



**Traffic Impact Study –
Proposed Mixed Use
Development**

**Former Halifax West High School Site
Dutch Village Road, Halifax, NS**

Presented To:

United Gulf Developments Limited
Halifax, NS

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1.0 Introduction

Background

United Gulf Developments Limited propose to redevelop the former Halifax West High School site on Dutch Village Road as a mixed use development to include residential, retail and commercial land uses. The proposed development illustrated on Figure 1 is expected to proceed during 2011.

GENIVAR Consultants Limited Partnership has been retained to complete a Traffic Impact Study satisfactory to the requirements of Halifax Regional Municipality (HRM).

A Traffic Impact Study Usually Considers Four Questions

A Traffic Impact Study for a proposed development usually consists of four steps to answer the following questions:

1. *What are the existing traffic situations* on streets adjacent to the study site? How have traffic volumes increased historically?
2. *What traffic changes are expected* at Study Area intersections? How many vehicle trips will be generated by the proposed development during weekday AM and PM peak hours? How will the traffic be distributed at the exits from the development and to Study Area streets and intersections?
3. *What traffic impacts will occur* on Study Area streets and intersections? How will level of service at intersections be affected?
4. *What street or intersection improvements are required* to mitigate project impacts on Study Area traffic movements?

Study Objectives

The objectives of this Study are to:

1. Develop projected 2011 and 2016 background weekday AM and PM peak hourly volumes for two Study Area intersections:
 - Dutch Village Road @ Alma Crescent
 - Alma Crescent @ Titus Street.
2. Evaluate traffic performance of the two Study Area intersections for projected 2011 and 2016 AM and PM peak hour volumes, without addition of site generated trips.
3. Estimate the number of trips that will be generated by the proposed mixed use development.
4. Distribute and assign site generated trips to site accesses on Dutch Village Road, as well as at Study Area intersections.
5. Evaluate impacts of site generated traffic on the performance and level of service of Study Area intersections for 2011 and 2016, and recommend changes that may be needed to mitigate impacts of site generated traffic.
6. Redistribute projected 2016 background weekday AM and PM peak hourly volumes for the reconfiguration of Dutch Village Road and Alma Crescent Study Area intersections proposed by HRM.
7. Evaluate impacts of site generated traffic on the performance and level of service of reconfigured Study Area intersections for 2016, and recommend changes that may be needed to mitigate impacts of site generated traffic.

2.0 Site Descriptions

Description of Proposed Development

The proposed development (Figure 1) will include a mixed use development with five buildings with access to Dutch Village Road. The development will include approximately 150 residential units and 115,600 square feet of commercial space (79,500 square feet office and 36,100 square feet retail). The space allocation for each building includes the following:

- Building A: 6 Floors @ 9,700 sq. ft = 58,200 sq. ft. Office;
- Building B: 2 Floors @ 9000 sq. ft = 18,000 Total; 1 Floor @ 9000 sq. ft. Retail and 1 Floor @ 9000 sq. ft. Office;
- Building C: Ground Floor Commercial with residential units above; 7300 sq. ft. Retail and 7300 sq. ft. Office;
- Building D: Ground Floor Commercial with residential units above; 12,300 sq. ft. Retail and 5000 sq. ft. Office;
- Building E: 7500 Retail;
- 76 surface parking spaces; and
- About 405 underground parking spaces.

Description of Study Area Streets and Intersections

Three intersections are considered in this Study (Figure 1) including two site entrance intersections:

- Alma Crescent @ Titus Street (existing intersection north of the site);
- Dutch Village Road @ Alma Crescent / Site Entrance (existing signalized intersection); and
- A right-in / right-out entrance to Dutch Village Road at the south site boundary.

The on-site traffic circulation, including access to underground parking, is illustrated on Figure 1.

Proposed Lacewood Connector

Within the next five years, it is expected that HRM will make significant changes to the street network near the proposed development, as illustrated in Figure 2. The one-way westbound section of Alma Crescent will be widened to provide a four lane two-way section of the proposed Lacewood Connector and a new signalized Titus Street / Alma Crescent intersection will be constructed.

Manual Traffic Counts

HRM obtained manual turning movement counts at the Dutch Village Road / Alma Crescent intersection during AM and PM peak hours on Wednesday, June 27, 2007, and the Titus Street / Alma Crescent intersection on Wednesday, July 15, 2009.

Projected 2011 and 2016 Peak Hourly Volumes

The 2007 and 2009 AM and PM peak hourly volumes have been adjusted by an annual growth rate of 1.0% to provide projected background 2011 AM and PM peak hourly volumes, without addition of site generated trips, which are illustrated diagrammatically in Figure A-1, Boxes A and B.

An annual growth rate has also been used to provide projected 2016 AM and PM background volumes, without addition of site generated trips, which are illustrated diagrammatically in Figure A-3, Boxes A and B.

3.0 Trip Generation, Trip Distribution and Assignment

**Trip Generation
Estimates for the
Mixed Use
Development**

The number of trips that will be generated by the proposed mixed use development has been estimated using trip generation rates published in *Trip Generation, 8th Edition*. Trip generation estimates for the proposed development (Table 1) include 208 vehicles per hour (141 vph entering and 67 vph exiting) during the AM peak hour and 276 vph (98 vph entering and 178 vph exiting) during the PM peak hour.

Land Use ¹	Number Units ²	Trip Generation Rates ¹				Trips Generated ³			
		AM Peak		PM Peak		AM Peak		PM Peak	
		In	Out	In	Out	In	Out	In	Out
Mid Rise Apt ⁴ (ITE 223)	150 units	0.09	0.21	0.23	0.16	14	32	35	24
General Office ⁵ (ITE 710)	63.2 KGLA	1.36	0.19	0.25	1.24	86	12	16	78
Medical Office ⁵ (ITE 720)	16.3 KGLA	1.82	0.48	0.93	2.53	30	8	15	41
Retail ⁶ (ITE 814)	36.1 KGLA	0.76	0.6	1.19	1.52	27	22	43	55
Total Estimated Trips for Full Site Development						157	74	109	198
Estimated Total Trips Reduced to Account for Non-vehicle Trips and On-Site Synergies ⁷						141	67	98	178

NOTES: 1. Trip generation rates are 'vehicles per hour per unit'. Rates are for indicated Land Uses and Land Use Codes, *Trip Generation, 8th Edition*, Institute of Transportation Engineers, 2008.
 2. Units are as indicated; KGLA is '1000 square feet gross leasable area'
 3. Vehicles per hour for peak hours.
 4. Hourly trip rates for Mid-Rise Apartments - 3 to 10 floors (ITE Land Use 223).
 5. Commercial space has been divided with approximately 80% General Office space (Land Use 710) and 20% Medical-Dental Office (Land Use Code 720).
 6. Speciality Retail land use includes "small strip shopping centres that contain a variety of retail shops and specialize in quality apparel; hard goods; and services such as real estate offices, dance studios, florists and small restaurants" (*Trip Generation*, p. 1386). Rates used include the average trip rate for PM peak hour (Page 1388) and since there are no published rates for AM Peak Hour, and AM peak hour trips to Speciality Retail are generally low, AM trip rates have been assumed to be 50% of the PM rate with reversal of the directional split.
 7. It is assumed that total vehicle trips generated by the site will be reduced by higher than average non-vehicle trips (walking and transit) as well as on-site synergies, or cross-shopping, between the various land uses. A 10% reduction has been used to estimate external trip generation for full build-out of the site.

Distribution and Assignment of Site Generated Trips to Existing Intersection Configurations

The following distribution has been used for primary trips generated by the mixed use development:

- South on Dutch Village Road - 40%
- East on Dutch Village Road / Alma Crescent - 30%
- North / West on Alma Crescent / Titus Street - 30%.

Pass-by trips, those which are made as 'intervening opportunity' stops to retail land uses, have been assumed to account for 20% of the site generated retail trips. Pass-by trips are estimated to account for 10 trips (5 entering and 5 exiting) during the AM peak hour and 20 trips (10 entering and 10 exiting) during the PM peak hour.

Site generated trips have been assigned in accordance with the above distribution percentages; 50% of primary trips entering the site from the north and east, and 50% of exiting trips to the south, have been assigned to the right-in / right-out driveway.

Site generated trips to the site entrances and existing intersections are illustrated diagrammatically in Figure A-2, Boxes A and B. Site generated trips have been added to projected 2011 background volumes (Figure A-1, Boxes A and B) to provide projected 2011 AM and PM peak hour volumes for existing intersection configurations that include site generated trips, shown diagrammatically in Figure A-2, Boxes C and D.

Projected 2016 Peak Hour Volumes to the Reconfigured Street Network

The projected 2016 background volumes for the existing intersections (Figure A-3, Boxes A and B) have been redistributed to the proposed reconfigured intersections to provide projected 2016 background volumes for the reconfigured intersections which are illustrated diagrammatically in Figure A-3, Boxes C and D.

Assignment of Projected 2016 Site Generated Trips to the Reconfigured Intersections

Site generated trips, assigned to the site entrances and the reconfigured intersections, are shown diagrammatically in Figure A-4, Boxes A and B. Site generated trips have been added to the projected 2016 background volumes (Figure A-3, Boxes C and D) to provide estimated 2016 AM and PM peak hour volumes for the reconfigured intersections that include site generated trips, shown diagrammatically in Figure A-4, Boxes C and D.

4.0 Intersection Performance Analysis

4.1 Signal Warrant Analysis

Traffic Signal Warrant Principles

A signal warrant analysis is completed to determine if the installation of traffic signals at an intersection will provide a positive impact on total intersection operation. That is, the benefits in time saved and improved safety that will accrue to vehicles entering from a side street will exceed the impact that signals will have in time lost and potential additional collisions for vehicles approaching the intersection on the main street.

The *Canadian Traffic Signal Warrant Matrix Analysis (Transportation Association of Canada (TAC), 2005)* uses six peak hours of vehicular and pedestrian volumes, and intersection, roadway, and study area characteristics to calculate a warrant point value.

The procedure considers the following details to determine whether traffic signals are warranted at a study intersection:

- The procedure considers that there must be an average of 75 vehicles per hour (vph) on a side street approach for the peak six hours, in order for signals to be considered. This avoids consideration of a signal installation at an area with low side street traffic.
- The warrant process calculates warrant points based on the cross product of conflicting vehicle and pedestrian movements. A value of 100 warrant points or higher is generally an indication that traffic signals will provide a positive impact to vehicle and pedestrian movements at an intersection.

Traffic Signal Warrant Analysis for Reconfigured Dutch Village Road Driveway Intersection

The construction of the reconfigured intersections being considered by HRM (Figure 2) will convert Dutch Village Road to one-way eastbound from the site driveway to the Lacewood Connector, so that there will not be any westbound approach volume to the site driveway intersection.

The assigned volumes on the reconfigured Dutch Village driveway exit include 54 vph during the AM peak hour (Figure A-4, Box C) and 144 vph during the PM peak hour (Figure A-4, Box D). Although the average driveway approach volume for six peak hours used in the TAC analysis process may actually be less than 75 vph, traffic signal warrant analysis has been completed using estimated 2016 volumes.

Signal warrant analysis using estimated 2016 vehicle volumes and without pedestrian volumes crossing east-west on Dutch Village Road provided 62 points (Table A-1, Appendix A). Signal warrant analysis with an assumed 20 pedestrians per hour crossing east-west provided 84 points (Table A-2, Appendix A).

While traffic signals are not expected to be warranted at the site driveway, the level of pedestrian cross walk protection for the Dutch Village Road crossing should be considered in the HRM redesign of area streets.

4.2 Level of Service Analysis

Intersection Level of Service Analysis

The level or quality of performance of an intersection in terms of traffic movement is determined by a level of service (LOS) analysis. LOS for intersections is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and increased travel time.

LOS	Signalized Intersections Control Delay (seconds per vehicle)	LOS Description	Two Way Stop Controlled (TWSC) Intersections Control Delay (seconds per vehicle)
A	less than 10.0	Very low delay; most vehicles do not stop (Excellent)	less than 10.0
B	between 10.0 and 20.0	Higher delay; more vehicles stop (Very Good)	between 10.0 and 15.0
C	between 20.0 and 35.0	Higher level of congestion; number of vehicles stopping is significant, although many still pass through intersection without stopping (Good)	between 15.0 and 25.0
D	between 35.0 and 55.0	Congestion becomes noticeable; vehicles must sometimes wait through more than one red light; many vehicles stop (Satisfactory)	between 25.0 and 35.0
E	between 55.0 and 80.0	Vehicles must often wait through more than one red light; considered by many agencies to be the limit of acceptable delay	between 35.0 and 50.0
F	greater than 80.0	This level is considered to be unacceptable to most drivers; occurs when arrival flow rates exceed the capacity of the intersection (Unacceptable)	greater than 50.0

LOS Criteria

LOS criteria (Table 2) are stated in terms of average control delay per vehicle which includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay,

Level of Service (LOS) Analysis

LOS analyses have been completed for weekday AM and PM peak hour volumes using *Synchro 6.0* for the following scenarios:

1. 2011 volumes without site; existing intersections (Figure A-1, Boxes A and B)
2. 2011 volumes with site; existing intersection (Figure A-2, Boxes C and D)
3. 2016 volumes without site; reconfigured intersections with traffic signals at Titus Street / Alma Crescent and with signals removed at Alma Crescent / Dutch Village (Figure A-3, Boxes C and D)
4. 2016 volumes with site; reconfigured intersections with traffic signals at Titus Street / Alma Crescent and with STOP control at the Site Entrance at the Alma Crescent / Dutch Village intersection (Figure A-4, Boxes C and D).

LOS analyses results are in Appendix B and are summarized in Tables 3 and 4 (existing intersections) and Tables 5 and 6 (reconfigured intersections).

Table 3 - LOS Titus Street & Alma Crescent (Existing Intersection) - STOP Controlled				
LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95% Queue (m) by Intersection Movement			Intersection LOS
	WB-TR (Alma WB)	NB-T (Alma NB)	SB-T (Titus SB)	
Weekday AM Peak Hour - 2011 Volumes - Without Development (Page B-1)				
Delay	9.9	0.0	0.0	1.1
v/c	0.20	0.07	0.34	-
Queue	5.2	0.0	0.0	-
Weekday AM Peak Hour - 2011 Projected Volumes - With Full Site Build-Out (Page B-5)				
Delay	10.0	0.0	0.0	1.0
v/c	0.19	0.08	0.35	-
Queue	5.3	0.0	0.0	-
Weekday PM Peak Hour - 2011 Volumes - Without Development (Page B-3)				
Delay	13.7	0.0	0.0	3.0
v/c	0.48	0.21	0.20	-
Queue	20.0	0.0	0.0	-
Weekday PM Peak Hour - 2011 Projected Volumes - With Full Site Build-Out (Page B-7)				
Delay	14.3	0.0	0.0	3.0
v/c	0.50	0.22	0.20	-
Queue	21.3	0.0	0.0	-

Table 4 - LOS Dutch Village Road & Alma Crescent (Existing Intersection) - Traffic Signals							
LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95% Queue (m) by Intersection Movement						Intersection LOS
	EB-LTR	WB-L	WB-TR	NB-LTR	SB-L	SB-TR	
Weekday AM Peak Hour - 2011 Volumes - Without Development (Page B-2)							
Delay		28.9	14.0	11.9	11.1	7.3	11.1
v/c		0.24	0.03	0.31	0.69	0.45	-
Queue		27.2	3.9	24.7	55.3	55.7	-
Weekday AM Peak Hour - 2011 Projected Volumes - With Full Site Build-Out (Page B-6)							
Delay	22.1	31.9	20.1	15.0	12.4	7.7	13.2
v/c	0.15	0.38	0.08	0.43	0.71	0.48	-
Queue	15.3	33.6	9.8	33.0	62.8	61.8	-
Weekday PM Peak Hour - 2011 Volumes - Without Development (Page B-4)							
Delay		32.5	7.4	15.3	8.4	5.8	13.5
v/c		0.44	0.20	0.42	0.52	0.28	-
Queue		46.8	11.2	51.3	26.3	30.5	-
Weekday PM Peak Hour - 2011 Projected Volumes - With Full Site Build-Out (Page B-8)							
Delay	28.7	52.8	9.5	16.3	8.6	5.9	17.5
v/c	0.41	0.77	0.23	0.49	0.53	0.30	-
Queue	37.2	66.3	14.2	56.6	26.2	32.9	-
NOTE: EB - Site Exit Driveway; WB - Dutch Village Road; NB - Dutch Village Road; SB- Alma Crescent.							

Table 5 - LOS Titus Street & Alma Crescent (Reconfigured Lacewood Connector Intersection) - Signals								
LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95% Queue (m) by Intersection Movement ¹							Intersection LOS
	EB-LT	EB-R	WB-L	WB-TR	NB-L	NB-LTR	SB-LTR ²	
Weekday AM Peak Hour - 2016 Volumes - Without Development (Page B-9)								
Delay	14.3	4.0	9.6	8.2	23.9	23.3	23.8	11.3
v/c	0.32	0.55	0.23	0.18	0.29	0.28	0.09	-
Queue	50.8	20.6	16.4	28.3	36.9	35.6	11.3	-
Weekday AM Peak Hour - 2016 Projected Volumes - With Full Site Build-Out (Page B-11)								
Delay	15.7	4.3	9.7	8.2	25.2	24.2	24.1	11.9
v/c	0.33	0.60	0.30	0.17	0.33	0.31	0.10	-
Queue	51.3	22.2	22.4	29.1	39.6	36.7	11.4	-
Weekday PM Peak Hour - 2016 Volumes - Without Development (Page B-10)								
Delay	20.6	5.7	14.0	16.7	23.3	22.9	24.7	17.2
v/c	0.31	0.47	0.42	0.47	0.55	0.53	0.11	-
Queue	30.2	18.5	38.9	68.7	71.0	68.9	10.6	-
Weekday PM Peak Hour - 2016 Projected Volumes - With Full Site Build-Out (Page B-13)								
Delay	21.1	5.8	15.0	17.0	24.1	23.6	24.8	17.6
v/c	0.31	0.54	0.43	0.58	0.59	0.58	0.12	-
Queue	31.7	19.7	37.9	91.1	86.8	84.2	11.3	-
NOTES: 1. See Figure 2: EB - Titus Street (Lacewood Connector); WB - Alma Crescent (Lacewood Connector); NB - Alma Crescent; SB - Parking Lot Exit 2. While volumes entering and exiting the Strip Mall have not been shown on the diagrammatic intersection volume figures in Appendix A, volumes of 1 vph have been used for EB-L and 10 vph for all other Strip Mall turning movements.								

Table 6 - LOS Dutch Village Road & Alma Crescent / Site Entrance (Reconfigured Intersection) - STOP							
LOS Criteria	Control Delay (sec/veh), v/c Ratio, and 95% Queue (m) by Intersection Movement						Intersection LOS
	EB-L	EB-TR	NB-L	NB-TR	SB-L	SB-TR	
Weekday AM Peak Hour - 2016 Volumes - With Full Site Build-Out (Page B-12)							
Delay	32.3	26.9	3.6	0.0	7.9	0.0	1.9
v/c	0.14	0.18	0.07	0.18	0.02	0.48	-
Queue	3.7	5.0	1.8	0.0	0.5	0.0	-
Weekday PM Peak Hour - 2016 Projected Volumes - With Full Site Build-Out (Page B-14)							
Delay	40.6	52.5	1.5	0.0	8.9	0.0	5.2
v/c	0.37	0.58	0.05	0.25	0.02	0.37	-
Queue	12.0	23.5	1.1	0.0	0.4	0.0	-
NOTE: See Figures 1 and 2: EB - Site Driveway; NB - Dutch Village Road; SB - Alma Crescent.							

**HRM Critical Limits
for Intersection
Evaluation**

The HRM *Guidelines for Preparation of Transportation Impact Studies* indicates the following critical limits for intersection evaluation:

- the v/c ratio of an intersection exceeds 0.85;
- the v/c ratio of an individual through movement or shared through/turning movement exceeds 0.85;
- the v/c ratio of an exclusive turning movement exceeds 1.0;
- an exclusive turning movement generates queues which exceed the available turning lane storage space.

**Summary LOS
Analyses for
Existing Intersection
Configurations**

Titus Street @ Alma Crescent (Table 3) and *Dutch Village Road @ Alma Crescent / Site Entrance (Table 4)* - Both intersections now operate with low to moderate average delays and with v/c ratios that are considerably lower than HRM critical limits. Site generated trips are not expected to have any significant impact to the level of performance of either intersection.

**Summary LOS
Analyses for
Reconfigured
Intersection
Configurations**

Titus Street @ Alma Crescent (Table 5) and *Dutch Village Road @ Alma Crescent / Site Entrance (Table 6)* - Both reconfigured intersections will operate with low to moderate average delays and with v/c ratios that are considerably lower than HRM critical limits for projected 2016 volumes that include site generated trips. Site generated trips are not expected to have any significant impact to the level of performance of either intersection.

**Conclusions -
Intersection
Performance
Analyses**

Site generated trips from the proposed mixed use development are not expected to have any significant impacts to the level of performance of either existing or reconfigured Study Area intersections.

5.0 Summary, Conclusions and Recommendations

- | | |
|---|--|
| Description of the Proposed Development | 1. The proposed development will include a mixed use development with five buildings with access to Dutch Village Road. The development will include the following land uses: <ul style="list-style-type: none">• 150 Residential units;• 36,100 square feet Retail space;• 79,500 square feet Office space;• 76 surface parking spaces; and• About 405 underground parking spaces. |
| Description of Study Area Streets | 2. Three intersections are considered in this Study including site entrance intersections: <ul style="list-style-type: none">• Alma Crescent @ Titus Street (existing intersection north of the site);• Dutch Village Road @ Alma Crescent / Site Entrance (existing signalized intersection); and• A right-in / right-out entrance to Dutch Village Road at the south site boundary. |
| Proposed Lacewood Connector Improvements at Titus Street and Alma Crescent | 3. Within the next five years, it is expected that HRM will make significant changes to the street network near the proposed development. The one-way westbound section of Alma Crescent will be widened to provide a four lane two-way section of the proposed Lacewood Connector and a new signalized Titus Street/ Alma Crescent intersection will be constructed. The reconfigured intersections will include making Dutch Village Road one-way east bound from the Site Entrance towards Joseph Howe Drive. |
| Annual Traffic Volume Growth Rate is 1.0% | 4. Available 2007 and 2009 manual turning movement counts obtained from HRM were used to project 2011 AM and PM peak hour volumes for Study Area intersections. A growth rate of 1.0% has also been used to project 2016 volumes for both existing and reconfigured intersections. |
| Trip Generation Estimates for the Mixed Use Development | 5. The number of trips that will be generated by the proposed mixed use development has been estimated based on number of residential units and area of retail and commercial space using rates published in <i>Trip Generation, 8th Edition</i> . Trip generation estimates for the proposed development include 208 vehicles per hour (141 vph entering and 67 vph exiting) during the AM peak hour and 276 vph (98 vph entering and 178 vph exiting) during the PM peak hour. |
| Trip Distribution | 6. Site generated trips have been distributed in the following manner: <ul style="list-style-type: none">• South on Dutch Village Road - 40%• East on Dutch Village Road / Alms Crescent - 30%• North / West on Alma Crescent / Titus Street - 30%. |

Traffic Signals are not expected to be Warranted for the Site Entrance on Dutch Village Road with Reconfigured Intersections

7. While traffic signals are not expected to be warranted at the site driveway intersection on Dutch Village Road after HRM completes street changes in the area, the level of pedestrian cross walk protection required for the existing signalized cross walk for east-west pedestrian crossings of Dutch Village Road at the south side of the intersection should be considered in the HRM redesign of area streets.

Summary Level of Service Analysis

8. Level of service analyses indicate the Titus Street @ Alma Crescent and Dutch Village Road @ Alma Crescent / Site Entrance intersections now operate with low to moderate average delays and with v/c ratios that are considerably lower than HRM critical limits. Site generated trips from the proposed mixed use development are not expected to have any significant impacts to the level of performance of either the existing or reconfigured intersections.

Conclusions

9. Site generated trips from the proposed mixed use development are not expected to have any significant impacts to the level of performance of either existing or reconfigured Titus Street @ Alma Crescent or Dutch Village Road @ Alma Crescent / Site Entrance intersections.

Recommendations

10. A. When HRM intersection changes are implemented and if the traffic signals are removed, the north site driveway should include two exit lanes. This will provide one lane for left turns to the north on Alma Crescent, and one for straight through and right turns to Dutch Village Road.

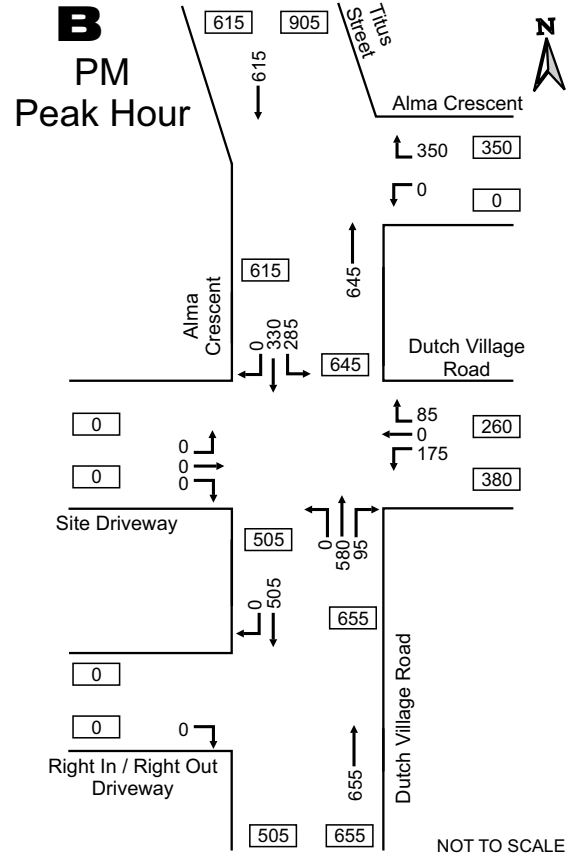
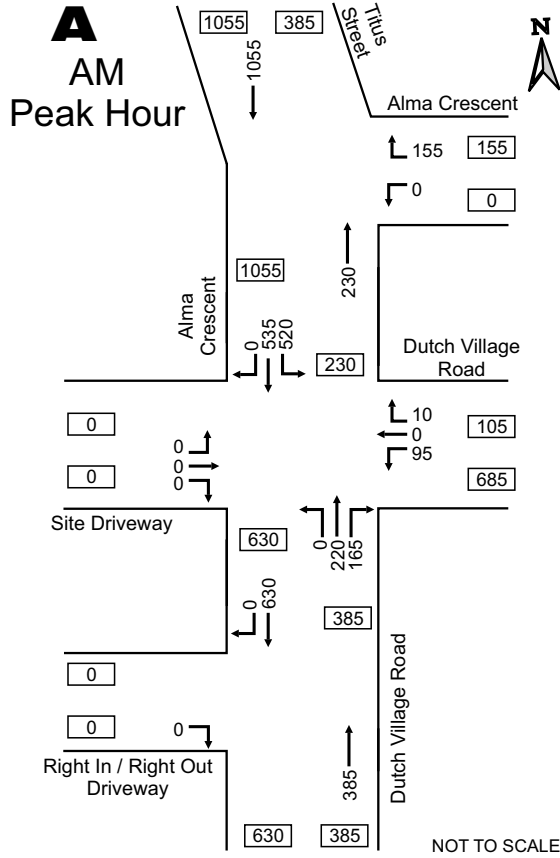
B. HRM should consider the level of pedestrian cross walk protection required for the existing signalized cross walk for east-west pedestrian crossings of Dutch Village Road at the south side of the Site Driveway / Dutch Village Road intersection in redesign of area streets.

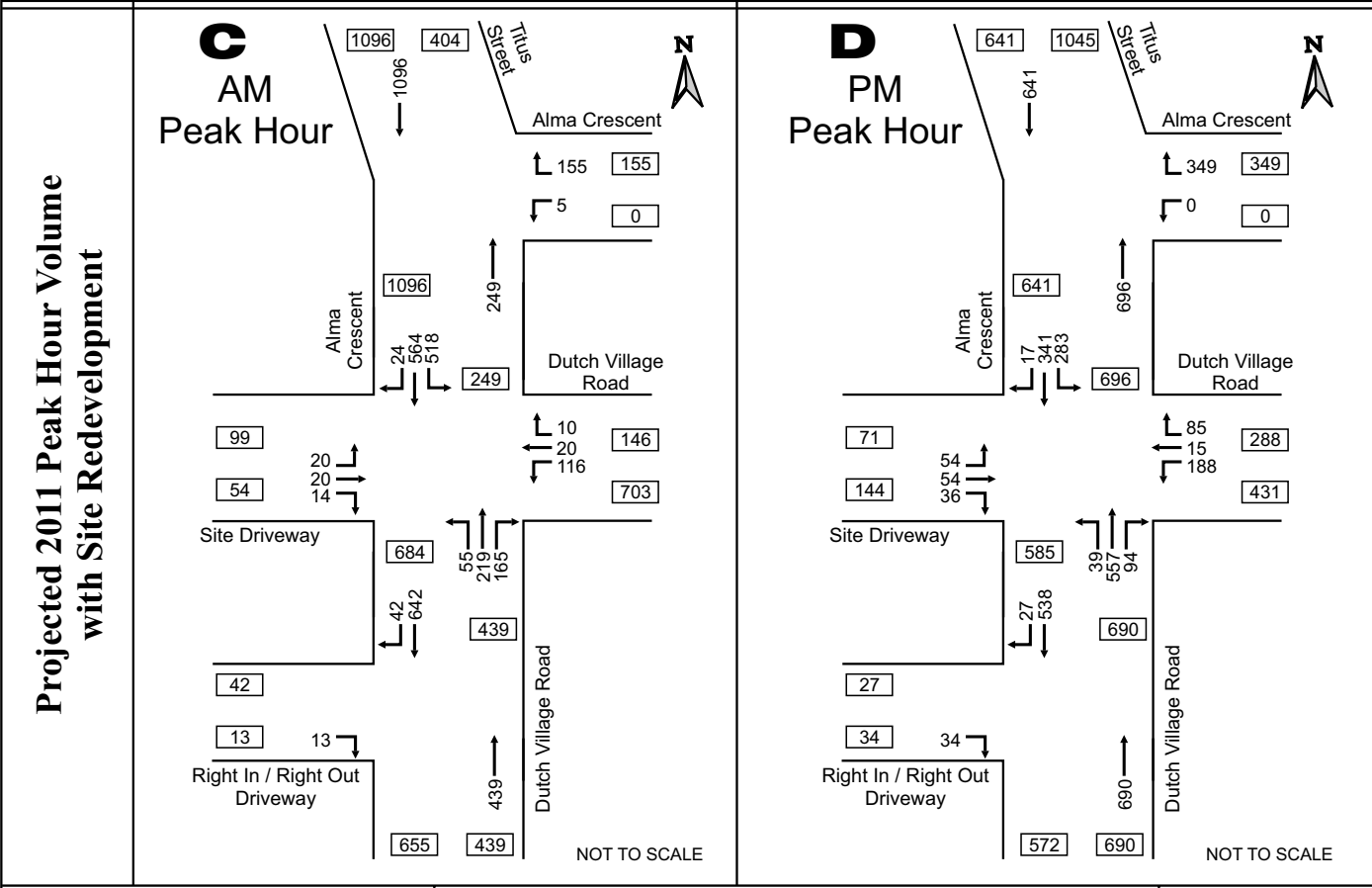
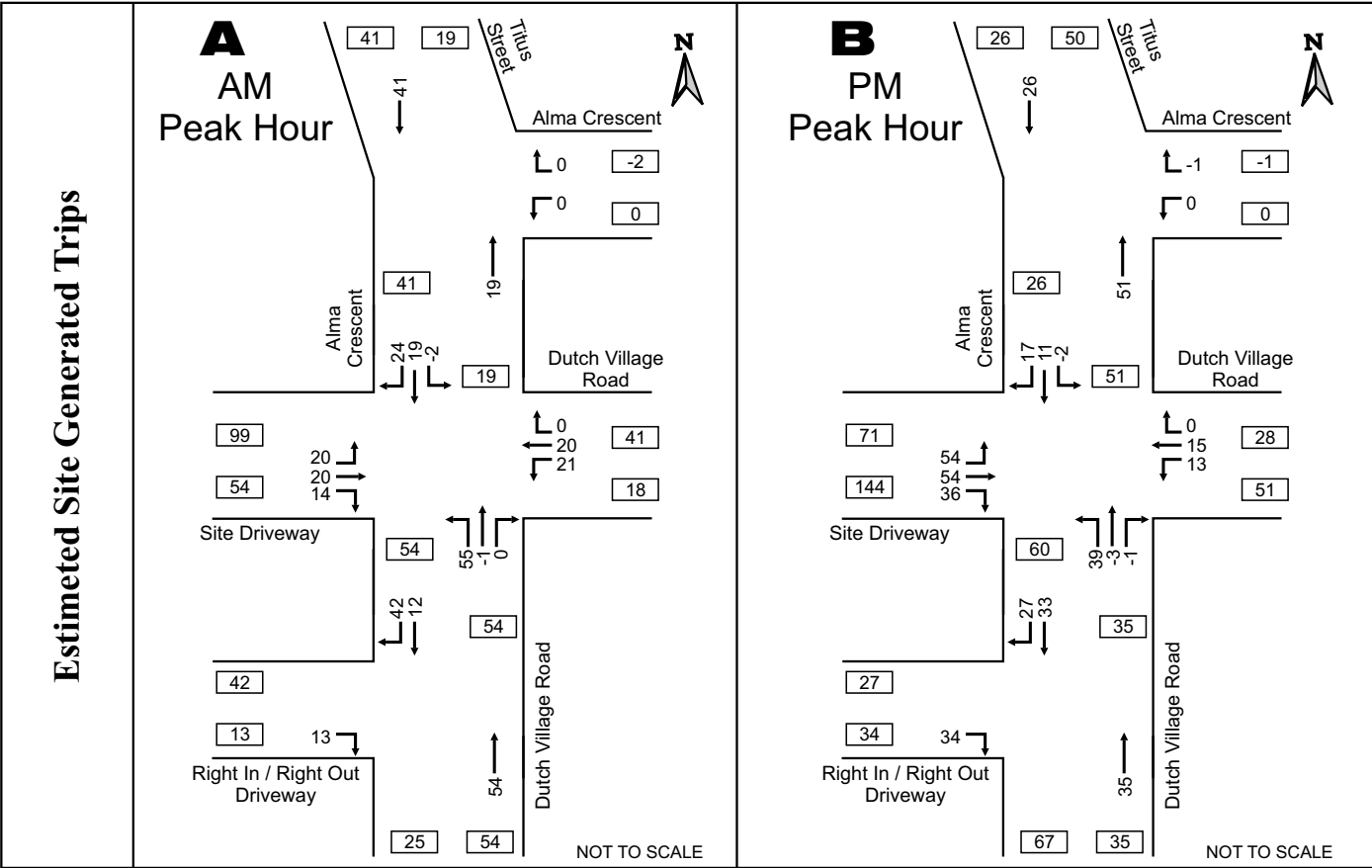
Appendix A

Traffic Volume Diagrams

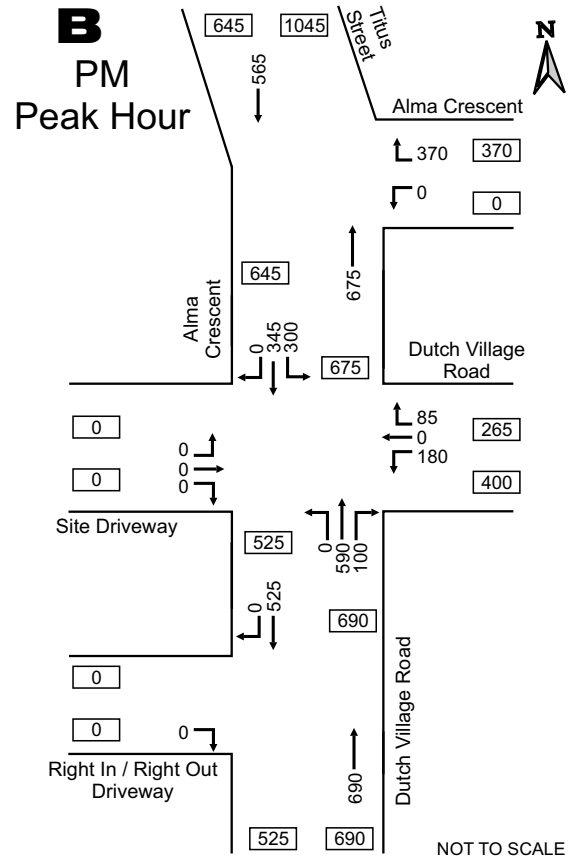
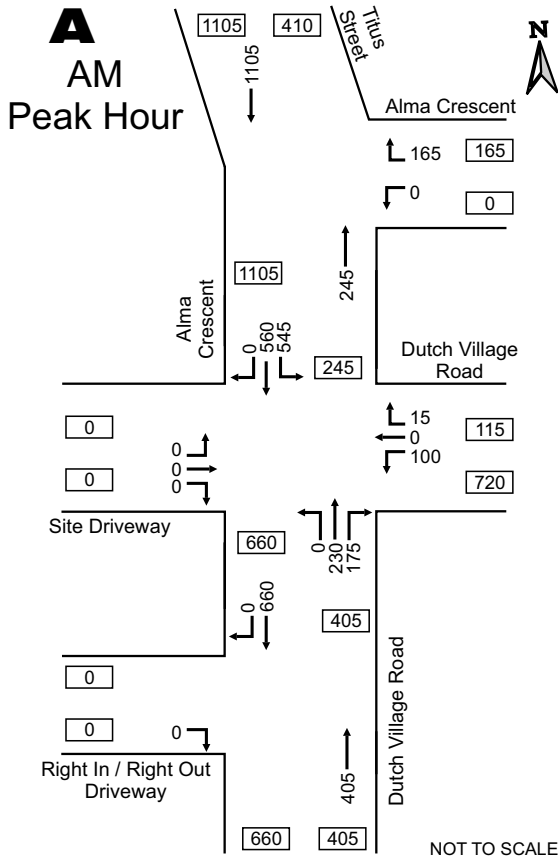
Signal Warrant Analysis

**Projected 2011 Peak Hour Volume
Existing Street Network without Site Redevelopment**

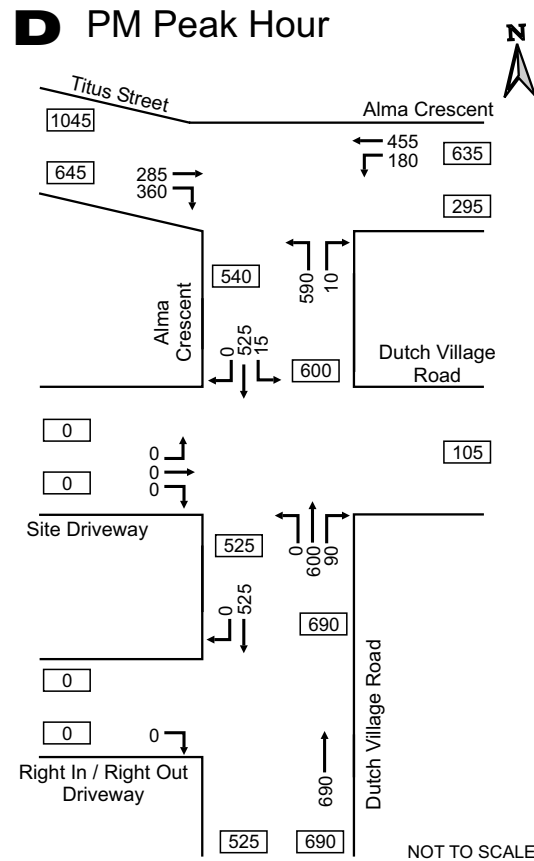
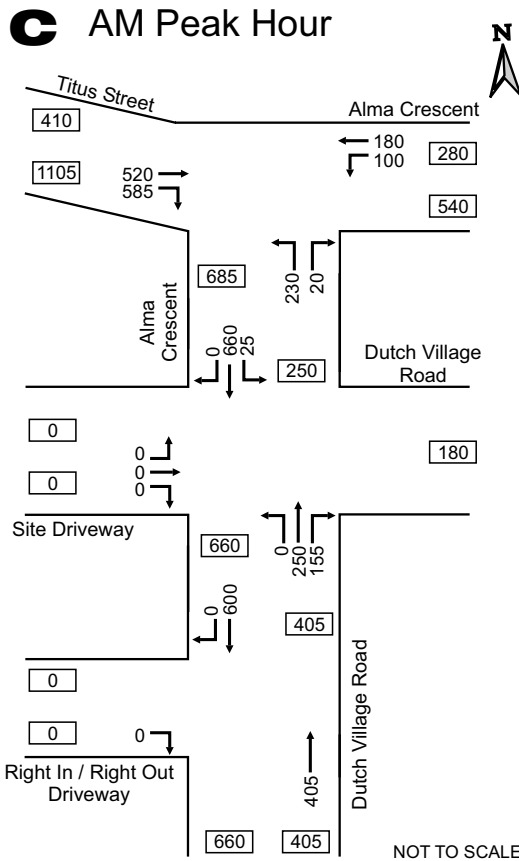


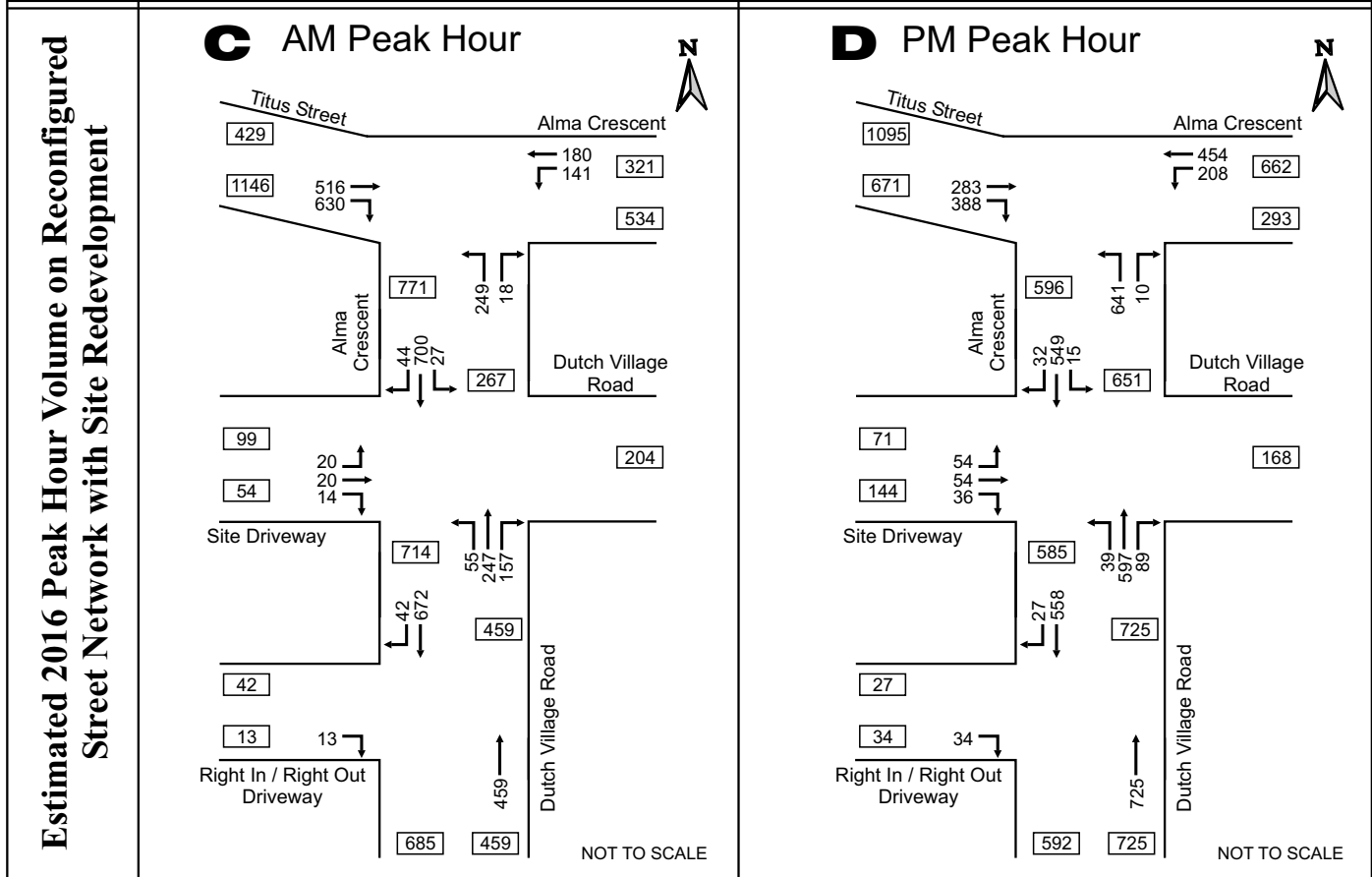
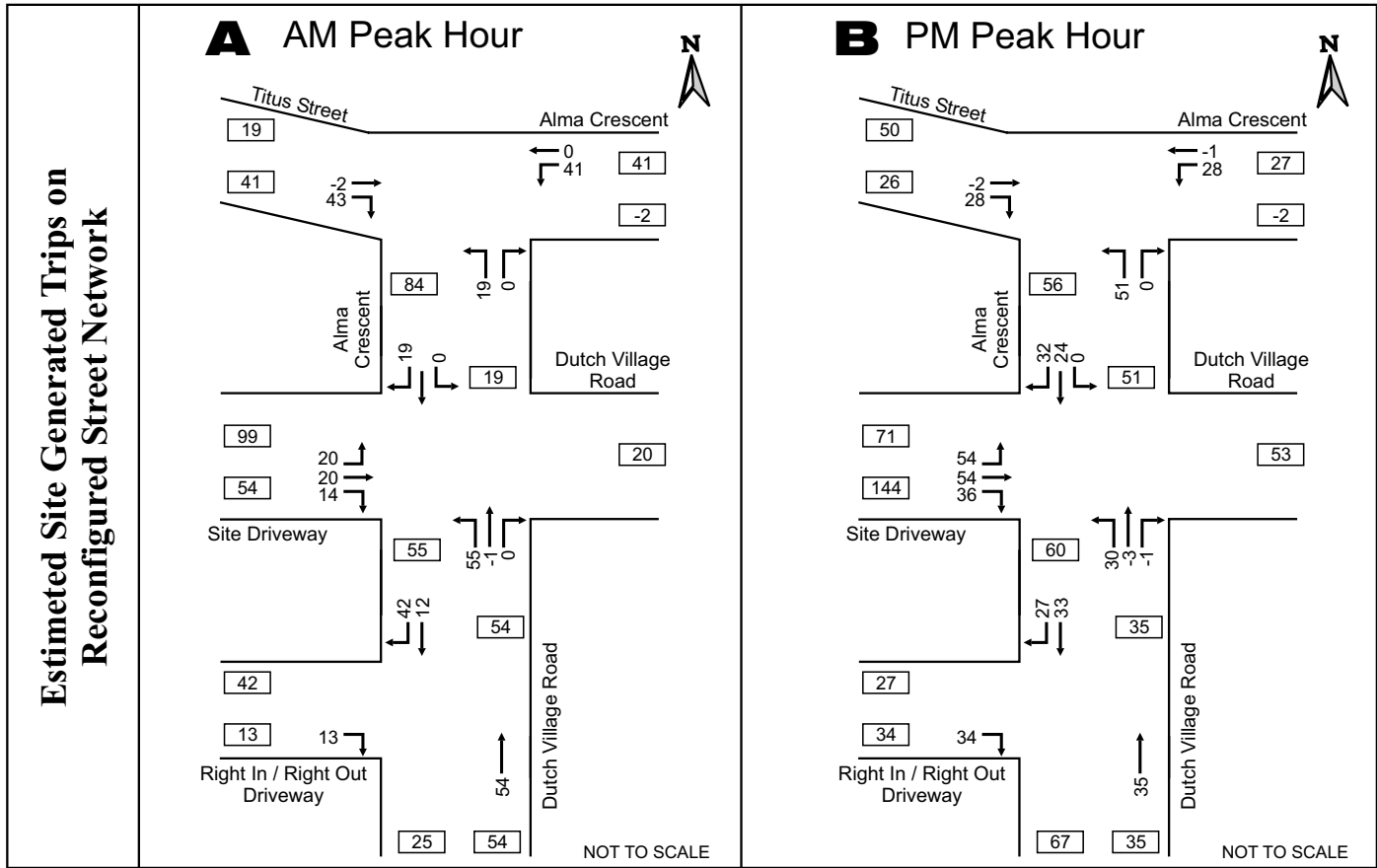


**Projected 2016 Peak Hour Volume
Existing Street Network without Site Redevelopment**



**Estimated 2016 Peak Hour Volume
Street Network with Reconfigured**





2005 Canadian Traffic Signal Warrant Matrix Analysis

Table A-1 - Dutch Village Road / Alma Crescent @ Site Entrance - Projected 2016 Volumes With Site (Without Pedestrians Crossing Dutch Village Road East - West)

Main Street (name)	DV Road - Alma Cres.	Direction (EW or NS)	NS	Date:	December 2010
Side Street (name)	Site Driveway	Direction (EW or NS)	EW	City:	HRM

Lane Configuration		Excl LT	Th & LT	Through or Th+RT=LT	Th & RT	Excl RT	Upstream Signal (m)	# of Thru Lanes
DV Road - Alma Cres.	NB			2				2
DV Road - Alma Cres.	SB			1		1		1
	WB							
Site Driveway	EB			1				

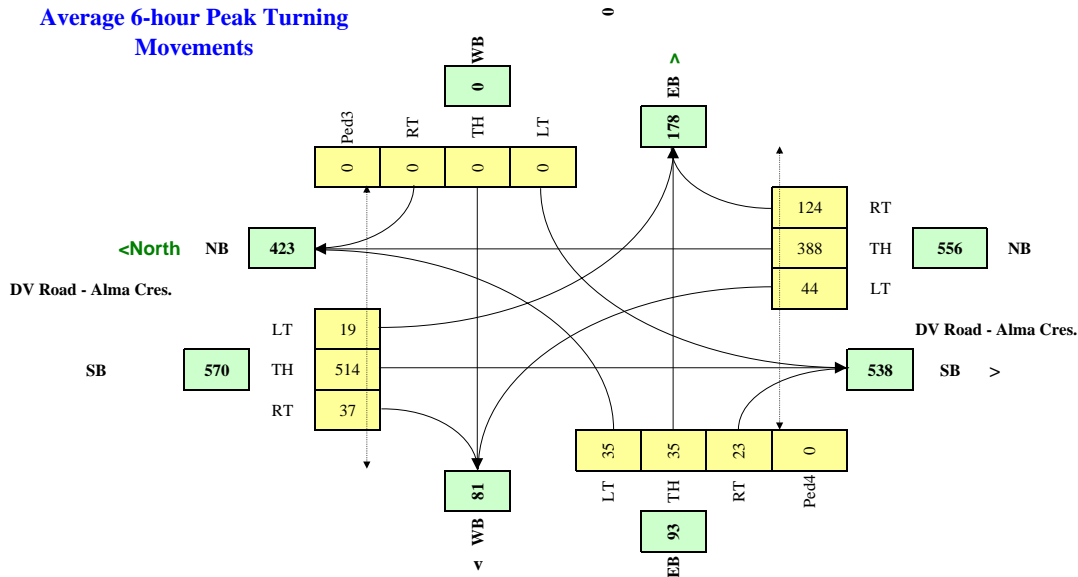
Other input		Speed (Km/h)	Trucks %	Bus Rt (y/n)	Median (m)
DV Road - Alma Cres.	NS	50	2.0%	y	
Site Driveway	EW		2.0%	n	

	Ped1	Ped2	Ped3	Ped4
	NS W Side	NS E Side	EW N Side	EW S side
7:00 - 8:00	0	0	0	0
8:00 - 9:00	0	0	0	0
11:00 - 12:00	0	0	0	0
12:00 - 13:00	0	0	0	0
15:30 - 16:30	0	0	0	0
16:30 - 17:30	0	0	0	0
Total (6-hour peak)	0	0	0	0
Average (6-hour peak)	0	0	0	0

Demographics		
Elementary School	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	380,000
Central Business District	(y/n)	n

Traffic Input	NB			SB			WB			EB		
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT
7:00 - 8:00	45	185	140	20	560	35	0	0	0	15	15	10
8:00 - 9:00	55	230	175	25	700	45	0	0	0	20	20	15
11:00 - 12:00	45	390	130	20	390	40	0	0	0	35	35	25
12:00 - 13:00	45	390	130	20	390	40	0	0	0	35	35	25
15:30 - 16:30	40	595	90	15	550	30	0	0	0	55	55	35
16:30 - 17:30	35	535	80	15	495	30	0	0	0	50	50	30
Total (6-hour peak)	265	2,325	745	115	3,085	220	0	0	0	210	210	140
Average (6-hour peak)	44	388	124	19	514	37	0	0	0	35	35	23

Average 6-hour Peak Turning Movements



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

W =	62	62	0
		Veh	Ped
NOT Warranted			

2005 Canadian Traffic Signal Warrant Matrix Analysis

Table A-2 - Dutch Village Road / Alma Crescent @ Site Entrance - Projected 2016 Volumes With Site (With Assumed Pedestrians Crossings Dutch Village Road East - West)

Main Street (name)	DV Road - Alma Cres.		Direction (EW or NS)	NS	Date:	December 2010	
Side Street (name)	Site Driveway		Direction (EW or NS)	EW	City:	HRM	

Lane Configuration		Excl LT	Th & LT	Through or Th+RT=LT	Th & RT	Excl RT	Upstream Signal (m)	# of Thru Lanes
DV Road - Alma Cres.	NB			2				2
DV Road - Alma Cres.	SB			1		1		1
	WB							
Site Driveway	EB			1				

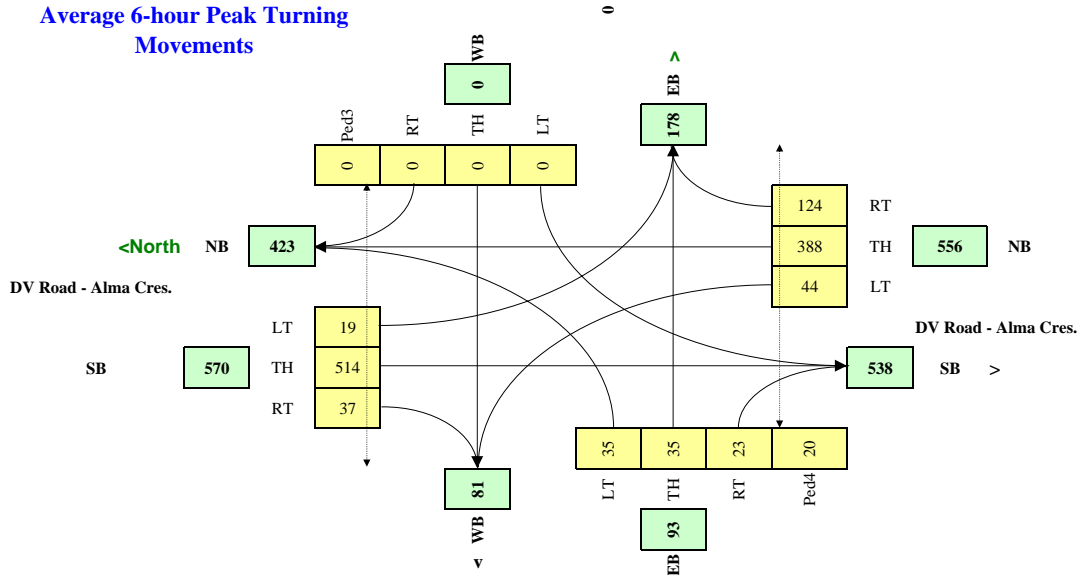
Other input		Speed (Km/h)	Trucks %	Bus Rt (y/n)	Median (m)
DV Road - Alma Cres.	NS	50	2.0%	y	
Site Driveway	EW		2.0%	n	

	Ped1	Ped2	Ped3	Ped4
	NS W Side	NS E Side	EW N Side	EW S side
7:00 - 8:00	0	0	0	20
8:00 - 9:00	0	0	0	20
11:00 - 12:00	0	0	0	20
12:00 - 13:00	0	0	0	20
15:30 - 16:30	0	0	0	20
16:30 - 17:30	0	0	0	20
Total (6-hour peak)	0	0	0	120
Average (6-hour peak)	0	0	0	20

Demographics		
Elementary School	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	380,000
Central Business District	(y/n)	n

Traffic Input	NB			SB			WB			EB		
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT
7:00 - 8:00	45	185	140	20	560	35	0	0	0	15	15	10
8:00 - 9:00	55	230	175	25	700	45	0	0	0	20	20	15
11:00 - 12:00	45	390	130	20	390	40	0	0	0	35	35	25
12:00 - 13:00	45	390	130	20	390	40	0	0	0	35	35	25
15:30 - 16:30	40	595	90	15	550	30	0	0	0	55	55	35
16:30 - 17:30	35	535	80	15	495	30	0	0	0	50	50	30
Total (6-hour peak)	265	2,325	745	115	3,085	220	0	0	0	210	210	140
Average (6-hour peak)	44	388	124	19	514	37	0	0	0	35	35	23

Average 6-hour Peak Turning Movements














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












W =	84	62	22
		Veh	Ped
NOT Warranted			

Appendix B

Level of Service Analysis

Appendix B - Intersection Level of Service Analysis
1: Titus Street & Alma Crescent

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			 			 
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	155	230	0	0	1055
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	168	250	0	0	1147
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (m)			71			
pX, platoon unblocked						
vC, conflicting volume	823	125			250	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	823	125			250	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	81			100	
cM capacity (veh/h)	312	902			1313	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	168	125	125	573	573	
Volume Left	0	0	0	0	0	
Volume Right	168	0	0	0	0	
cSH	902	1700	1700	1700	1700	
Volume to Capacity	0.19	0.07	0.07	0.34	0.34	
Queue Length 95th (m)	5.2	0.0	0.0	0.0	0.0	
Control Delay (s)	9.9	0.0	0.0	0.0	0.0	
Lane LOS	A					
Approach Delay (s)	9.9	0.0		0.0		
Approach LOS	A					
Intersection Summary						
Average Delay			1.1			
Intersection Capacity Utilization			45.4%		ICU Level of Service	A
Analysis Period (min)			15			

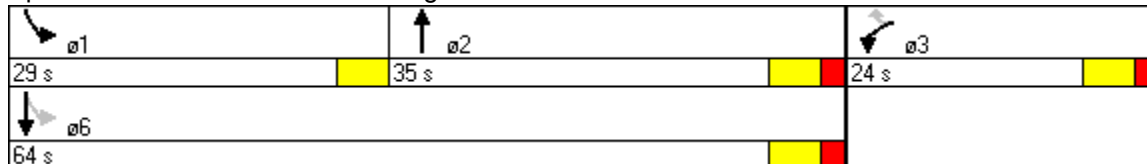
						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
Satd. Flow (prot)	1789	1601	3350	0	1789	1883
Flt Permitted	0.950				0.394	
Satd. Flow (perm)	1789	1601	3350	0	742	1883
Satd. Flow (RTOR)		11	179			
Volume (vph)	95	10	220	165	520	535
Lane Group Flow (vph)	103	11	418	0	565	582
Turn Type		Perm			pm+pt	
Protected Phases	3		2		1	6
Permitted Phases		3			6	
Total Split (s)	24.0	24.0	35.0	0.0	29.0	64.0
Act Effct Green (s)	21.0	21.0	32.0		61.0	61.0
Actuated g/C Ratio	0.24	0.24	0.36		0.69	0.69
v/c Ratio	0.24	0.03	0.31		0.69	0.45
Control Delay	28.9	14.0	11.9		11.1	7.3
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	28.9	14.0	11.9		11.1	7.3
LOS	C	B	B		B	A
Approach Delay	27.5		11.9			9.2
Approach LOS	C		B			A
Queue Length 50th (m)	14.1	0.0	14.3		36.7	37.4
Queue Length 95th (m)	27.2	3.9	24.7		55.3	55.7
Internal Link Dist (m)	172.1		187.3			46.7
Turn Bay Length (m)						
Base Capacity (vph)	427	390	1332		824	1305
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.24	0.03	0.31		0.69	0.45

Intersection Summary










Cycle Length: 88
 Actuated Cycle Length: 88
 Offset: 12 (14%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Control Type: Pretimed
 Maximum v/c Ratio: 0.69
 Intersection Signal Delay: 11.1
 Intersection Capacity Utilization 78.0%
 Analysis Period (min) 15













Intersection LOS: B
 ICU Level of Service D

Splits and Phases: 2: Dutch Village Road & Alma Crescent



Appendix B - Intersection Level of Service Analysis
1: Titus Street & Alma Crescent

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	350	645	0	0	615
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	380	701	0	0	668
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (m)			71			
pX, platoon unblocked	0.88	0.88			0.88	
vC, conflicting volume	1035	351			701	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	904	127			525	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	52			100	
cM capacity (veh/h)	243	792			914	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	380	351	351	334	334	
Volume Left	0	0	0	0	0	
Volume Right	380	0	0	0	0	
cSH	792	1700	1700	1700	1700	
Volume to Capacity	0.48	0.21	0.21	0.20	0.20	
Queue Length 95th (m)	20.0	0.0	0.0	0.0	0.0	
Control Delay (s)	13.7	0.0	0.0	0.0	0.0	
Lane LOS	B					
Approach Delay (s)	13.7	0.0		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay			3.0			
Intersection Capacity Utilization			46.2%		ICU Level of Service	A
Analysis Period (min)			15			

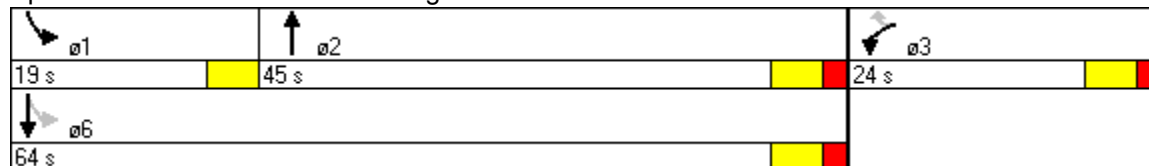
						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			 			
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
Satd. Flow (prot)	1789	1601	3500	0	1789	1883
Flt Permitted	0.950				0.279	
Satd. Flow (perm)	1789	1601	3500	0	525	1883
Satd. Flow (RTOR)		92	30			
Volume (vph)	175	85	560	95	285	330
Lane Group Flow (vph)	190	92	712	0	310	359
Turn Type		Perm			pm+pt	
Protected Phases	3		2		1	6
Permitted Phases		3			6	
Total Split (s)	24.0	24.0	45.0	0.0	19.0	64.0
Act Effct Green (s)	21.0	21.0	42.0		61.0	61.0
Actuated g/C Ratio	0.24	0.24	0.48		0.69	0.69
v/c Ratio	0.44	0.20	0.42		0.52	0.28
Control Delay	32.5	7.4	15.3		8.4	5.8
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	32.5	7.4	15.3		8.4	5.8
LOS	C	A	B		A	A
Approach Delay	24.3		15.3			7.0
Approach LOS	C		B			A
Queue Length 50th (m)	27.4	0.0	37.8		16.7	19.7
Queue Length 95th (m)	46.8	11.2	51.3		26.3	30.5
Internal Link Dist (m)	172.1		187.3			46.9
Turn Bay Length (m)						
Base Capacity (vph)	427	452	1686		594	1305
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.44	0.20	0.42		0.52	0.28










Intersection Summary

Cycle Length: 88
 Actuated Cycle Length: 88
 Offset: 12 (14%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Control Type: Pretimed
 Maximum v/c Ratio: 0.52
 Intersection Signal Delay: 13.5
 Intersection Capacity Utilization 73.3%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service D

Splits and Phases: 2: Dutch Village Road & Alma Crescent



						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	155	249	0	0	1096
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	168	271	0	0	1191
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (m)			71			
pX, platoon unblocked						
vC, conflicting volume	866	135			271	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	866	135			271	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	81			100	
cM capacity (veh/h)	292	889			1290	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	168	135	135	596	596	
Volume Left	0	0	0	0	0	
Volume Right	168	0	0	0	0	
cSH	889	1700	1700	1700	1700	
Volume to Capacity	0.19	0.08	0.08	0.35	0.35	
Queue Length 95th (m)	5.3	0.0	0.0	0.0	0.0	
Control Delay (s)	10.0	0.0	0.0	0.0	0.0	
Lane LOS	A					
Approach Delay (s)	10.0	0.0		0.0		
Approach LOS	A					
Intersection Summary						
Average Delay			1.0			
Intersection Capacity Utilization			46.6%		ICU Level of Service	A
Analysis Period (min)			15			

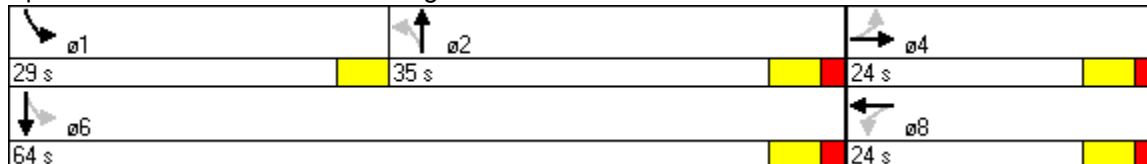
Appendix B - Intersection Level of Service Analysis
2: Dutch Village Road & Alma Crescent

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Satd. Flow (prot)	0	1787	0	1789	1789	0	0	3358	0	1789	1872	0
Flt Permitted		0.909		0.748				0.816		0.355		
Satd. Flow (perm)	0	1654	0	1409	1789	0	0	2757	0	669	1872	0
Satd. Flow (RTOR)		15			11			160			6	
Volume (vph)	20	20	14	116	20	10	55	219	165	518	554	24
Lane Group Flow (vph)	0	59	0	126	33	0	0	477	0	563	628	0
Turn Type	Perm			Perm			Perm			pm+pt		
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Total Split (s)	24.0	24.0	0.0	24.0	24.0	0.0	35.0	35.0	0.0	29.0	64.0	0.0
Act Effct Green (s)		21.0		21.0	21.0			32.0		61.0	61.0	
Actuated g/C Ratio		0.24		0.24	0.24			0.36		0.69	0.69	
v/c Ratio		0.15		0.38	0.08			0.43		0.71	0.48	
Control Delay		22.1		31.9	20.1			15.0		12.4	7.7	
Queue Delay		0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay		22.1		31.9	20.1			15.0		12.4	7.7	
LOS		C		C	C			B		B	A	
Approach Delay		22.1			29.5			15.0			9.9	
Approach LOS		C			C			B			A	
Queue Length 50th (m)		5.8		17.8	2.9			20.0		36.4	41.5	
Queue Length 95th (m)		15.3		33.6	9.8			33.0		62.8	61.8	
Internal Link Dist (m)		39.2			172.1			187.3			46.7	
Turn Bay Length (m)												
Base Capacity (vph)		406		336	435			1104		795	1299	
Starvation Cap Reductn		0		0	0			0		0	0	
Spillback Cap Reductn		0		0	0			0		0	0	
Storage Cap Reductn		0		0	0			0		0	0	
Reduced v/c Ratio		0.15		0.38	0.08			0.43		0.71	0.48	










Intersection Summary

Cycle Length: 88
 Actuated Cycle Length: 88
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
 Control Type: Pretimed
 Maximum v/c Ratio: 0.71
 Intersection Signal Delay: 13.2
 Intersection Capacity Utilization 93.9%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service F

Splits and Phases: 2: Dutch Village Road & Alma Crescent



Appendix B - Intersection Level of Service Analysis
1: Titus Street & Alma Crescent

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	349	696	0	0	641
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	379	757	0	0	697
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage (veh)						
Upstream signal (m)			71			
pX, platoon unblocked	0.88	0.88			0.88	
vC, conflicting volume	1105	378			757	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	979	150			581	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	50			100	
cM capacity (veh/h)	217	763			867	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	379	378	378	348	348	
Volume Left	0	0	0	0	0	
Volume Right	379	0	0	0	0	
cSH	763	1700	1700	1700	1700	
Volume to Capacity	0.50	0.22	0.22	0.20	0.20	
Queue Length 95th (m)	21.3	0.0	0.0	0.0	0.0	
Control Delay (s)	14.3	0.0	0.0	0.0	0.0	
Lane LOS	B					
Approach Delay (s)	14.3	0.0		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay			3.0			
Intersection Capacity Utilization			47.5%		ICU Level of Service	A
Analysis Period (min)			15			

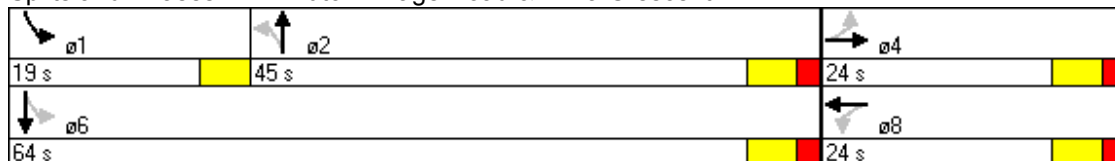
Appendix B - Intersection Level of Service Analysis
2: Dutch Village Road & Alma Crescent

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Satd. Flow (prot)	0	1787	0	1789	1642	0	0	3496	0	1789	1870	0
Flt Permitted		0.856		0.588				0.913		0.262		
Satd. Flow (perm)	0	1557	0	1107	1642	0	0	3202	0	493	1870	0
Satd. Flow (RTOR)		18			92			27			6	
Volume (vph)	54	54	36	188	15	85	39	557	94	283	341	17
Lane Group Flow (vph)	0	157	0	204	108	0	0	749	0	308	389	0
Turn Type	Perm			Perm			Perm			pm+pt		
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Total Split (s)	24.0	24.0	0.0	24.0	24.0	0.0	45.0	45.0	0.0	19.0	64.0	0.0
Act Effct Green (s)		21.0		21.0	21.0			42.0		61.0	61.0	
Actuated g/C Ratio		0.24		0.24	0.24			0.48		0.69	0.69	
v/c Ratio		0.41		0.77	0.23			0.49		0.53	0.30	
Control Delay		28.7		52.8	9.5			16.3		8.6	5.9	
Queue Delay		0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay		28.7		52.8	9.5			16.3		8.6	5.9	
LOS		C		D	A			B		A	A	
Approach Delay		28.7			37.8			16.3			7.1	
Approach LOS		C			D			B			A	
Queue Length 50th (m)		19.7		32.3	2.1			41.6		16.6	21.4	
Queue Length 95th (m)		37.2		#66.3	14.2			56.6		26.2	32.9	
Internal Link Dist (m)		39.1			172.1			187.3			46.9	
Turn Bay Length (m)												
Base Capacity (vph)		385		264	462			1542		577	1298	
Starvation Cap Reductn		0		0	0			0		0	0	
Spillback Cap Reductn		0		0	0			0		0	0	
Storage Cap Reductn		0		0	0			0		0	0	
Reduced v/c Ratio		0.41		0.77	0.23			0.49		0.53	0.30	

Intersection Summary

Cycle Length: 88
 Actuated Cycle Length: 88
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Control Type: Pretimed
 Maximum v/c Ratio: 0.77
 Intersection Signal Delay: 17.5
 Intersection Capacity Utilization 107.9%
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Dutch Village Road & Alma Crescent



1: Titus Street & Alma Crescent

2016 AM Peak Hour without Site, realigned roads (Fig A3-C Vol)

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Satd. Flow (prot)	0	3579	1601	1789	1868	0	1700	1697	0	0	1770	0
Flt Permitted		0.955		0.270			0.950	0.960			0.984	
Satd. Flow (perm)	0	3418	1601	509	1868	0	1700	1697	0	0	1770	0
Satd. Flow (RTOR)			625		4			4			11	
Volume (vph)	1	520	575	100	180	10	230	10	10	10	10	10
Lane Group Flow (vph)	0	566	625	109	207	0	137	135	0	0	33	0
Turn Type	Perm		Perm	pm+pt			Split			custom		
Protected Phases		2		1	6		3	3		4	4	
Permitted Phases	2		2	6						4		
Total Split (s)	35.0	35.0	35.0	14.0	49.0	0.0	30.0	30.0	0.0	21.0	21.0	0.0
Act Effct Green (s)		26.0	26.0	26.4	31.5		14.7	14.7			11.6	
Actuated g/C Ratio		0.52	0.52	0.49	0.63		0.28	0.28			0.20	
v/c Ratio		0.32	0.55	0.23	0.18		0.29	0.28			0.09	
Control Delay		14.3	4.0	9.6	8.2		23.9	23.3			23.8	
Queue Delay		0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Total Delay		14.3	4.0	9.6	8.2		23.9	23.3			23.8	
LOS		B	A	A	A		C	C			C	
Approach Delay		8.9			8.7			23.6			23.8	
Approach LOS		A			A			C			C	
Queue Length 50th (m)		17.2	0.0	3.0	5.9		10.0	9.4			1.6	
Queue Length 95th (m)		50.8	20.6	16.4	28.3		36.9	35.6			11.3	
Internal Link Dist (m)		108.9			114.6			54.2			27.9	
Turn Bay Length (m)			36.0									
Base Capacity (vph)		2028	1204	537	1331		765	766			564	
Starvation Cap Reductn		0	0	0	0		0	0			0	
Spillback Cap Reductn		0	0	0	0		0	0			0	
Storage Cap Reductn		0	0	0	0		0	0			0	
Reduced v/c Ratio		0.28	0.52	0.20	0.16		0.18	0.18			0.06	

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 50.1

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.55

Intersection Signal Delay: 11.3

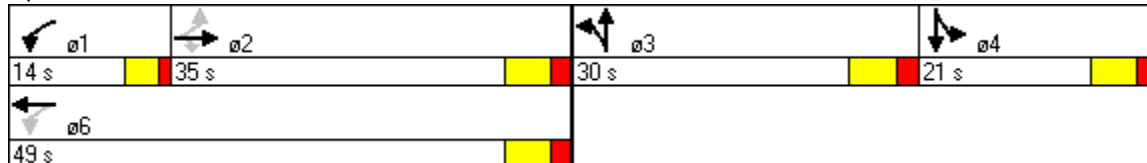
Intersection LOS: B

Intersection Capacity Utilization 60.7%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: Titus Street & Alma Crescent



1: Titus Street & Alma Crescent

2016 PM Peak Hour without Site, realigned roads (Fig A3-D Vol)

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Satd. Flow (prot)	0	3579	1601	1789	1878	0	1700	1704	0	0	1770	0
Flt Permitted		0.954		0.453			0.950	0.954			0.984	
Satd. Flow (perm)	0	3414	1601	853	1878	0	1700	1704	0	0	1770	0
Satd. Flow (RTOR)			380		1			1			11	
Volume (vph)	1	285	350	180	455	10	590	5	5	10	10	10
Lane Group Flow (vph)	0	311	380	196	506	0	329	322	0	0	33	0
Turn Type	Perm		Perm	pm+pt			Split			custom		
Protected Phases		2		1	6		3	3		4	4	
Permitted Phases	2		2	6						4		
Total Split (s)	35.0	35.0	35.0	14.0	49.0	0.0	30.0	30.0	0.0	21.0	21.0	0.0
Act Effct Green (s)		17.0	17.0	26.3	26.7		19.8	19.8			10.4	
Actuated g/C Ratio		0.30	0.30	0.44	0.46		0.34	0.34			0.16	
v/c Ratio		0.31	0.51	0.37	0.58		0.56	0.55			0.11	
Control Delay		20.6	5.7	14.0	16.7		23.3	22.9			24.7	
Queue Delay		0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Total Delay		20.6	5.7	14.0	16.7		23.3	22.9			24.7	
LOS		C	A	B	B		C	C			C	
Approach Delay		12.4			15.9			23.1			24.7	
Approach LOS		B			B			C			C	
Queue Length 50th (m)		11.8	0.0	8.8	27.5		23.8	23.1			1.7	
Queue Length 95th (m)		31.7	19.1	33.0	91.4		79.1	77.1			11.3	
Internal Link Dist (m)		108.9			114.6			54.2			27.9	
Turn Bay Length (m)			36.0									
Base Capacity (vph)		1584	947	547	1155		749	751			470	
Starvation Cap Reductn		0	0	0	0		0	0			0	
Spillback Cap Reductn		0	0	0	0		0	0			0	
Storage Cap Reductn		0	0	0	0		0	0			0	
Reduced v/c Ratio		0.20	0.40	0.36	0.44		0.44	0.43			0.07	

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 57.5

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.58

Intersection Signal Delay: 17.2

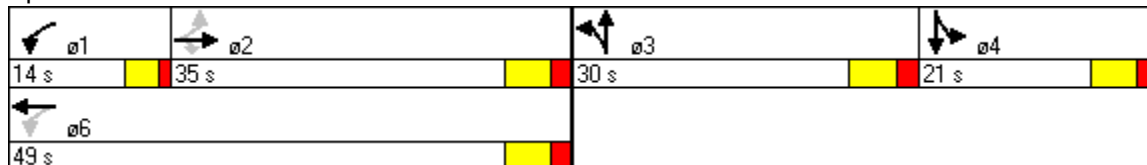
Intersection LOS: B

Intersection Capacity Utilization 65.8%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 1: Titus Street & Alma Crescent



1: Titus Street & Alma Crescent

2016 AM Peak Hour with Site, realigned roads (Fig A4-C Vol)

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Satd. Flow (prot)	0	3579	1601	1789	1868	0	1700	1690	0	0	1770	0
Flt Permitted		0.955		0.273			0.950	0.959			0.984	
Satd. Flow (perm)	0	3418	1601	514	1868	0	1700	1690	0	0	1770	0
Satd. Flow (RTOR)			674		4			5			11	
Volume (vph)	1	516	620	141	180	10	249	5	13	10	10	10
Lane Group Flow (vph)	0	562	674	153	207	0	149	141	0	0	33	0
Turn Type	Perm		Perm	pm+pt			Split			custom		
Protected Phases		2		1	6		3	3		4	4	
Permitted Phases	2		2	6						4		
Total Split (s)	35.0	35.0	35.0	14.0	49.0	0.0	30.0	30.0	0.0	21.0	21.0	0.0
Act Effct Green (s)		26.6	26.6	30.4	35.4		14.8	14.8			11.4	
Actuated g/C Ratio		0.49	0.49	0.54	0.66		0.26	0.26			0.19	
v/c Ratio		0.33	0.60	0.30	0.17		0.33	0.31			0.10	
Control Delay		15.7	4.3	9.7	8.2		25.2	24.4			24.1	
Queue Delay		0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Total Delay		15.7	4.3	9.7	8.2		25.2	24.4			24.1	
LOS		B	A	A	A		C	C			C	
Approach Delay		9.5			8.8			24.8			24.1	
Approach LOS		A			A			C			C	
Queue Length 50th (m)		17.7	0.0	4.4	6.0		11.1	10.1			1.6	
Queue Length 95th (m)		51.3	22.2	22.4	29.1		39.6	36.7			11.4	
Internal Link Dist (m)		108.9			114.6			54.2			27.9	
Turn Bay Length (m)			36.0									
Base Capacity (vph)		1925	1196	555	1321		716	715			529	
Starvation Cap Reductn		0	0	0	0		0	0			0	
Spillback Cap Reductn		0	0	0	0		0	0			0	
Storage Cap Reductn		0	0	0	0		0	0			0	
Reduced v/c Ratio		0.29	0.56	0.28	0.16		0.21	0.20			0.06	

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 53.8

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.60

Intersection Signal Delay: 11.9

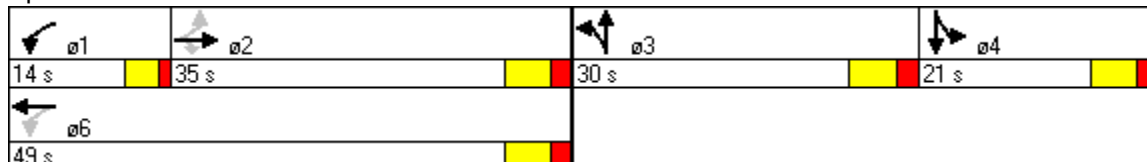
Intersection LOS: B

Intersection Capacity Utilization 63.5%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: Titus Street & Alma Crescent



2: Dutch Village Road & Alma Crescent

2016 AM Peak Hour with Site, realigned roads (Fig A4-C Vol)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	20	20	14	0	0	0	55	247	157	27	700	44
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	22	15	0	0	0	60	268	171	29	761	48
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)												78
pX, platoon unblocked	0.99	0.99	0.99	0.99	0.99		0.99					
vC, conflicting volume	1097	1232	785	1319	1341	220	809			268		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1098	1234	783	1322	1344	220	807			268		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	86	86	95	100	100	100	93			98		
cM capacity (veh/h)	153	157	333	90	135	784	806			1292		
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2						
Volume Total	22	37	194	305	29	809						
Volume Left	22	0	60	0	29	0						
Volume Right	0	15	0	171	0	48						
cSH	153	201	806	1700	1292	1700						
Volume to Capacity	0.14	0.18	0.07	0.18	0.02	0.48						
Queue Length 95th (m)	3.7	5.0	1.8	0.0	0.5	0.0						
Control Delay (s)	32.3	26.9	3.6	0.0	7.9	0.0						
Lane LOS	D	D	A		A							
Approach Delay (s)	28.9		1.4		0.3							
Approach LOS	D											
Intersection Summary												
Average Delay			1.9									
Intersection Capacity Utilization			66.3%		ICU Level of Service					C		
Analysis Period (min)			15									

1: Titus Street & Alma Crescent

2016 PM Peak Hour with Site, realigned roads (Fig A4-D Vol)

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Satd. Flow (prot)	0	3579	1601	1789	1878	0	1700	1704	0	0	1770	0
Flt Permitted		0.954		0.455			0.950	0.954			0.984	
Satd. Flow (perm)	0	3414	1601	857	1878	0	1700	1704	0	0	1770	0
Satd. Flow (RTOR)			411		1			1			11	
Volume (vph)	1	283	378	208	454	10	641	5	5	10	10	10
Lane Group Flow (vph)	0	309	411	226	504	0	358	349	0	0	33	0
Turn Type	Perm		Perm	pm+pt			Split			custom		
Protected Phases		2		1	6		3	3		4	4	
Permitted Phases	2		2	6						4		
Total Split (s)	35.0	35.0	35.0	14.0	49.0	0.0	30.0	30.0	0.0	21.0	21.0	0.0
Act Effct Green (s)		17.1	17.1	26.6	27.0		20.8	20.8			10.3	
Actuated g/C Ratio		0.29	0.29	0.44	0.46		0.35	0.35			0.16	
v/c Ratio		0.31	0.54	0.43	0.58		0.59	0.58			0.12	
Control Delay		21.1	5.8	15.0	17.0		24.1	23.6			24.8	
Queue Delay		0.0	0.0	0.0	0.0		0.0	0.0			0.0	
Total Delay		21.1	5.8	15.0	17.0		24.1	23.6			24.8	
LOS		C	A	B	B		C	C			C	
Approach Delay		12.4			16.4			23.9			24.8	
Approach LOS		B			B			C			C	
Queue Length 50th (m)		12.8	0.0	11.3	30.0		27.4	26.6			1.8	
Queue Length 95th (m)		31.7	19.7	37.9	91.1		86.8	84.2			11.3	
Internal Link Dist (m)		108.9			114.6			54.2			27.9	
Turn Bay Length (m)			36.0									
Base Capacity (vph)		1553	952	543	1138		743	745			460	
Starvation Cap Reductn		0	0	0	0		0	0			0	
Spillback Cap Reductn		0	0	0	0		0	0			0	
Storage Cap Reductn		0	0	0	0		0	0			0	
Reduced v/c Ratio		0.20	0.43	0.42	0.44		0.48	0.47			0.07	

Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 58.8

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.59

Intersection Signal Delay: 17.6

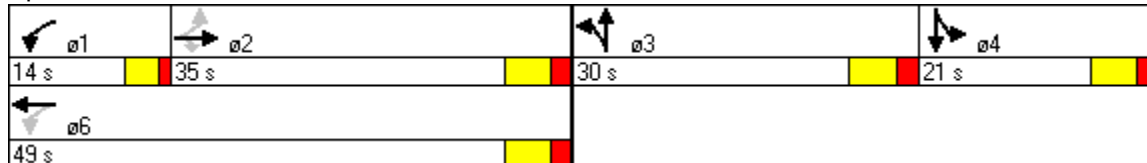
Intersection LOS: B

Intersection Capacity Utilization 67.1%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 1: Titus Street & Alma Crescent



2: Dutch Village Road & Alma Crescent

2016 PM Peak Hour with Site, realigned roads (Fig A4-D Vol)

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	54	54	36	0	0	0	39	597	89	15	549	32
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	59	59	39	0	0	0	42	649	97	16	597	35
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)												78
pX, platoon unblocked	0.93	0.93	0.93	0.93	0.93		0.93					
vC, conflicting volume	1056	1380	614	1480	1446	373	632			649		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1060	1408	586	1515	1479	373	604			649		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	63	51	91	100	100	100	95			98		
cM capacity (veh/h)	158	120	423	41	109	625	903			933		
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2						
Volume Total	59	98	367	421	16	632						
Volume Left	59	0	42	0	16	0						
Volume Right	0	39	0	97	0	35						
cSH	158	168	903	1700	933	1700						
Volume to Capacity	0.37	0.58	0.05	0.25	0.02	0.37						
Queue Length 95th (m)	12.0	23.5	1.1	0.0	0.4	0.0						
Control Delay (s)	40.6	52.5	1.5	0.0	8.9	0.0						
Lane LOS	E	F	A		A							
Approach Delay (s)	48.1		0.7		0.2							
Approach LOS	E											
Intersection Summary												
Average Delay			5.2									
Intersection Capacity Utilization			60.7%		ICU Level of Service					B		
Analysis Period (min)			15									