



1223 Michael Street, Suite 100, Ottawa, Ontario K1J 7T2
Tel: 613.738.4160 • Fax: 613.739.7105
www.delcan.com

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.

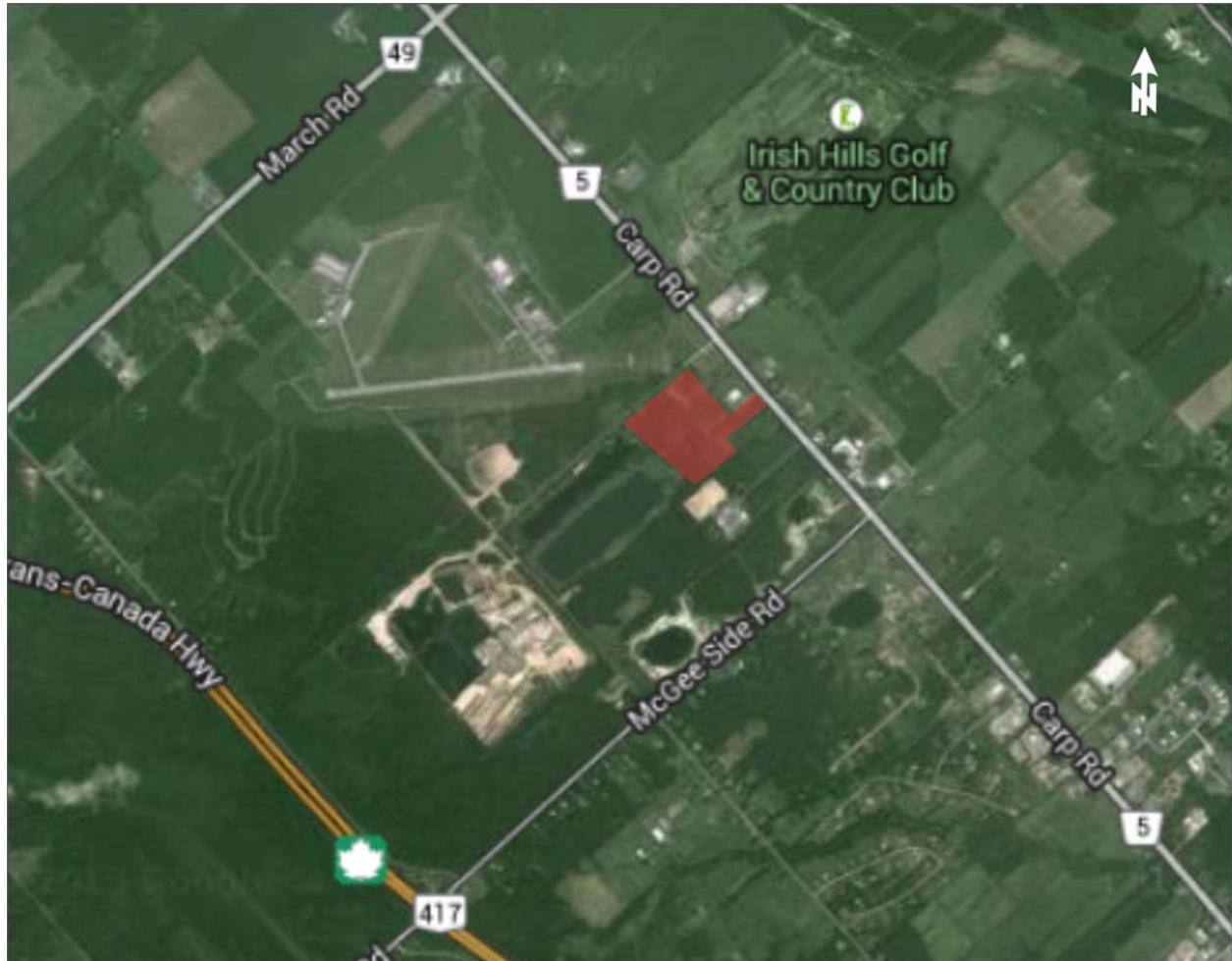
3.0 Existing Transportation Conditions

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

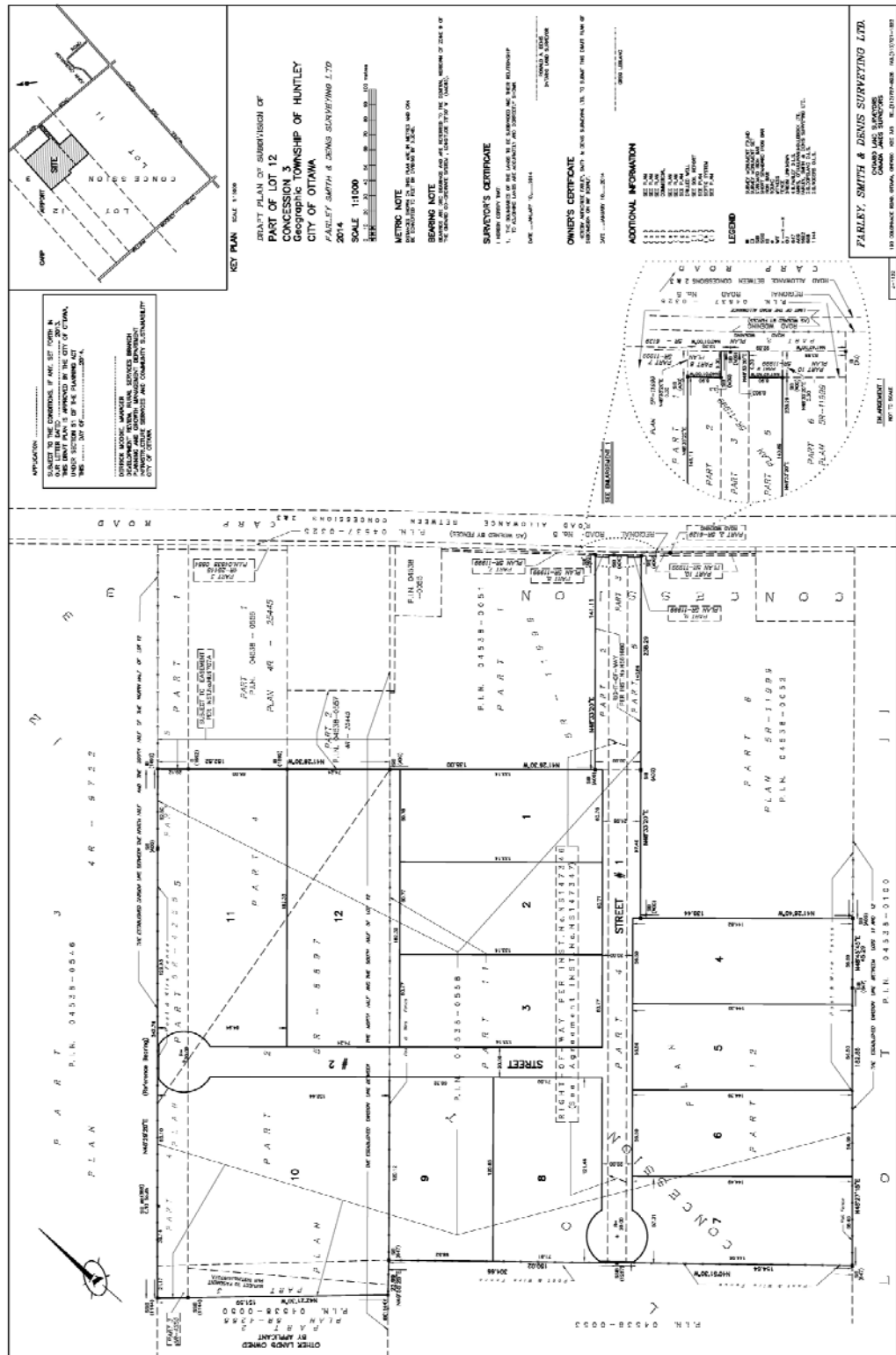


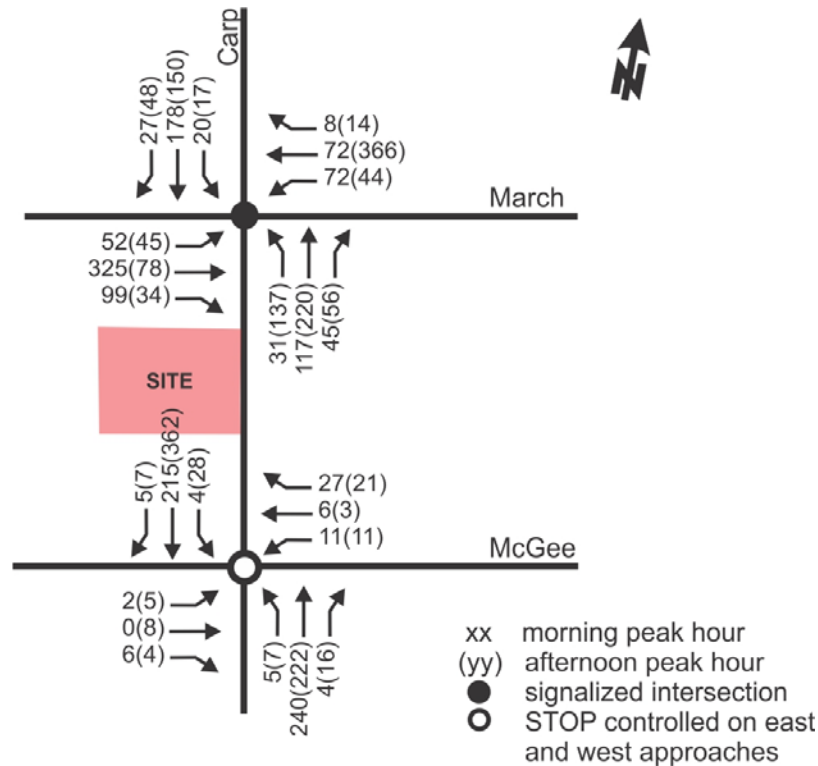
Figure 3: Existing Peak Hour Traffic

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. | | | | | | |

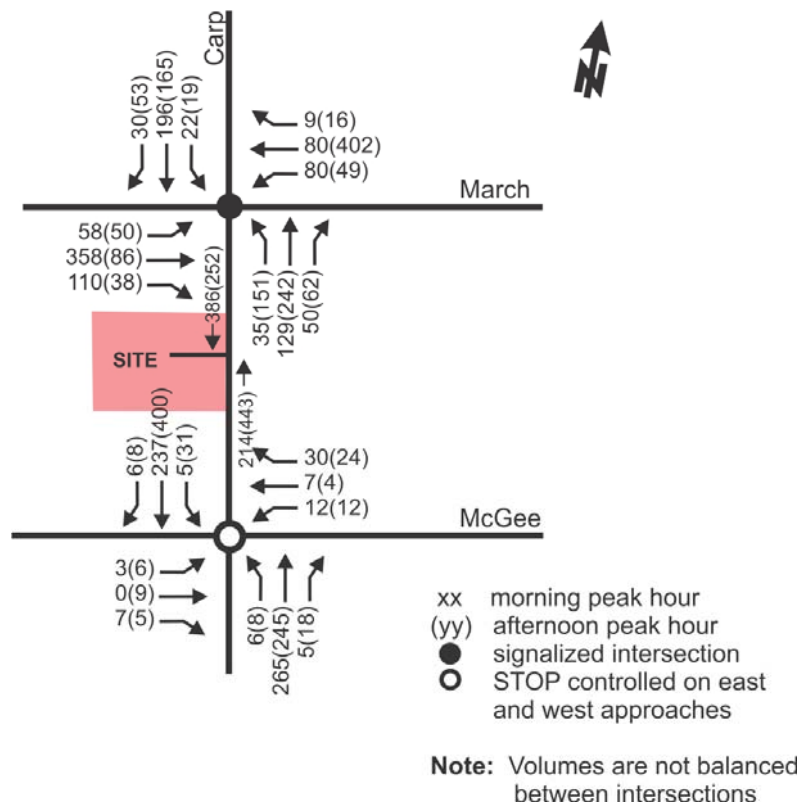
As shown in Table 1, the signalized Carp/March intersection 'as a whole' is currently operating at an excellent LoS 'A' during both the weekday morning and afternoon peak hours, with respect to the City of Ottawa operating standards of LoS 'D' or better ($0.90 > v/c > 0.00$). This is indicative of significant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

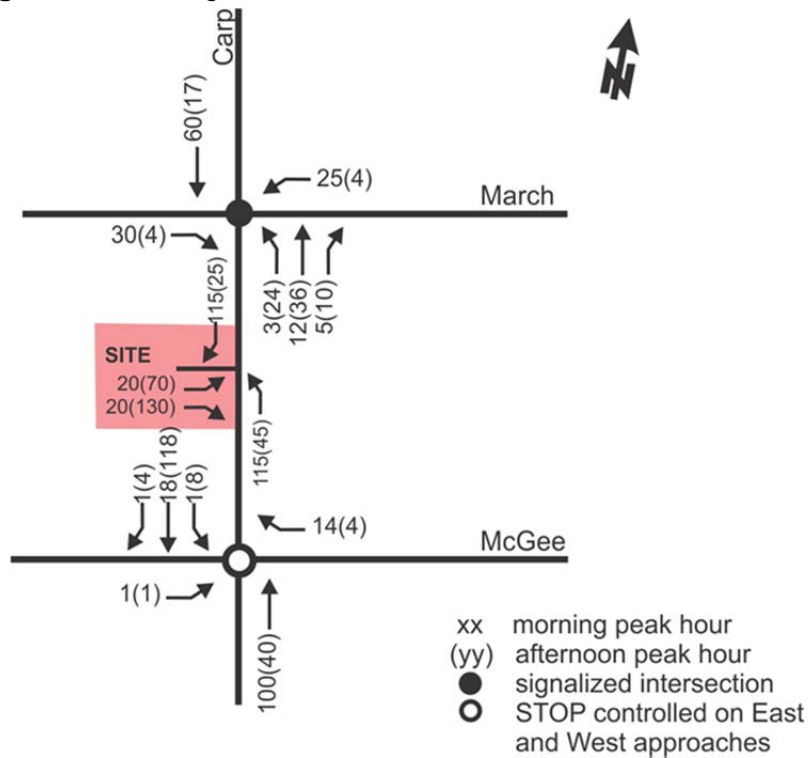
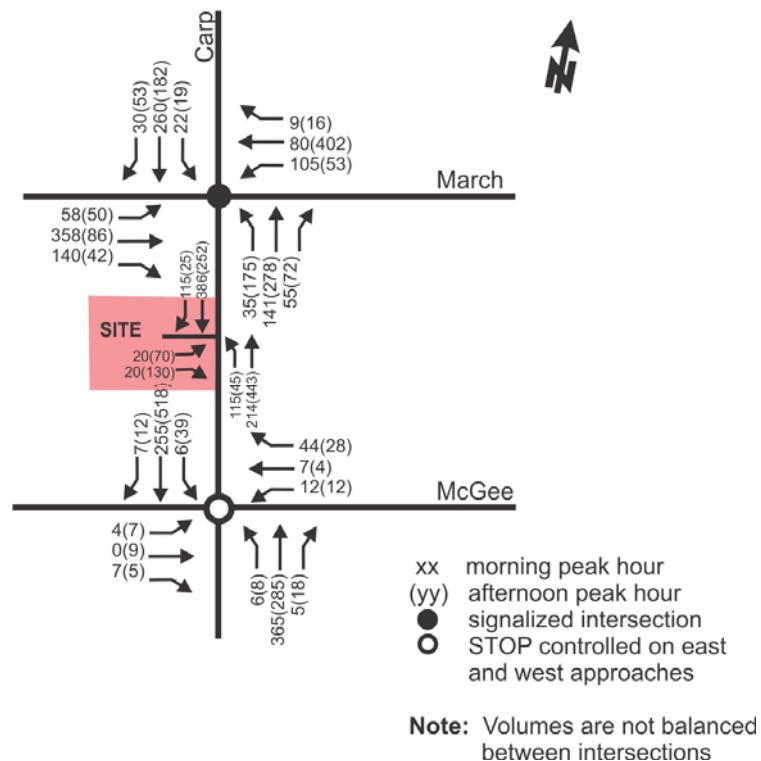


Figure 6: Total Projected Horizon Year Traffic Volumes



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

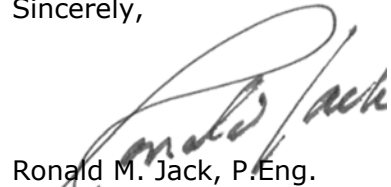
Based on the foregoing analysis, the findings, conclusions and recommendations of this Transportation Overview are as follows.

- 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", is written over the printed name.

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

Attachments

Appendix A

Current 2013 Traffic Counts

- Carp/March
- Carp/McGee Side

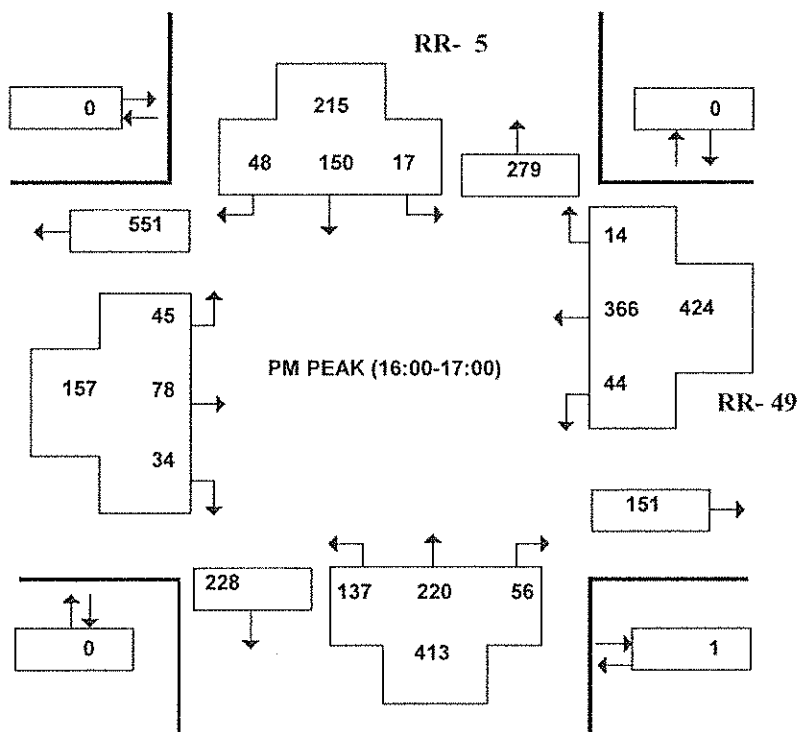
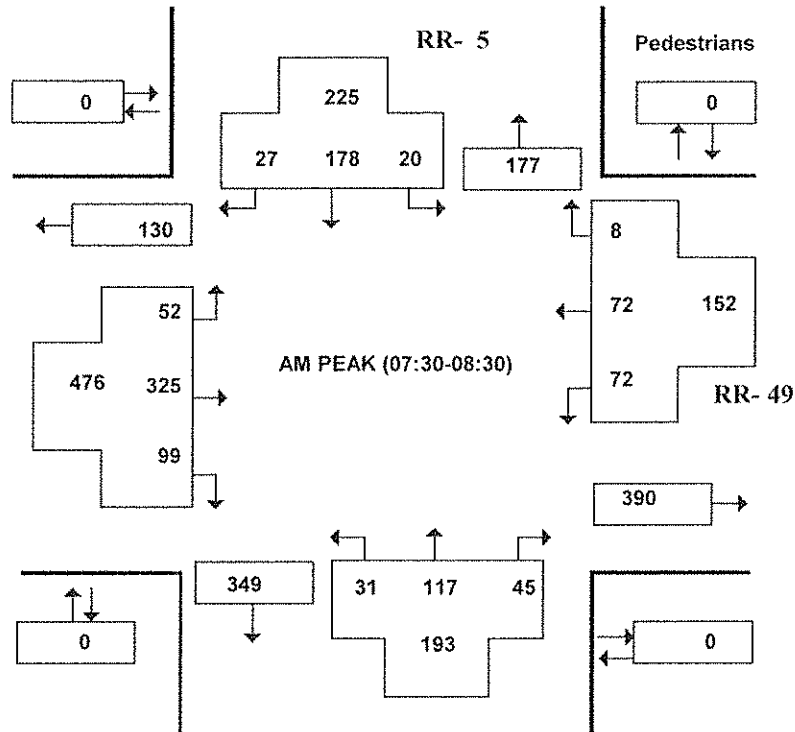
CARP RD and MARCH RD

(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

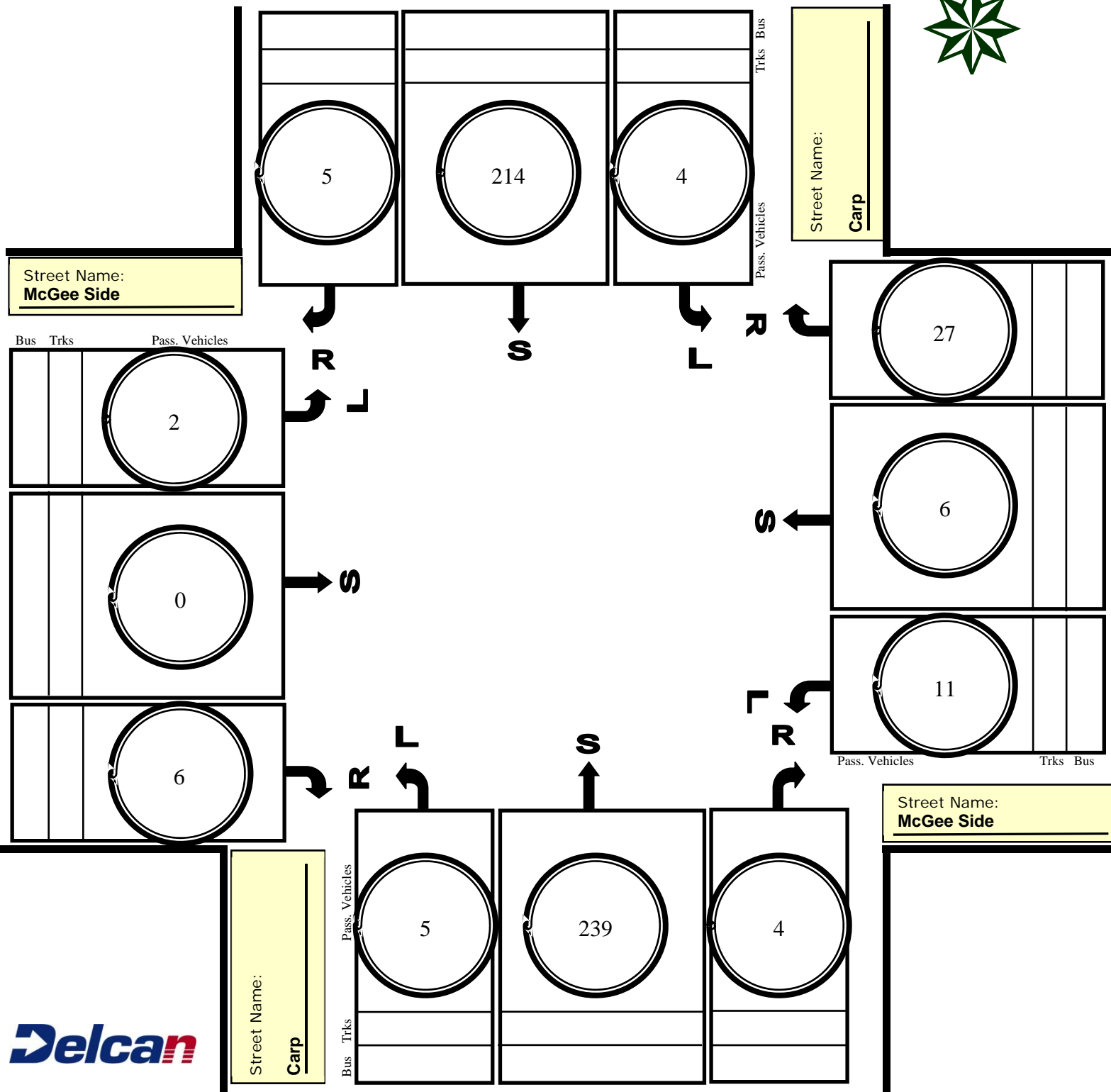
Chkd by: _____ Date: _____

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

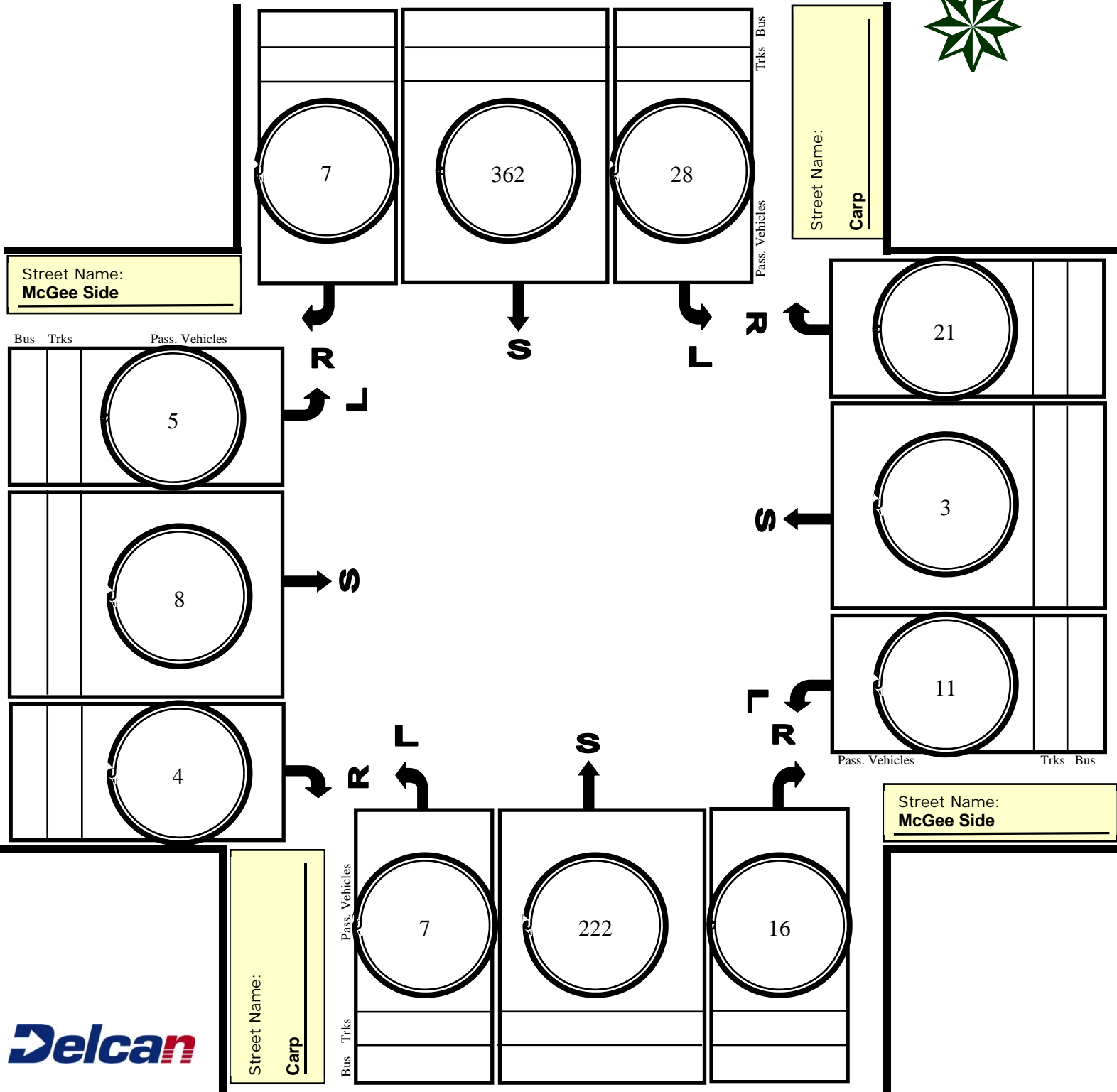
Observer: Cathie Lytle Weather: Clear

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.

















N







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 | | | | | | | | None | | | None | |
| 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 LOS: B | | | |
| Intersection Capacity Utilization 85.2% | | | | | ICU Level of Service E | | | |
| Analysis Period (min) 15 | | | | | | | | |

Splits and Phases: 1: Carp & March

| | |
|---|---|
|  |  |
| 51.2 s | 51.2 s |
|  |  |
| 51.2 s | 51.2 s |

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 | | | | | | | | None | | | None | |
| 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 |

North Leg

| 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%

West Leg

| 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

East Leg

| 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

South Leg

| 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 |

North Leg

| 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%

West Leg

| 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

East Leg

| 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

South Leg

| 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 |

North Leg

| 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%

West Leg

| 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

East Leg

| 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

South Leg

| 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 LOS: B | | | |
| Intersection Capacity Utilization 86.1% | | | | | ICU Level of Service E | | | |
| Analysis Period (min) 15 | | | | | | | | |










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 | | | | | | | | None | | | None | |
| 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 | | | |
| IC, single (s) | 6.4 | 6.2 | 4.1 | | | |
| IC, 2 stage (s) | | | | | | |
| IF (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 LOS: B | | | |
| Intersection Capacity Utilization 89.9% | | | | | ICU Level of Service E | | | |
| Analysis Period (min) 15 | | | | | | | | |










Splits and Phases: 1: Carp & March

| | |
|---|---|
|  |  |
| 51.2 s | 51.2 s |
|  |  |
| 51.2 s | 51.2 s |

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 | | | | | | | | None | | | None | |
| 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 | | | | None | None | |
| 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 | | | |
| IC, single (s) | 6.4 | 6.2 | 4.1 | | | |
| IC, 2 stage (s) | | | | | | |
| IF (s) | 3.5 | 3.3 | 2.2 | | | |
| p0 queue free % | 77 | 82 | 96 | | | |
| cMI 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

| Existing | | | | | | | | | | | |
|--------------|--|-----|---|-----|--|-----|---------------------------|-----|------------------------|-----|--|
| 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 | | | |
| 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 | | | |

