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January 21, 2014

OUR REF: TO3131TOZ

EMAIL TO: greg.leblanc@sympatico.ca

Greg Leblanc
1963 Old Carp Road
Carp, ON K0A 1L0

Dear Greg:

**Re: 3119 Carp Road Plan of Subdivision
Transportation Brief**

1.0 INTRODUCTION

From the information provided it is our understanding that you wish to submit a Plan of Subdivision application for a proposed rural commercial/industrial subdivision of approximately 300,000 ft² at the above-noted address. From the concept plan provided, the site is located on the west side of Carp Road and will be accessed by a single site driveway that cul-de-sacs at the west boundary of the property. It appears that no other lands/development will be connected to this site driveway. The site in its local context is depicted in Figure 1 and the subdivision's Concept Plan is shown on Figure 2.

2.0 SCOPE OF WORK

As the proposed development will generate more than 75 vph and a Plan of Subdivision approval is being sought, the City's Transportation Impact Assessment Guidelines indicate that a Community Transportation Study is the required level of traffic study. However, given the somewhat isolated location of the proposed subdivision and that it has only one proposed driveway connection to Carp Road, we discussed the scope of work with Amira Shehata of the City of Ottawa. Through discussions it was agreed that a Traffic Brief that focussed on the site specific transportation issues and requirements would be sufficient. Within this context, it was agreed that the study area would extend to and include the Carp Road intersections with each of March Road, the Site Driveway and the McGee Side Road. Accordingly, the Traffic Brief is provided herein.

3.0 Existing Transportation Conditions

3.1 Carp Road

Carp Road is a two-lane arterial road with a posted speed of 80 kph through the study area. It has a rural cross-section with a right-of-way protection policy of 30 m. Its intersection with March Road is traffic signal controlled with left-turn lanes provided on all four approaches.

Its intersection with McGee Side Road is STOP sign controlled on the east-west approaches only, and there are no turn lanes. Adjacent to the site, Carp Road is two lanes wide with gravel shoulders.

Figure 1: Site Context



3.2 Peak Hour Volumes and Intersection Operation

With regard to peak hour traffic volumes, these are depicted on Figure 3 and included as Appendix A. The Carp/March count was provided by the City of Ottawa and Delcan conducted the Carp/McGee intersection in December 2013. Peak direction volumes total approximately 400 with the two-directional total being approximately 550 vph during the morning peak hour and 650 vph during the afternoon peak hour. As shown in Table 1, the study area's two main intersections currently operate at a very good level of service (LoS 'A' to 'C'), with there being significant spare capacity.

Figure 2: Concept Plan

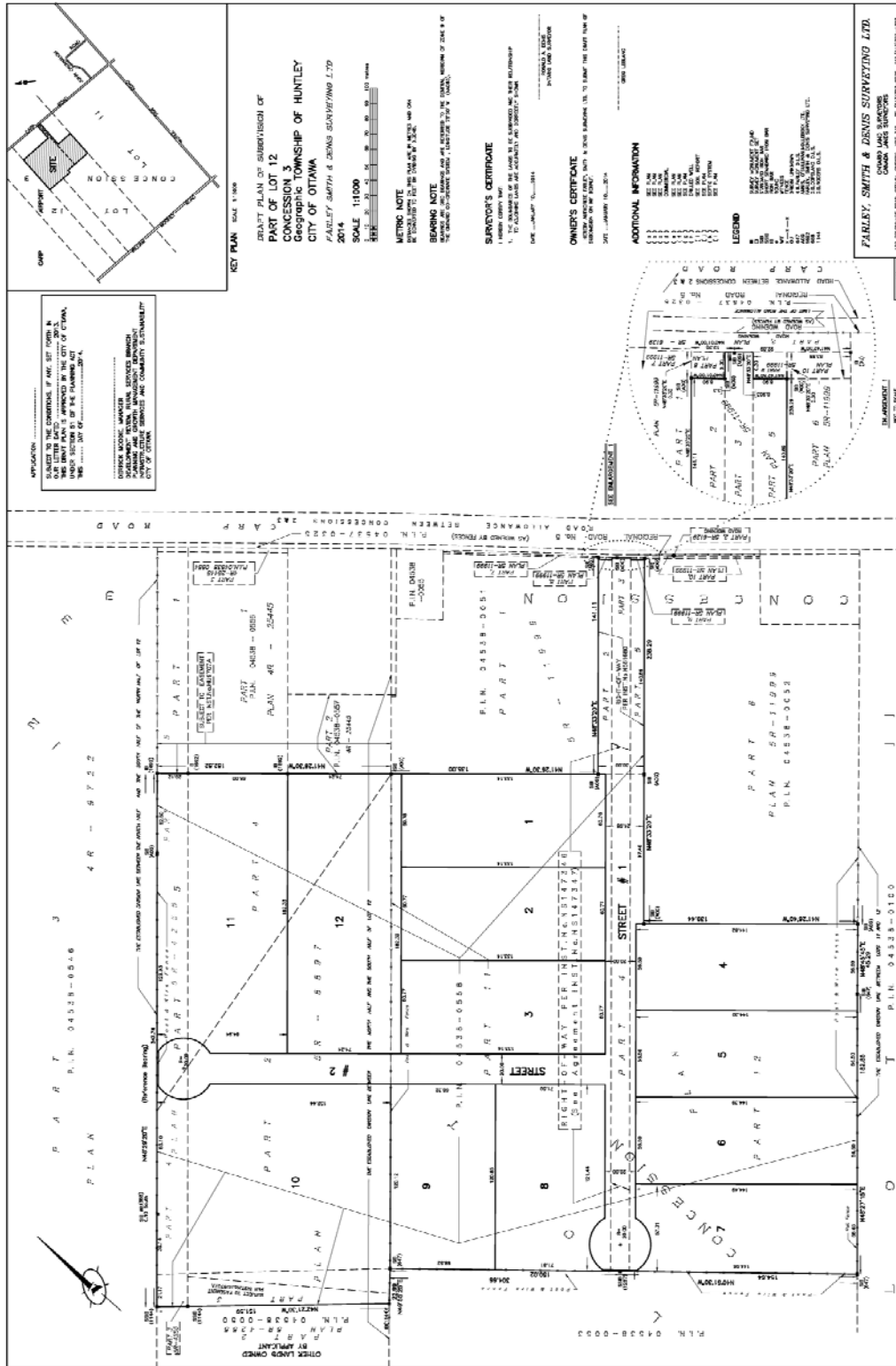


Figure 3: Existing Peak Hour Traffic

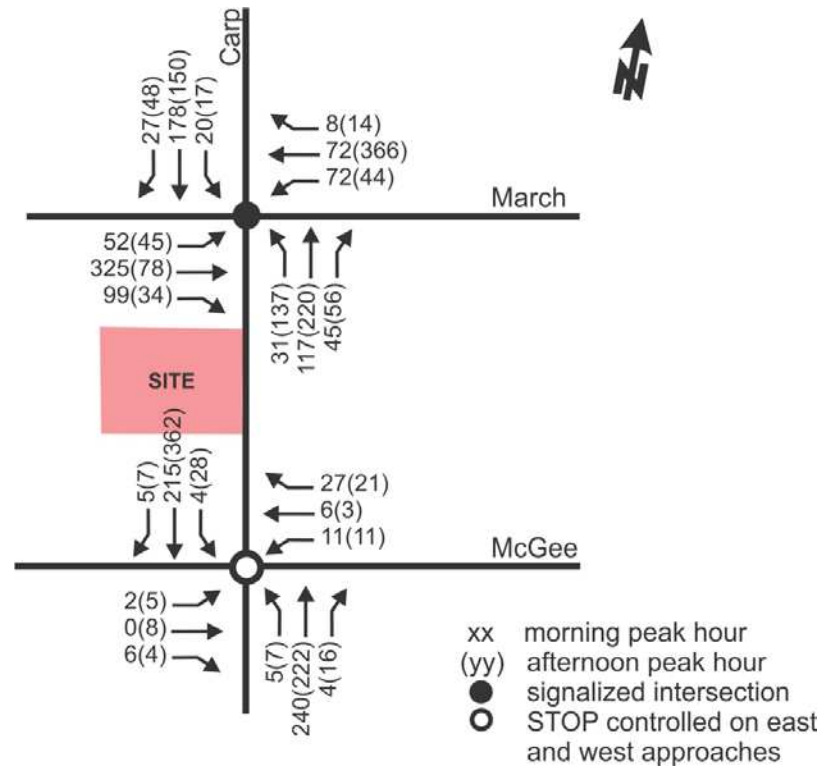


Table 1 provides a summary of existing traffic operations at key study area intersections, based on the Synchro (V8) traffic analysis software. The subject intersections were assessed in terms of the volume-to-capacity (v/c) ratio/delay and the corresponding Level of Service (LoS) for the 'critical movement(s)'. The signalized Carp/March intersection 'as a whole' was assessed based on a weighted v/c ratio and the Synchro model output of existing conditions is provided within Appendix B.

Table 1: Existing Performance at Study Area Intersections

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
Carp/March	C(B)	0.73(0.69)	EBT(WBT)	16.0(14.9)	A(A)	0.54(0.53)
Carp/McGee Side	B(B)	11.3(14.9)	WBT(EBT)	1.3(1.5)	-	-

Note: Analysis of signalized intersections assumes a PHF of 0.95 and a saturation flow rate of 1800 veh/h/lane.

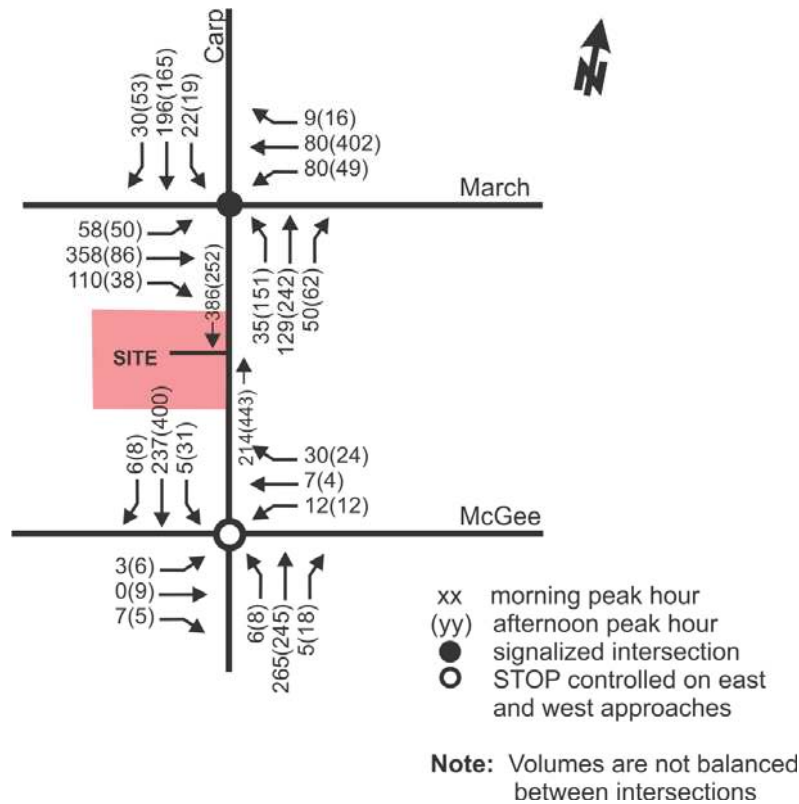
As shown in Table 1, the signalized Carp/March intersection 'as a whole' is currently operating at an excellent LoS 'A' during both the weekday morning and afternoon peak hours, with respect to the City of Ottawa operating standards of LoS 'D' or better ($0.90 > v/c > 0.00$). This is indicative of significant spare capacity at this intersection.

With regard to 'critical movements' at study area intersections, they are currently operating at an acceptable LoS 'C' or better during both the weekday morning and afternoon peak hours.

3.3 Background Traffic Growth

Five City of Ottawa traffic counts at the Carp/March Road intersection, between 2006 and 2013, were used to estimate background traffic growth. The analysis results are provided in Appendix C and based on this analysis, a 1% growth rate for 10 years is assumed appropriate for the horizon year of the proposed subdivision. As such, the existing 2013 volumes depicted in Figure 3 were increased by a factor 1.1 to estimate 2023 horizon year background volumes as depicted in Figure 4.

Figure 4: 2023 Horizon Year Background Traffic Volumes



4.0 Project Site Traffic Generation

The proposed development is best described as a rural commercial/industrial subdivision comprised of 12 lots and totalling of 300,000 ft² of floor area. The ITE Trip Generation Manual (9th Edition) was used to derive the appropriate peak hour vehicle trip rate. As there is no directly equivalent land use, a number of land uses within the Manual were considered. These uses, and their peak hour vehicle trip rates per 1000 ft² of development area, are provided in Table 2.

Table 2: Sample ITE Vehicle Trip Rates

Use	ITE Category	Veh/ 1000 ft ² and Directional Split	
		Morning Peak Hour	Afternoon Peak Hour
Light Industrial	110	0.92 (88/12)	0.97(12/88)
Industrial Park	130	0.82(82/18)	0.85(21/79)
Warehouse	150	0.42(65/35)	0.48(19/81)
Construction Equipment Rental	811	-	0.99(28/72)
Tractor Supply Store	810	0.7	1.4(45/55)

Based on the Table 2 rates, and as the subdivision will likely be comprised of a combination of light industrial, warehouse and rural commercial uses, the following rates and directional splits were considered appropriate for analysis purposes.

- Morning peak hour: 0.9 veh/1000 ft², with an 85% in/15% out directional split
- Afternoon peak hour: 0.9/veh 1000 ft² with a 25% in/75% out directional split

Applying these volumes to the proposed 300,000 ft² of development results in the peak hour site-generated traffic as summarized in Table 3.

Table 3: Projected Site-Generated Traffic

Use	(vehicle per hour)					
	Morning Peak Hour			Afternoon Peak Hour		
	In	Out	Total	In	Out	Total
Industrial / rural commercial (300,000 ft ²)	230	40	270	70	200	270

With regard to distribution and assignment of these site-generated vehicle trips, the morning and afternoon peak hour traffic flow on the adjacent section of Carp Road was considered, as were the existing turning volumes at the March and McGee intersections. The resultant assignment of projected peak hour traffic is depicted on Figure 5.

Figure 5: Assignment of Projected Site-Generated Traffic

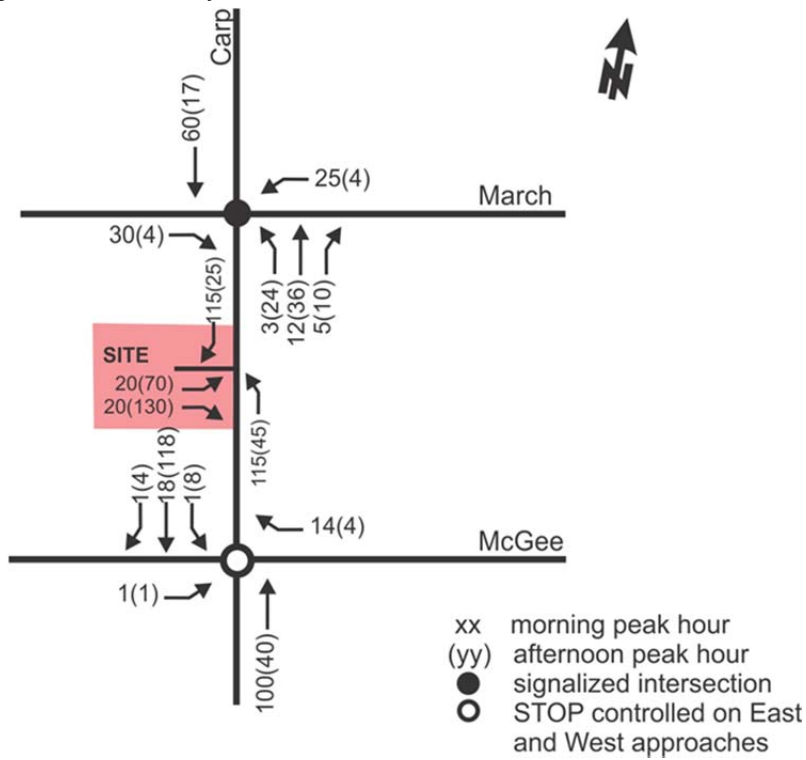
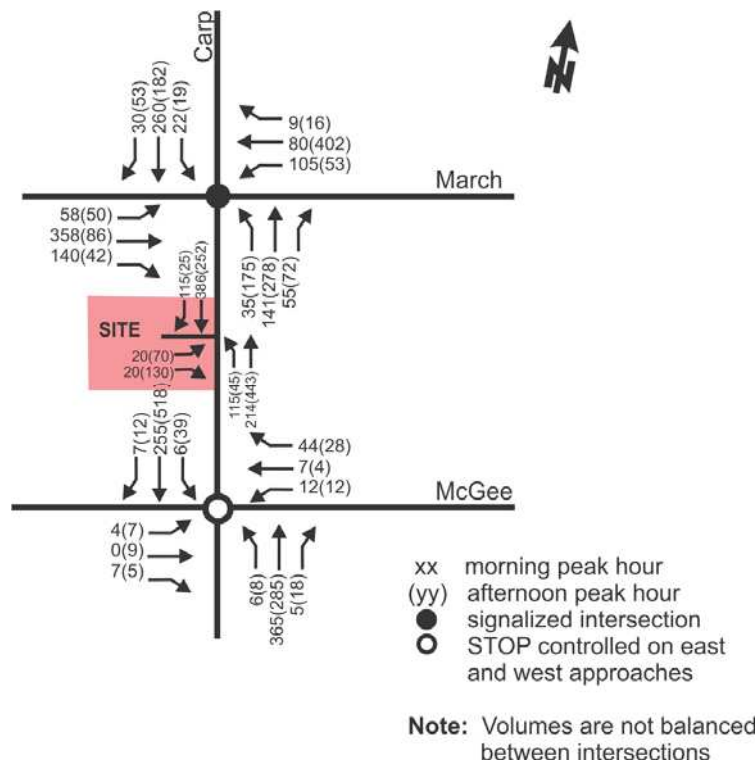


Figure 6: Total Projected Horizon Year Traffic Volumes



5.0 Assessment of Projected Conditions

The combination of site-generated traffic plus 2023 horizon year background traffic volumes is depicted in Figure 6. The results of the intersection capacity analysis of the three study area intersections for these total projected conditions are provided in Table 4.

Table 4 provides a summary of projected performance of the study area intersections and the Synchro model output of projected conditions is provided within Appendix D.

Table 4: Projected Performance at Study Area Intersections

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
Carp/March	C(C)	0.77(0.71)	EBT(WBT)	18.4(16.5)	B(A)	0.62(0.58)
Carp/Site	C(C)	16.2(16.7)	EBL(EBL)	2.2(4.0)	-	-
Carp/McGee Side	B(C)	12.8(20.1)	WBT(EBT)	1.5(1.8)	-	-

Note: Analysis of signalized intersections assumes a PHF of 0.95 and a saturation flow rate of 1800 veh/h/lane.

As shown in Table 4, with no signal timing plan modifications, the signalized Carp/March intersection 'as a whole' is projected to continue operating at an excellent LoS 'B' or better during both peak hours. With regard to 'critical movements' at study area intersections, they are projected to operate at an acceptable LoS 'C' or better during both the weekday morning and afternoon peak hours. This is similar to the existing conditions summarized in Table 1.

With regard to the Carp/McGee intersection, it too will continue to operate at an excellent LoS 'B'/'C', with no modification required.

With regard to the proposed development's new driveway connection to Carp Road, it is projected to operate at a very good LoS 'C' during both peak periods, however, the total projected volumes do require turn lanes on Carp Road at this location (Appendix E).

Based on projected horizon traffic volumes and using a 90 km/h highway design speed, an auxiliary northbound left-turn lane and southbound right-turn lane are warranted/recommended on Carp Road at the site driveway. The recommended storage lengths and taper lengths are 70 m and 75 m respectively for the right-turn lane and 60 m and 145 m for the left-turn lane. These lanes are not needed initially, but only when a certain turn movement threshold is reached. These thresholds are 60 vph for the southbound right-turn lane and approximately 20 to 30 vph for the northbound left-turn lane. Therefore, with regard to timing of implementation, they could be provided initially if

desired by the proponent, or traffic conditions could be monitored as development proceeds, and implementation could occur when warranted.

With regard to throat length on the site driveway connection to Carp Road, it is well over 100 m long before any of the subdivision lots are reached, therefore there is no throat length issue.

6.0 Findings, Conclusions and Recommendations

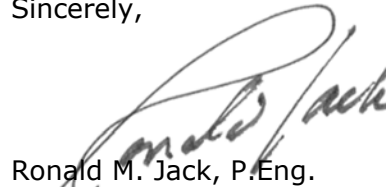
Based on the foregoing analysis, the findings, conclusions and recommendations of this Transportation Overview are as follows.

- The proposed development on the west side of Carp Road has the potential for approximately 300,000 ft² of commercial/industrial uses spread out over a number of lots;
- The adjacent section of Carp Road has a two-lane rural cross-section with a posted speed of 80 kph and a right-of-way protection policy of 30 m;
- The study area intersections of Carp/March and Carp/McGee currently operate at very good levels of service in the LoS 'B' to 'C' range;
- A 10-year horizon and a background growth rate of 1% per year was used for analysis of projected conditions at full site build-out;
- The proposed commercial/industrial subdivision is estimated to generate approximately 270 vph two-way total at full build-out;
- With the combination of existing traffic plus background traffic growth plus site-generated traffic, the three study area intersections of Carp/March, Carp/McGee and Carp/Site Driveway are projected to operate at an acceptable LoS 'C' during peak hours;
- As the site driveway is a minimum of 100 m long before there is an on-site connection to any lot, there is no throat length issue;
- The site-generated traffic does not require any modifications to off-site intersections, however, turn lanes are required on Carp Road at the Carp/Site Driveway intersection. Due to the design speed of Carp Road, a southbound right-turn lane with 70 m of storage and 75 of taper is required. For the northbound left-turn movement, 60 m of storage and 145 m of taper are required; and
- The above-noted turn lanes at the Carp/Site Driveway intersection are not required initially, but will be warranted when the southbound right-turn reaches approximately 60 vph and the northbound left-turn reaches approximately 30 vph. Monitoring of site-generated traffic is recommended to determine when these thresholds are met and the turn lanes are required.

Based on the foregoing, and assuming the identified turn lanes are implemented at the appropriate time, the proposed development is recommended from a transportation perspective.

Please call if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Ronald M. Jack". The signature is written in a cursive, flowing style.

Ronald M. Jack, P.Eng.
Vice President
Manager, Transportation Division

Attachments

Appendix A

Current 2013 Traffic Counts

- Carp/March
- Carp/McGee Side

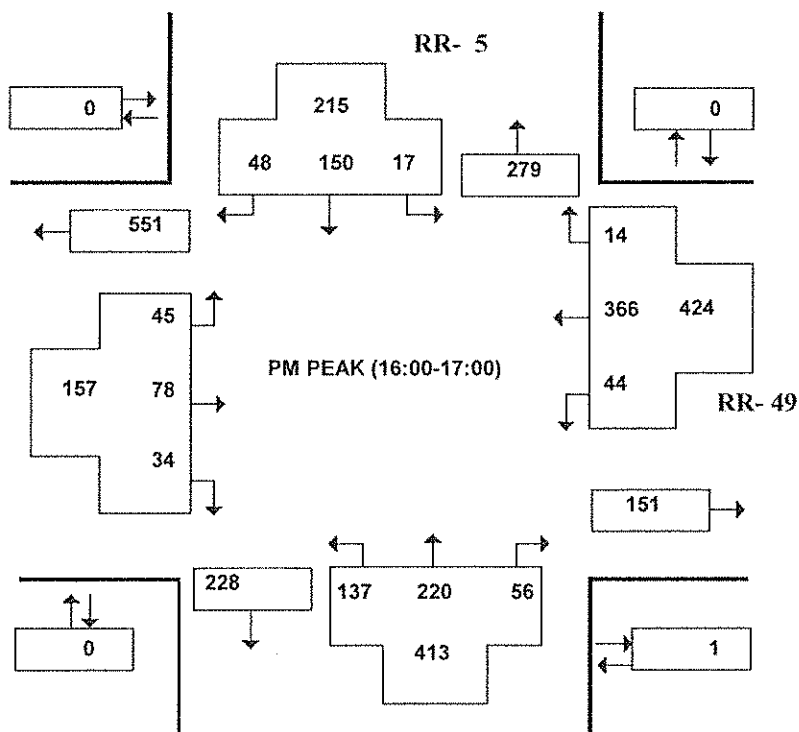
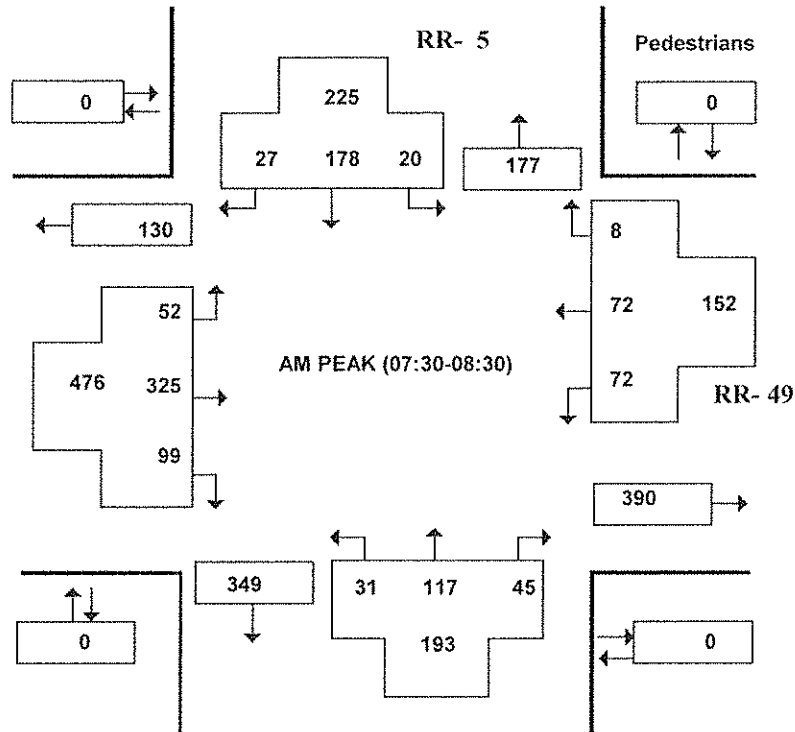
CARP RD and MARCH RD

(ULRS Listing RR- 5 & RR- 49)

Survey Date: Tuesday 20 August 2013
 Conditions: DRY
 Start Time: 0700

Total Observed U-Turns
 Northbound: 0 Southbound: 0
 Eastbound: 0 Westbound: 0

AADT Factor
 Tuesday in August is
 0.9



DIRECTIONAL TRAFFIC FLOW

Intersection: Carp at McGee Side

DATE: Day: 4 Month: December Year: 2013 Day of Week: Wednesday

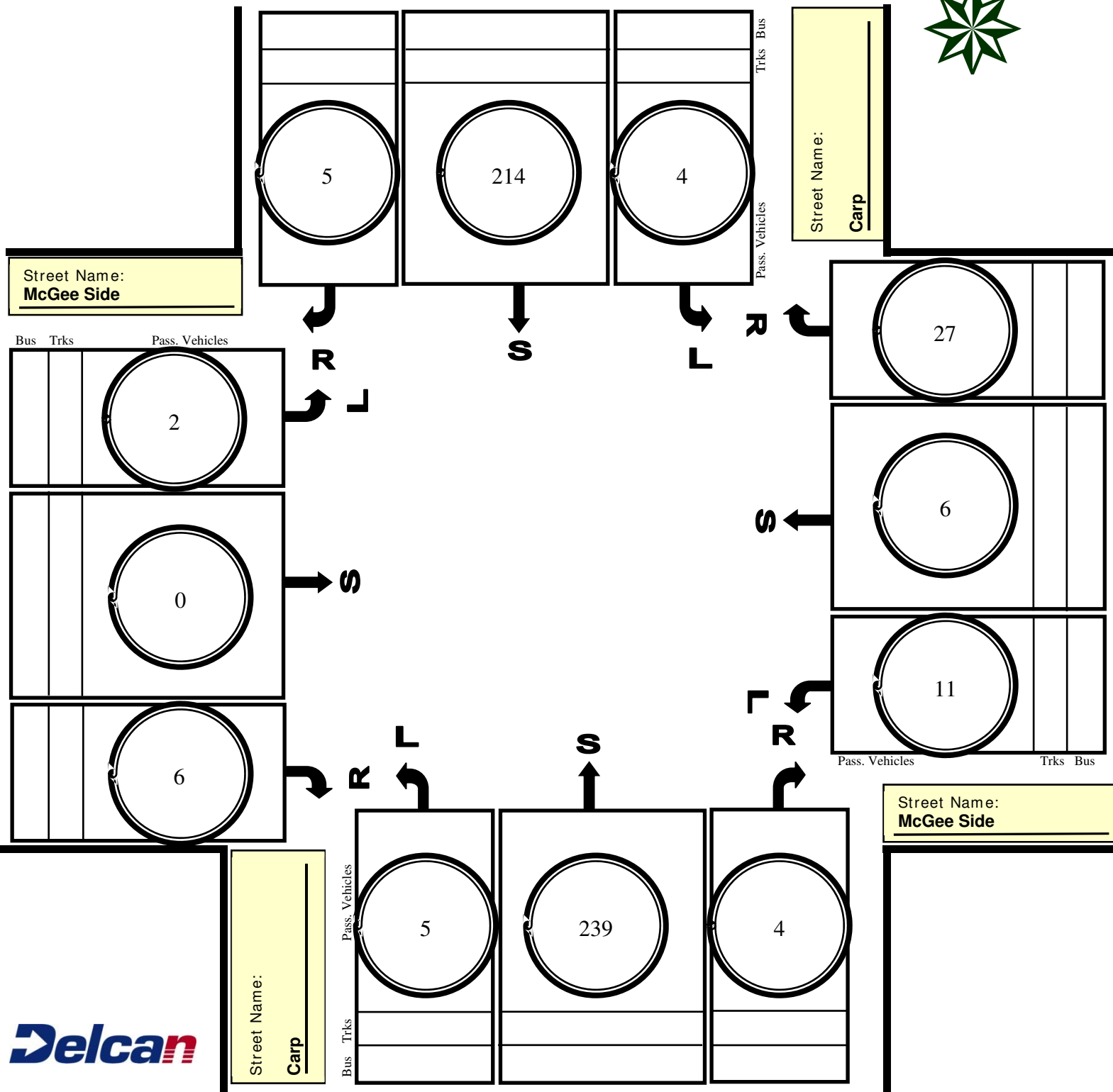
Observer: Cathie Lytle Weather: Clear

Chkd by: _____ Date: _____

TIME PERIOD: From: 7 : 30 To: 8 : 30

- Instructions: 1) Use tally marks to indicate vehicles.
2) Use one sheet for each 15-minute period.

N



DIRECTIONAL TRAFFIC FLOW

Intersection: Carp at McGee Side

DATE: Day: 4 Month: December Year: 2013 Day of Week: Wednesday

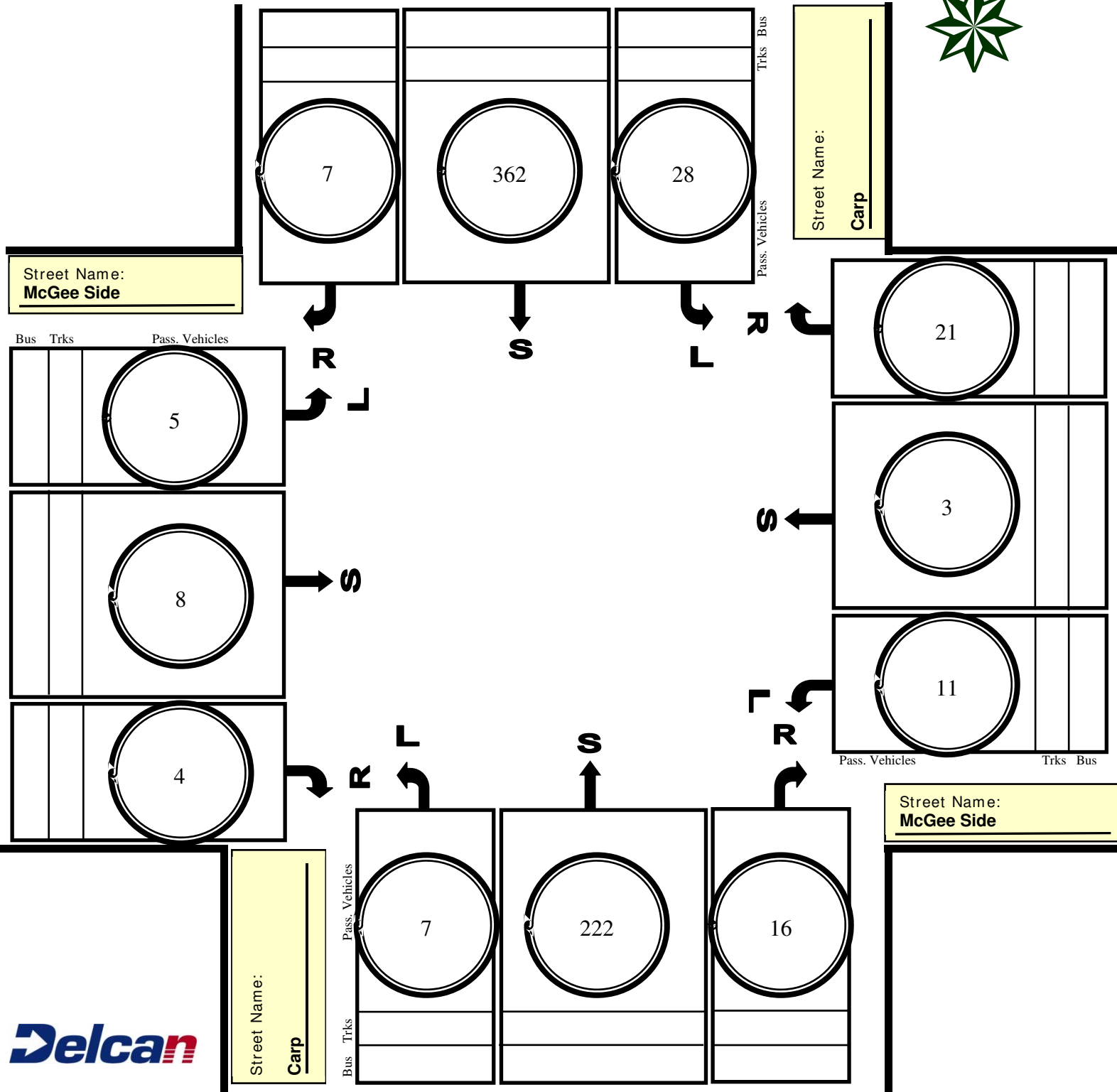
Observer: Cathie Lytle Weather: Clear

Chkd by: _____ Date: _____

TIME PERIOD: From: 4 : 00 To: 5 : 00

Instructions: 1) Use tally marks to indicate vehicles.
2) Use one sheet for each 15-minute period.

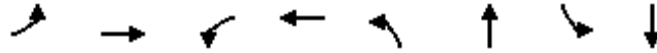
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Appendix B

SYNCHRO Analysis: Existing Conditions

Existing AM
1: Carp & March



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	52	325	72	72	31	117	20	178
Lane Group Flow (vph)	55	446	76	84	33	170	21	215
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	21.0	21.0	21.0	21.0
Minimum Split (s)	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
Total Split (s)	51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
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	6.2	6.2	6.2	6.2
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)	18.0	18.0	18.0	18.0	21.2	21.2	21.2	21.2
Actuated g/C Ratio	0.35	0.35	0.35	0.35	0.41	0.41	0.41	0.41
v/c Ratio	0.13	0.73	0.33	0.14	0.07	0.24	0.04	0.30
Control Delay	11.5	21.5	16.3	10.7	11.9	11.0	11.7	12.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.5	21.5	16.3	10.7	11.9	11.0	11.7	12.6
LOS	B	C	B	B	B	B	B	B
Approach Delay		20.4		13.4		11.2		12.5
Approach LOS		C		B		B		B
Queue Length 50th (m)	3.3	33.0	5.0	4.7	1.7	8.1	1.1	11.8
Queue Length 95th (m)	8.8	57.7	13.2	11.3	7.1	22.5	5.2	30.0
Internal Link Dist (m)		511.9		443.6		2852.2		206.9
Turn Bay Length (m)	115.0		90.0		115.0		100.0	
Base Capacity (vph)	1100	1515	576	1545	977	1505	1018	1537
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	0.05	0.29	0.13	0.05	0.03	0.11	0.02	0.14

Intersection Summary

Cycle Length: 102.4
 Actuated Cycle Length: 51.6
 Natural Cycle: 55
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.73
 Intersection Signal Delay: 16.0
 Intersection LOS: B
 Intersection Capacity Utilization 75.4%
 ICU Level of Service D
 Analysis Period (min) 15

Splits and Phases: 1: Carp & March

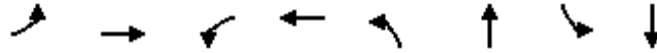
51.2 s				51.2 s			
51.2 s				51.2 s			

Existing AM
2: Carp & McGee Side



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	6	11	6	27	5	240	4	4	215	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	2	0	6	12	6	28	5	253	4	4	226	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type												
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	534	505	229	509	505	255	232			257		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	534	505	229	509	505	255	232			257		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	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 %	100	100	99	98	99	96	100			100		
cM capacity (veh/h)	433	466	810	468	466	784	1336			1308		
Direction, Lane #												
	EB 1	WB 1	NB 1	SB 1								
Volume Total	8	46	262	236								
Volume Left	2	12	5	4								
Volume Right	6	28	4	5								
cSH	665	621	1336	1308								
Volume to Capacity	0.01	0.07	0.00	0.00								
Queue Length 95th (m)	0.3	1.8	0.1	0.1								
Control Delay (s)	10.5	11.3	0.2	0.2								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.5	11.3	0.2	0.2								
Approach LOS	B	B										
Intersection Summary												
Average Delay			1.3									
Intersection Capacity Utilization			26.7%	ICU Level of Service	A							
Analysis Period (min)			15									

Existing PM
1: Carp & March



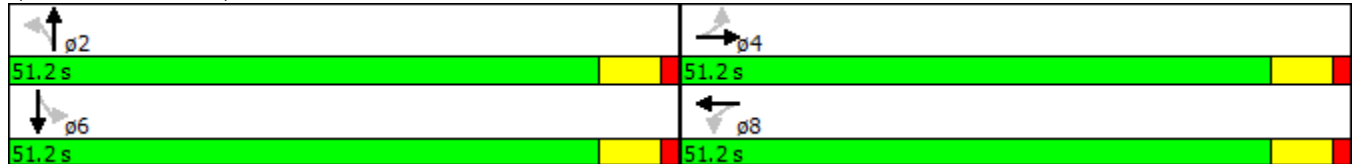
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	45	78	44	366	137	220	17	150
Lane Group Flow (vph)	47	118	46	400	144	291	18	209
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	21.0	21.0	21.0	21.0
Minimum Split (s)	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
Total Split (s)	51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
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	6.2	6.2	6.2	6.2
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)	16.4	16.4	16.4	16.4	21.2	21.2	21.2	21.2
Actuated g/C Ratio	0.33	0.33	0.33	0.33	0.42	0.42	0.42	0.42
v/c Ratio	0.19	0.21	0.12	0.69	0.30	0.39	0.04	0.28
Control Delay	13.6	10.1	11.9	21.1	13.4	12.6	10.9	11.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.6	10.1	11.9	21.1	13.4	12.6	10.9	11.1
LOS	B	B	B	C	B	B	B	B
Approach Delay		11.1		20.1		12.9		11.1
Approach LOS		B		C		B		B
Queue Length 50th (m)	2.9	5.5	2.8	29.7	7.7	15.3	0.9	10.0
Queue Length 95th (m)	8.6	13.7	7.9	52.1	23.0	39.1	4.6	27.3
Internal Link Dist (m)		511.9		443.6		2852.2		206.9
Turn Bay Length (m)	115.0		90.0		115.0		100.0	
Base Capacity (vph)	671	1539	1097	1602	1010	1564	937	1553
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	0.07	0.08	0.04	0.25	0.14	0.19	0.02	0.13

Intersection Summary

Cycle Length: 102.4
 Actuated Cycle Length: 50.1
 Natural Cycle: 55
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.69
 Intersection Signal Delay: 14.9
 Intersection Capacity Utilization 85.2%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 1: Carp & March



Existing PM
2: Carp & McGee Side



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	8	4	11	3	21	7	222	16	28	362	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	5	8	4	12	3	22	7	234	17	29	381	7
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type												
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	724	709	385	709	704	242	388			251		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	724	709	385	709	704	242	388			251		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	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 %	98	98	99	97	99	97	99			98		
cM capacity (veh/h)	322	349	663	333	351	797	1170			1315		
Direction, Lane #												
	EB 1	WB 1	NB 1	SB 1								
Volume Total	18	37	258	418								
Volume Left	5	12	7	29								
Volume Right	4	22	17	7								
cSH	382	515	1170	1315								
Volume to Capacity	0.05	0.07	0.01	0.02								
Queue Length 95th (m)	1.1	1.7	0.1	0.5								
Control Delay (s)	14.9	12.5	0.3	0.8								
Lane LOS	B	B	A	A								
Approach Delay (s)	14.9	12.5	0.3	0.8								
Approach LOS	B	B										
Intersection Summary												
Average Delay			1.5									
Intersection Capacity Utilization			44.1%	ICU Level of Service	A							
Analysis Period (min)			15									

Appendix C

Background Traffic Growth Analysis

Carp/ March
8 hrs

Year	Date	North Leg		South Leg		East Leg		West Leg		Total
		SB	NB	NB	SB	WB	EB	EB	WB	
2006	Monday 8 May	1381	1377	1944	1897					6599
2008	Tuesday 3 June	1185	1397	1951	1720					
2009	Tuesday 16 June 2009	1286	1801	2220	1552					6859
2011	Thursday 30 June	1184	1359	1810	1580					5933
2013	Tuesday 20 August	1730	1770	2216	2078					7794

Year	Counts				% Change			
	NB	SB	NB+SB	INT	NB	SB	NB+SB	INT
2006	1377	1381	2758	6599				
2008	1397	1185	2582	0	1.5%	-14.2%	-6.4%	-100.0%
2009	1801	1286	3087	6859	28.9%	8.5%	19.6%	
2011	1359	1184	2543	5933	-24.5%	-7.9%	-17.6%	-13.5%
2013	1770	1730	3500	7794	30.2%	46.1%	37.6%	31.4%

Regression Estimate 2006 1402 1207 2610
 Regression Estimate 2013 1687 1508 3195
 Average Annual Change 2.68% 3.23% 2.93%

Year	Counts				% Change			
	EB	WB	EB+WB	INT	EB	WB	EB+WB	INT
2006				6599				
2008				0				-100.0%
2009				6859				
2011				5933				-13.5%
2013				7794				31.4%

Regression Estimate 2006
 Regression Estimate 2013
 Average Annual Change

Year	Counts				% Change			
	EB	WB	EB+WB	INT	EB	WB	EB+WB	INT
2006				6599				
2008				0				-100.0%
2009				6859				
2011				5933				-13.5%
2013				7794				31.4%

Regression Estimate 2006
 Regression Estimate 2013
 Average Annual Change

Year	Counts				% Change			
	NB	SB	NB+SB	INT	NB	SB	NB+SB	INT
2006	1944	1897	3841	6599				
2008	1951	1720	3671	0	0.4%	-9.3%	-4.4%	-100.0%
2009	2220	1552	3772	6859	13.8%	-9.8%	2.8%	
2011	1810	1580	3390	5933	-18.5%	1.8%	-10.1%	-13.5%
2013	2216	2078	4294	7794	22.4%	31.5%	26.7%	31.4%

Regression Estimate 2006 1953 1704 3657
 Regression Estimate 2013 2108 1831 3938
 Average Annual Change 1.09% 1.03% 1.07%

Carp/ March
AM Peak

Year	Date	North Leg		South Leg		East Leg		West Leg		Total
		SB	NB	NB	SB	WB	EB	EB	WB	
2006	Monday 8 May	261	141	194	396					992
2008	Tuesday 3 June	214	167	182	366					929
2009	Tuesday 16 June 2009	235	193	182	320					930
2011	Thursday 30 June	205	150	181	293					829
2013	Tuesday 20 August	225	177	193	349					944

Year	Counts				% Change			
	NB	SB	NB+SB	INT	NB	SB	NB+SB	INT
2006	141	261	402	992				
2008	167	214	381	929	18.4%	-18.0%	-5.2%	-6.4%
2009	193	235	428	930	15.6%	9.8%	12.3%	0.1%
2011	150	205	355	829	-22.3%	-12.8%	-17.1%	-10.9%
2013	177	225	402	944	18.0%	9.8%	13.2%	13.9%

Regression Estimate 2006 155 245 400
 Regression Estimate 2013 176 210 387
 Average Annual Change 1.81% -2.13% -0.49%

Year	Counts				% Change			
	EB	WB	EB+WB	INT	EB	WB	EB+WB	INT
2006				992				
2008				929				-6.4%
2009				930				0.1%
2011				829				-10.9%
2013				944				13.9%

Regression Estimate 2006
 Regression Estimate 2013
 Average Annual Change

Year	Counts				% Change			
	EB	WB	EB+WB	INT	EB	WB	EB+WB	INT
2006				992				
2008				929				-6.4%
2009				930				0.1%
2011				829				-10.9%
2013				944				13.9%

Regression Estimate 2006
 Regression Estimate 2013
 Average Annual Change

Year	Counts				% Change			
	NB	SB	NB+SB	INT	NB	SB	NB+SB	INT
2006	194	396	590	992				
2008	182	366	548	929	-6.2%	-7.6%	-7.1%	-6.4%
2009	182	320	502	930	0.0%	-12.6%	-8.4%	0.1%
2011	181	293	474	829	-0.5%	-8.4%	-5.6%	-10.9%
2013	193	349	542	944	6.6%	19.1%	14.3%	13.9%

Regression Estimate 2006 187 375 562
 Regression Estimate 2013 186 313 499
 Average Annual Change -0.05% -2.58% -1.70%

Carp/ March
PM Peak

Year	Date	North Leg		South Leg		East Leg		West Leg		Total
		SB	NB	NB	SB	WB	EB	EB	WB	
2006	Monday 8 May	171	255	407	200					1033
2008	Tuesday 3 June	214	167	182	366					929
2009	Tuesday 16 June 2009	170	407	547	202					1326
2011	Thursday 30 June	192	235	362	230					1019
2013	Tuesday 20 August	215	279	413	228					1135

Year	Counts				% Change			
	NB	SB	NB+SB	INT	NB	SB	NB+SB	INT
2006	255	171	426	1033				
2008	167	214	381	929	-34.5%	25.1%	-10.6%	-10.1%
2009	407	170	577	1326	143.7%	-20.6%	51.4%	42.7%
2011	235	192	427	1019	-42.3%	12.9%	-26.0%	-23.2%
2013	279	215	494	1135	18.7%	12.0%	15.7%	11.4%

Regression Estimate 2006 255 177 432
 Regression Estimate 2013 283 209 492
 Average Annual Change 1.50% 2.38% 1.87%

Year	Counts				% Change			
	EB	WB	EB+WB	INT	EB	WB	EB+WB	INT
2006				1033				
2008				929				-10.1%
2009				1326				42.7%
2011				1019				-23.2%
2013				1135				11.4%

Regression Estimate 2006
 Regression Estimate 2013
 Average Annual Change

Year	Counts				% Change			
	EB	WB	EB+WB	INT	EB	WB	EB+WB	INT
2006				1033				
2008				929				-10.1%
2009				1326				42.7%
2011				1019				-23.2%
2013				1135				11.4%

Regression Estimate 2006
 Regression Estimate 2013
 Average Annual Change

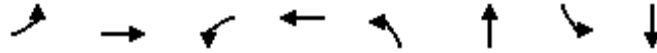
Year	Counts				% Change			
	NB	SB	NB+SB	INT	NB	SB	NB+SB	INT
2006	407	200	607	1033				
2008	182	366	548	929	-55.3%	83.0%	-9.7%	-10.1%
2009	547	202	749	1326	200.5%	-44.8%	36.7%	42.7%
2011	362	230	592	1019	-33.8%	13.9%	-21.0%	-23.2%
2013	413	228	641	1135	14.1%	-0.9%	8.3%	11.4%

Regression Estimate 2006 358 255 613
 Regression Estimate 2013 408 235 643
 Average Annual Change 1.89% -1.17% 0.68%

Appendix D

SYNCHRO Analysis: Projected Conditions

Projected AM
1: Carp & March



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	58	358	105	80	38	141	22	260
Lane Group Flow (vph)	61	524	111	93	40	206	23	306
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	21.0	21.0	21.0	21.0
Minimum Split (s)	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
Total Split (s)	51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
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	6.2	6.2	6.2	6.2
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)	22.0	22.0	22.0	22.0	22.1	22.1	22.1	22.1
Actuated g/C Ratio	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
v/c Ratio	0.13	0.77	0.54	0.14	0.10	0.30	0.05	0.45
Control Delay	11.3	22.8	23.8	10.5	14.6	13.7	14.1	16.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.3	22.8	23.8	10.5	14.6	13.7	14.1	16.7
LOS	B	C	C	B	B	B	B	B
Approach Delay		21.6		17.7		13.8		16.6
Approach LOS		C		B		B		B
Queue Length 50th (m)	3.7	41.3	8.1	5.3	2.5	11.9	1.4	21.3
Queue Length 95th (m)	10.3	78.0	23.2	13.2	9.8	32.7	6.5	52.3
Internal Link Dist (m)		511.9		443.6		1943.8		206.9
Turn Bay Length (m)	115.0		90.0		115.0		100.0	
Base Capacity (vph)	1006	1387	432	1423	797	1387	908	1422
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	0.06	0.38	0.26	0.07	0.05	0.15	0.03	0.22

Intersection Summary

Cycle Length: 102.4
 Actuated Cycle Length: 56.7
 Natural Cycle: 60
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.77
 Intersection Signal Delay: 18.4
 Intersection Capacity Utilization 86.1%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 1: Carp & March

51.2 s	51.2 s
51.2 s	51.2 s

Projected AM
2: Carp & McGee Side



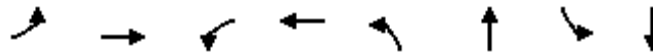
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	0	7	12	7	44	6	365	5	6	255	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	4	0	7	13	7	46	6	384	5	6	268	7
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type												
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	734	687	272	692	688	387	276			389		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	734	687	272	692	688	387	276			389		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	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 %	99	100	99	96	98	93	100			99		
cM capacity (veh/h)	305	366	767	352	365	661	1287			1169		
Direction, Lane #												
	EB 1	WB 1	NB 1	SB 1								
Volume Total	12	66	396	282								
Volume Left	4	13	6	6								
Volume Right	7	46	5	7								
cSH	494	526	1287	1169								
Volume to Capacity	0.02	0.13	0.00	0.01								
Queue Length 95th (m)	0.5	3.3	0.1	0.1								
Control Delay (s)	12.5	12.8	0.2	0.2								
Lane LOS	B	B	A	A								
Approach Delay (s)	12.5	12.8	0.2	0.2								
Approach LOS	B	B										
Intersection Summary												
Average Delay			1.5									
Intersection Capacity Utilization			34.7%	ICU Level of Service	A							
Analysis Period (min)			15									

Projected AM
9: Carp & Site



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	20	20	115	214	386	115
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	21	21	121	225	406	121
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type						
None						
None						
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	934	467	527			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	934	467	527			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	92	96	88			
cM capacity (veh/h)	261	596	1040			
Direction, Lane #						
	EB 1	NB 1	SB 1			
Volume Total	42	346	527			
Volume Left	21	121	0			
Volume Right	21	0	121			
cSH	363	1040	1700			
Volume to Capacity	0.12	0.12	0.31			
Queue Length 95th (m)	3.0	3.0	0.0			
Control Delay (s)	16.2	3.9	0.0			
Lane LOS	C	A				
Approach Delay (s)	16.2	3.9	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			2.2			
Intersection Capacity Utilization			60.8%	ICU Level of Service		B
Analysis Period (min)			15			

Projected PM
1: Carp & March



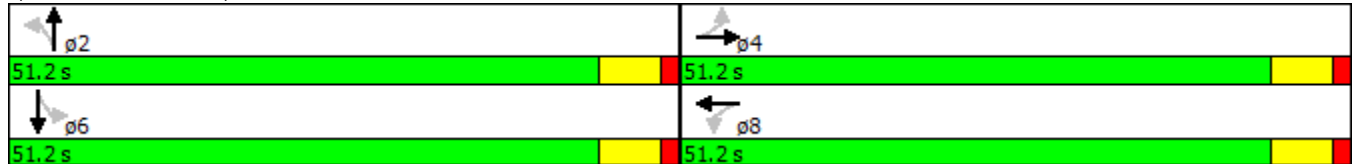
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	50	86	53	402	175	278	19	182
Lane Group Flow (vph)	53	135	56	440	184	369	20	248
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	21.0	21.0	21.0	21.0
Minimum Split (s)	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
Total Split (s)	51.2	51.2	51.2	51.2	51.2	51.2	51.2	51.2
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
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	6.2	6.2	6.2	6.2
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)	18.9	18.9	18.9	18.9	22.7	22.7	22.7	22.7
Actuated g/C Ratio	0.35	0.35	0.35	0.35	0.42	0.42	0.42	0.42
v/c Ratio	0.23	0.22	0.13	0.71	0.41	0.50	0.05	0.34
Control Delay	15.2	10.8	12.7	22.1	16.3	15.5	12.4	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.2	10.8	12.7	22.1	16.3	15.5	12.4	12.9
LOS	B	B	B	C	B	B	B	B
Approach Delay		12.0		21.1		15.7		12.9
Approach LOS		B		C		B		B
Queue Length 50th (m)	3.3	6.5	3.4	33.7	11.1	22.1	1.0	13.2
Queue Length 95th (m)	11.3	18.2	10.7	69.8	33.4	57.8	5.4	36.9
Internal Link Dist (m)		511.9		443.6		2479.8		206.9
Turn Bay Length (m)	115.0		90.0		115.0		100.0	
Base Capacity (vph)	558	1445	1016	1506	916	1470	753	1466
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	0.09	0.09	0.06	0.29	0.20	0.25	0.03	0.17

Intersection Summary

Cycle Length: 102.4
 Actuated Cycle Length: 54.3
 Natural Cycle: 55
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.71
 Intersection Signal Delay: 16.5
 Intersection Capacity Utilization 89.9%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 1: Carp & March



Projected PM
2: Carp & McGee Side



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	7	9	5	12	4	29	8	285	18	39	518	12
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	7	9	5	13	4	31	8	300	19	41	545	13
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type												
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	993	969	552	970	966	309	558			319		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	993	969	552	970	966	309	558			319		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	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 %	96	96	99	94	98	96	99			97		
cM capacity (veh/h)	206	243	534	216	244	731	1013			1241		
Direction, Lane #												
	EB 1	WB 1	NB 1	SB 1								
Volume Total	22	47	327	599								
Volume Left	7	13	8	41								
Volume Right	5	31	19	13								
cSH	261	403	1013	1241								
Volume to Capacity	0.08	0.12	0.01	0.03								
Queue Length 95th (m)	2.1	3.0	0.2	0.8								
Control Delay (s)	20.1	15.1	0.3	0.9								
Lane LOS	C	C	A	A								
Approach Delay (s)	20.1	15.1	0.3	0.9								
Approach LOS	C	C										
Intersection Summary												
Average Delay			1.8									
Intersection Capacity Utilization			59.4%	ICU Level of Service	B							
Analysis Period (min)			15									

Projected PM
3: Carp & Site



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	70	130	45	443	252	25
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	74	137	47	466	265	26
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type						
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	839	278	292			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	839	278	292			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	77	82	96			
cM capacity (veh/h)	323	760	1270			
Direction, Lane #						
	EB 1	NB 1	SB 1			
Volume Total	211	514	292			
Volume Left	74	47	0			
Volume Right	137	0	26			
cSH	516	1270	1700			
Volume to Capacity	0.41	0.04	0.17			
Queue Length 95th (m)	14.9	0.9	0.0			
Control Delay (s)	16.7	1.1	0.0			
Lane LOS	C	A				
Approach Delay (s)	16.7	1.1	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			4.0			
Intersection Capacity Utilization		65.4%		ICU Level of Service		C
Analysis Period (min)			15			

Appendix E

Left-Turn Lane Warrant Analysis

	Design Speed	Advancing Traffic Volume (V_A)		Opposing Traffic Volume (V_O)		Left Turn Traffic Volume (V_L)		% of Left Turning Traffic		Warrant Left Turn Lane
		AM	PM	AM	PM	AM	PM	AM	PM	
Existing										
Carp/Site	90	329	488	501	277	115	45	35%	9%	Yes

Peak	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
	Warrant?											
AM	115	214			386	115	20		20			
PM	45	443			252	25	70		130			

