727	369	1	4	4
Future Volume (vph)	2	727	369	1	4	4
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.932	
Flt Protected					0.976	
Satd. Flow (prot)	0	1784	1784	0	1623	0
Flt Permitted					0.976	
Satd. Flow (perm)	0	1784	1784	0	1623	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		132.7	143.7		44.1	
Travel Time (s)		9.6	10.3		3.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	790	401	1	4	4
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	792	402	0	8	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type: Other						
Control Type: Unsignalized						
Intersection Capacity Utilization 52.1% ICU Level of Service A						
Analysis Period (min) 15						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

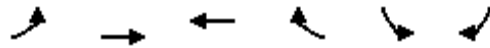
2024 Total Future AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	30	694	339	19	33	20
Future Volume (vph)	30	694	339	19	33	20
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.993		0.949	
Flt Protected		0.998			0.970	
Satd. Flow (prot)	0	1749	1720	0	1644	0
Flt Permitted		0.974			0.970	
Satd. Flow (perm)	0	1707	1720	0	1644	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			8		23	
Link Speed (k/h)		50	50		50	
Link Distance (m)		160.2	91.9		133.2	
Travel Time (s)		11.5	6.6		9.6	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	0%	4%	5%	6%	0%	5%
Adj. Flow (vph)	34	789	385	22	38	23
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	823	407	0	61	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2		1	
Detector Template	Left	Thru	Thru		Left	
Leading Detector (m)	6.1	30.5	30.5		6.1	
Trailing Detector (m)	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	6.1	1.8	1.8		6.1	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	
Protected Phases		2	6		4	
Permitted Phases	2					
Detector Phase	2	2	6		4	
Switch Phase						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2024 Total Future AM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Minimum Initial (s)	4.0	4.0	4.0		4.0	
Minimum Split (s)	29.1	29.1	29.1		21.3	
Total Split (s)	43.0	43.0	43.0		22.0	
Total Split (%)	66.2%	66.2%	66.2%		33.8%	
Maximum Green (s)	37.9	37.9	37.9		16.7	
Yellow Time (s)	3.3	3.3	3.3		3.3	
All-Red Time (s)	1.8	1.8	1.8		2.0	
Lost Time Adjust (s)		0.0	0.0		0.0	
Total Lost Time (s)		5.1	5.1		5.3	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	C-Max	C-Max	C-Max		Max	
Walk Time (s)	13.0	13.0	13.0		4.0	
Flash Dont Walk (s)	5.0	5.0	5.0		9.0	
Pedestrian Calls (#/hr)	0	0	0		0	
Act Effect Green (s)		37.9	37.9		16.7	
Actuated g/C Ratio		0.58	0.58		0.26	
v/c Ratio		0.83	0.40		0.14	
Control Delay		20.4	8.7		14.1	
Queue Delay		0.0	0.0		0.0	
Total Delay		20.4	8.7		14.1	
LOS		C	A		B	
Approach Delay		20.4	8.7		14.1	
Approach LOS		C	A		B	
Queue Length 50th (m)		71.0	23.2		3.5	
Queue Length 95th (m)		#138.0	37.9		11.0	
Internal Link Dist (m)		136.2	67.9		109.2	
Turn Bay Length (m)						
Base Capacity (vph)		995	1006		439	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		0.83	0.40		0.14	

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Offset: 53 (82%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 16.4
Intersection Capacity Utilization 76.3%
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2024 Total Future AM
851 Richmond Road TIS

Splits and Phases: 4: Richmond Road & Cleary Avenue



HCM Unsignalized Intersection Capacity Analysis

2: Richmond Road & West Site Access

2024 Total Future AM
851 Richmond Road TIS

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	727	369	1	4	4
Future Volume (Veh/h)	2	727	369	1	4	4
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	790	401	1	4	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)		340	304			
pX, platoon unblocked	0.95				0.75	0.95
vC, conflicting volume	402				1196	402
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	345				950	345
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				98	99
cM capacity (veh/h)	1154				217	664
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	792	402	8			
Volume Left	2	0	4			
Volume Right	0	1	4			
cSH	1154	1700	328			
Volume to Capacity	0.00	0.24	0.02			
Queue Length 95th (m)	0.0	0.0	0.6			
Control Delay (s)	0.0	0.0	16.3			
Lane LOS	A		C			
Approach Delay (s)	0.0	0.0	16.3			
Approach LOS			C			
Intersection Summary						
Average Delay			0.1			
Intersection Capacity Utilization			52.1%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2024 Total Future PM
851 Richmond Road TIS

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	103	422	232	111	364	187	295	457	118	248	358	101
Future Volume (vph)	103	422	232	111	364	187	295	457	118	248	358	101
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	65.0		0.0	65.0		0.0	60.0		0.0	30.0		0.0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (m)	85.0			60.0			15.0			45.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.947			0.949			0.969			0.967	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1712	3160	0	1729	3282	0	1662	1645	0	1729	1760	0
Flt Permitted	0.334			0.219			0.176			0.396		
Satd. Flow (perm)	602	3160	0	399	3282	0	308	1645	0	721	1760	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		101			89			17			15	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		143.1			207.3			173.3			231.8	
Travel Time (s)		10.3			14.9			12.5			16.7	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	1%	4%	3%	0%	0%	0%	4%	8%	4%	0%	0%	0%
Adj. Flow (vph)	105	431	237	113	371	191	301	466	120	253	365	103
Shared Lane Traffic (%)												
Lane Group Flow (vph)	105	668	0	113	562	0	301	586	0	253	468	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (m)	6.1	30.5		6.1	30.5		6.1	30.5		6.1	30.5	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Position(m)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Size(m)	6.1	1.8		6.1	1.8		6.1	1.8		6.1	1.8	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(m)		28.7			28.7			28.7			28.7	
Detector 2 Size(m)		1.8			1.8			1.8			1.8	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2		1	6		3	8			4	

Lanes, Volumes, Timings
1: Woodroffe Avenue & Richmond Road

2024 Total Future PM
851 Richmond Road TIS



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2			6			8			4		
Detector Phase	5	2		1	6		3	8		4	4	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	10.2	24.2		10.2	24.2		8.9	33.6		33.6	33.6	
Total Split (s)	14.0	33.0		14.0	33.0		16.0	53.0		37.0	37.0	
Total Split (%)	14.0%	33.0%		14.0%	33.0%		16.0%	53.0%		37.0%	37.0%	
Maximum Green (s)	7.8	26.8		7.8	26.8		11.1	46.4		30.4	30.4	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	3.3		3.3	3.3	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.2	6.2		6.2	6.2		4.9	6.6		6.6	6.6	
Lead/Lag	Lead	Lag		Lead	Lag		Lead			Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes			Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		None	C-Max		None	Max		Max	Max	
Walk Time (s)		7.0			7.0			7.0		7.0	7.0	
Flash Dont Walk (s)		11.0			11.0			20.0		20.0	20.0	
Pedestrian Calls (#/hr)		0			0			0		0	0	
Act Effect Green (s)	34.6	27.1		35.8	29.6		48.1	46.4		30.4	30.4	
Actuated g/C Ratio	0.35	0.27		0.36	0.30		0.48	0.46		0.30	0.30	
v/c Ratio	0.36	0.72		0.47	0.54		1.01	0.76		1.16	0.86	
Control Delay	22.7	33.0		25.7	27.8		76.5	29.2		143.3	48.9	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	22.7	33.0		25.7	27.8		76.5	29.2		143.3	48.9	
LOS	C	C		C	C		E	C		F	D	
Approach Delay		31.6			27.5			45.3			82.0	
Approach LOS		C			C			D			F	
Queue Length 50th (m)	12.6	52.8		13.6	41.9		~36.2	88.4		~58.2	82.6	
Queue Length 95th (m)	23.3	73.1		24.8	59.0		#88.9	132.7		#105.2	#136.8	
Internal Link Dist (m)		119.1			183.3			149.3			207.8	
Turn Bay Length (m)	65.0			65.0			60.0			30.0		
Base Capacity (vph)	296	928		246	1033		298	772		219	545	
Starvation Cap Reductn	0	0		0	0		0	0		0	0	
Spillback Cap Reductn	0	0		0	0		0	0		0	0	
Storage Cap Reductn	0	0		0	0		0	0		0	0	
Reduced v/c Ratio	0.35	0.72		0.46	0.54		1.01	0.76		1.16	0.86	

Intersection Summary

Area Type: Other

Cycle Length: 100

Actuated Cycle Length: 100

Offset: 35 (35%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.16

Intersection Signal Delay: 46.5

Intersection LOS: D

Intersection Capacity Utilization 95.4%

ICU Level of Service F

Analysis Period (min) 15

Lanes, Volumes, Timings 1: Woodroffe Avenue & Richmond Road

2024 Total Future PM
851 Richmond Road TIS

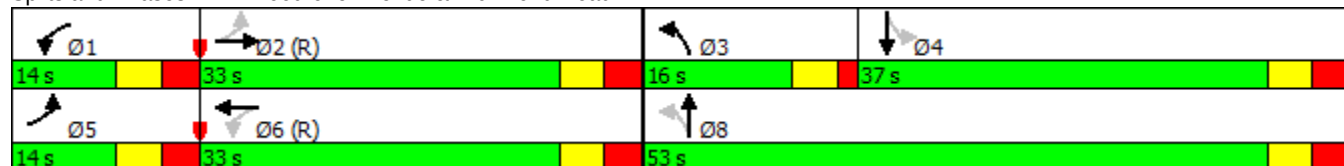
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

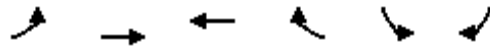
Queue shown is maximum after two cycles.

Splits and Phases: 1: Woodroffe Avenue & Richmond Road



Lanes, Volumes, Timings
2: Richmond Road & West Site Access

2024 Total Future PM
851 Richmond Road TIS



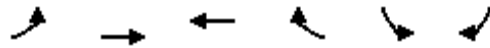
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	5	457	917	4	3	3
Future Volume (vph)	5	457	917	4	3	3
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.999		0.932	
Flt Protected					0.976	
Satd. Flow (prot)	0	1784	1783	0	1623	0
Flt Permitted					0.976	
Satd. Flow (perm)	0	1784	1783	0	1623	0
Link Speed (k/h)		50	50		50	
Link Distance (m)		133.7	142.8		42.6	
Travel Time (s)		9.6	10.3		3.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	497	997	4	3	3
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	502	1001	0	6	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	61.2%
Analysis Period (min)	15
	ICU Level of Service B

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

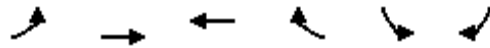
2024 Total Future PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	39	410	873	61	33	35
Future Volume (vph)	39	410	873	61	33	35
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.991		0.931	
Flt Protected		0.996			0.976	
Satd. Flow (prot)	0	1780	1787	0	1654	0
Flt Permitted		0.594			0.976	
Satd. Flow (perm)	0	1062	1787	0	1654	0
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			9		36	
Link Speed (k/h)		50	50		50	
Link Distance (m)		160.2	91.9		133.2	
Travel Time (s)		11.5	6.6		9.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	2%	1%	0%	0%	0%
Adj. Flow (vph)	41	427	909	64	34	36
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	468	973	0	70	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24			14	24	14
Number of Detectors	1	2	2		1	
Detector Template	Left	Thru	Thru		Left	
Leading Detector (m)	6.1	30.5	30.5		6.1	
Trailing Detector (m)	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	6.1	1.8	1.8		6.1	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		28.7	28.7			
Detector 2 Size(m)		1.8	1.8			
Detector 2 Type		Cl+Ex	Cl+Ex			
Detector 2 Channel						
Detector 2 Extend (s)		0.0	0.0			
Turn Type	Perm	NA	NA		Prot	
Protected Phases		2	6		4	
Permitted Phases	2					
Detector Phase	2	2	6		4	
Switch Phase						

Lanes, Volumes, Timings
4: Richmond Road & Cleary Avenue

2024 Total Future PM
851 Richmond Road TIS



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Minimum Initial (s)	4.0	4.0	4.0		4.0	
Minimum Split (s)	29.1	29.1	29.1		21.3	
Total Split (s)	43.0	43.0	43.0		22.0	
Total Split (%)	66.2%	66.2%	66.2%		33.8%	
Maximum Green (s)	37.9	37.9	37.9		16.7	
Yellow Time (s)	3.3	3.3	3.3		3.3	
All-Red Time (s)	1.8	1.8	1.8		2.0	
Lost Time Adjust (s)		0.0	0.0		0.0	
Total Lost Time (s)		5.1	5.1		5.3	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	
Recall Mode	C-Max	C-Max	C-Max		Max	
Walk Time (s)	13.0	13.0	13.0		4.0	
Flash Dont Walk (s)	5.0	5.0	5.0		9.0	
Pedestrian Calls (#/hr)	0	0	0		0	
Act Effect Green (s)		37.9	37.9		16.7	
Actuated g/C Ratio		0.58	0.58		0.26	
v/c Ratio		0.76	0.93		0.16	
Control Delay		20.4	30.2		12.1	
Queue Delay		0.0	0.0		0.0	
Total Delay		20.4	30.2		12.1	
LOS		C	C		B	
Approach Delay		20.4	30.2		12.1	
Approach LOS		C	C		B	
Queue Length 50th (m)		37.3	94.1		3.1	
Queue Length 95th (m)		#90.3	#180.7		11.5	
Internal Link Dist (m)		136.2	67.9		109.2	
Turn Bay Length (m)						
Base Capacity (vph)		619	1045		451	
Starvation Cap Reductn		0	0		0	
Spillback Cap Reductn		0	0		0	
Storage Cap Reductn		0	0		0	
Reduced v/c Ratio		0.76	0.93		0.16	

Intersection Summary

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 65

Offset: 53 (82%), Referenced to phase 2:EBTL and 6:WBT, Start of Green

Natural Cycle: 70

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 26.3

Intersection LOS: C

Intersection Capacity Utilization 69.8%

ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Lanes, Volumes, Timings
 4: Richmond Road & Cleary Avenue

2024 Total Future PM
 851 Richmond Road TIS

Splits and Phases: 4: Richmond Road & Cleary Avenue



HCM Unsignalized Intersection Capacity Analysis

2: Richmond Road & West Site Access

2024 Total Future PM
851 Richmond Road TIS

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	5	457	917	4	3	3
Future Volume (Veh/h)	5	457	917	4	3	3
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	497	997	4	3	3
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)		341	303			
pX, platoon unblocked	0.49				0.54	0.49
vC, conflicting volume	1001				1506	999
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	480				1107	476
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				98	99
cM capacity (veh/h)	530				124	288
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	502	1001	6			
Volume Left	5	0	3			
Volume Right	0	4	3			
cSH	530	1700	173			
Volume to Capacity	0.01	0.59	0.03			
Queue Length 95th (m)	0.2	0.0	0.8			
Control Delay (s)	0.3	0.0	26.5			
Lane LOS	A		D			
Approach Delay (s)	0.3	0.0	26.5			
Approach LOS			D			
Intersection Summary						
Average Delay			0.2			
Intersection Capacity Utilization			61.2%	ICU Level of Service		B
Analysis Period (min)			15			