

**PARSONS**

# **Transportation & Traffic Analysis Final Report**

## **Major Mackenzie Drive Improvements Municipal Class Environmental Assessment**

**July 2018**

**Prepared for:  
The Regional Municipality of York  
17250 Yonge Street  
Newmarket, ON  
L3Y 6Z1**



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July 30, 2018

Our Ref: [476323]

The Regional Municipality of York  
17250 Yonge Street  
Newmarket, ON, Canada  
L3Y 6Z1

**Re: Major Mackenzie Drive Environmental Assessment – Transportation & Traffic  
Analysis Final Report**

We are pleased to provide you (1) pdf copy of the completed Transportation and Traffic Analysis Final Report as part of the Major Mackenzie Drive Class Environmental Assessment (EA) study between Highway 400 and Jane Street.

If you would like any additional information or further clarifications on any aspect of our submission, please contact the undersigned at (905) 943-0575

Yours truly,

**Yannis Stogios, P. Eng.**  
Senior Project Manager

## Report Prepared By:



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**Altaf Hussain, P. Eng.**  
Senior Transportation Engineer



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**Matthew Di Maria, C. Tech.**  
Traffic Technologist

## Report Reviewed By:

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**Yannis Stogios, P. Eng.**

### List of Revisions:

| VERSION | DATE           | DESCRIPTION             |
|---------|----------------|-------------------------|
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| 2       | December 2017  | Draft Report for Review |
| 3       | May 2018       | Updated Draft Report    |
| 4       | July 2018      | Final Report            |
|         |                |                         |

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## 1. BACKGROUND

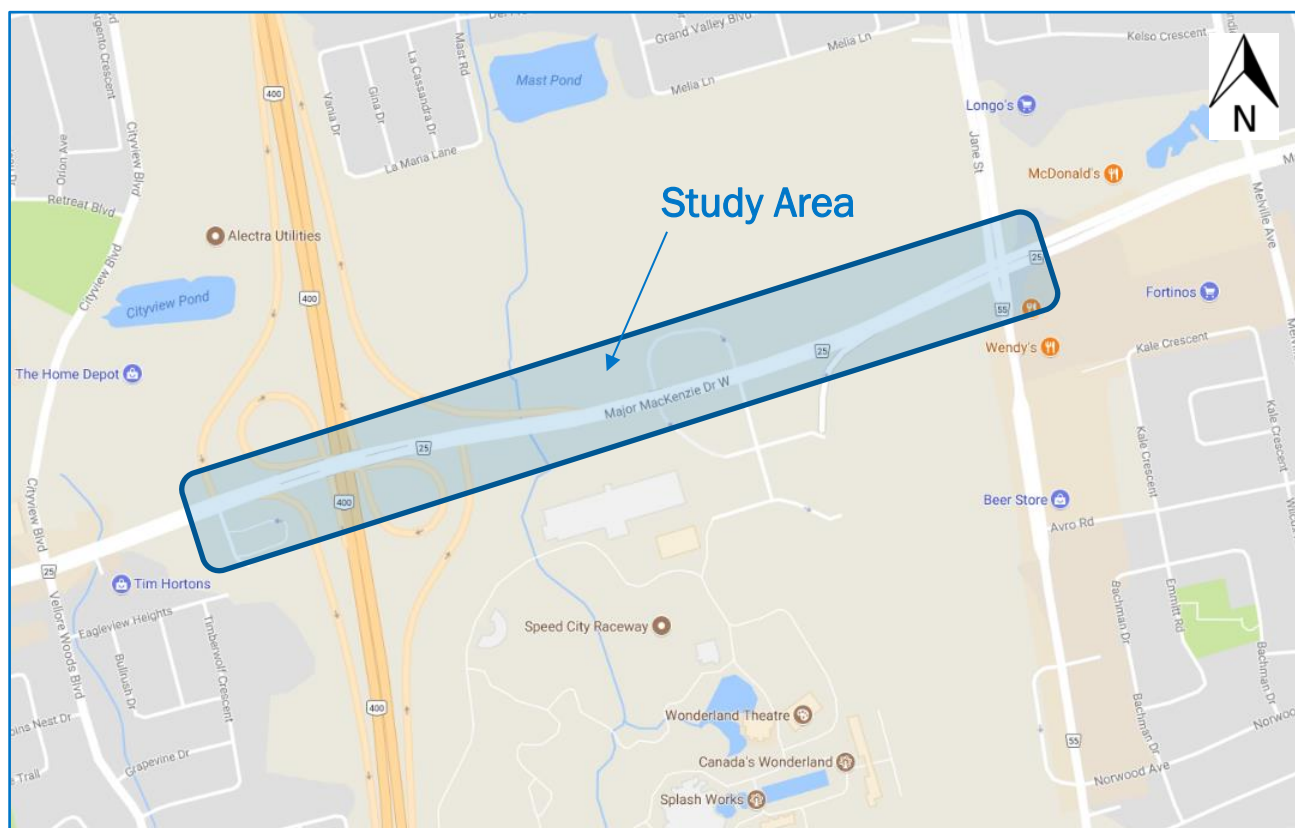
Parsons has been retained by the Regional Municipality of York to undertake a Municipal Class Environmental Assessment (EA) study to identify and assess future roadway improvements for Major Mackenzie Drive (Regional Road 25) between Highway 400 and Jane Street (Regional Road 55). Improvements for Major Mackenzie Drive have been identified in the York Region Transportation Master Plan (TMP) and this project is included in the York Region 2016 10-Year Roads and Transit Capital Construction Program.

The improvements are required in order to accommodate projected growth adjacent to the corridor including the Mackenzie Vaughan Hospital. The intention of the improvements will be to increase east-west lane capacity, improve connectivity and provide mobility options for multiple modes of transportation including transit, cycling and walking.

### 1.1 STUDY AREA

The project limits for the EA study include a section of approximately 1.1km of Major Mackenzie Drive from the Highway 400 west terminal interchange in the west to Jane Street (Regional Road 55) in the east. The study area corridor is currently adjacent to the future hospital, future transit hub and Canada’s Wonderland Amusement Park. The study area limits are presented in **Figure 1**. Within the study area, Major Mackenzie Drive is currently a four-lane east-west urban arterial road, which contains four signalized intersections.

**Figure 1: Traffic Analysis Study Area**



## 1.2 TRANSPORTATION ANALYSIS SCOPE

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The following tasks highlight the transportation and traffic analysis scope of work as part of the Major Mackenzie Drive Class EA Study:

- Summarize and review the existing traffic volumes provided by the Region;
- Undertake the existing Major Mackenzie Drive corridor capacity and intersection operation analysis to identify any operational issues;
- Conduct safety performance assessment based on the historical collisions to identify any safety-related concerns within the project limits;
- Review and assess the traffic impact study reports as provided by the Region and conducted for various developments in the study area;
- Estimate future traffic volumes using a general traffic growth rate, and potential traffic generation from the future land uses proposed in the proximity of the study limits;
- Undertake the Major Mackenzie Drive corridor capacity and intersection operation analysis using the future projected traffic volumes without improvements (Do Nothing Scenario) and identify the geometric improvements needed to improve the traffic flows along the study corridor; and
- Analyze the Major Mackenzie corridor with future traffic conditions and present the preferred future lane configurations for both the corridor and intersections.

All traffic analysis for this study was completed using guidelines identified in the York Region Transportation Mobility Plan Guidelines for Development Applications dated November 2016. Particular parameters regarding the highlighting of volume to capacity ratios (v/c) and levels of service include:

- An intersection where the overall v/c ratio exceeds 0.85 in urban areas;
- An individual movement v/c ratio exceeds 0.85 in urban areas;
- An exclusive turning movement lane in which queues exceed available storage; and
- Exclusive left and right turn lanes are inaccessible due to queue lengths within through lanes.

## 2. EXISTING (2016) TRAFFIC CONDITIONS

### 2.1 ANALYSIS APPROACH AND TOOLS

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The traffic analysis conducted for this study considers the capacity and level of service for individual intersections and mid-block sections along the study corridor. Intersections were analyzed using the procedures of the Highway Capacity Manual (HCM) methodologies for signalized and unsignalized intersections, as implemented in the Synchro / SimTraffic software developed by Trafficware.

Level of Service (LOS) is identified for each intersection approach and each lane group. Control delay alone is used to characterize LOS for the entire intersection or an approach. Control delay and volume-to-capacity (V/C) ratio are used to characterize LOS for a lane group. Delay quantifies the variations in travel time due to traffic signal control. It is also a surrogate measure of driver discomfort and fuel consumption. The volume-to-capacity (V/C) ratio quantifies the degree to which the capacity of each signal phase is utilized by a defined lane group.

**Table 1** summarizes the characteristics of each level of service at signalized intersections.



The LOS criteria for unsignalized intersections are somewhat different from the criteria for signalized intersections because perceptions of facility users differ. The expectation is that a signalized intersection is designed to carry higher traffic volumes and will present greater delay than an unsignalized intersection. Unsignalized intersections are also associated with more uncertainty for users, as delays are less predictable than at signalized junctions. This uncertainty can reduce driver’s delay tolerance. **Table 2** summarizes the characteristics of each level of service at unsignalized intersections.

**Table 1: Signalized Intersection Level of Service Characteristics**

| LEVEL OF SERVICE | FEATURES   | CONTROL DELAY (SEC/VEH) |
|------------------|--|-------------------------|
| A                | Describes operations with very low control delay, up to 10 seconds/ vehicle. This level of service occurs when progression is extremely favorable and most vehicles arrive during the green phase. Most vehicles do not stop at all at this LOS. Short cycle lengths may also contribute to low delay.   | ≤ 10                    |
| B                | Describes operations with control delay greater than 10 seconds and up to 20 seconds/vehicle. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop at this level than at LOS A, causing longer average delays.  | > 10 to 20              |
| C                | Describes operations with control delay greater than 20 seconds and up to 35 seconds/vehicle. These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant, though many still pass through the intersection without stopping.  | > 20 to 35              |
| D                | Describes operations with control delay greater than 35 seconds and up to 55 seconds/vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavourable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures become noticeable.                                      | > 35 to 55              |
| E                | Describes operations with control delay greater than 55 seconds and up to 80 seconds/vehicle. This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.   | > 55 to 80              |
| F                | <b>LOS F</b> describes operations with control delay in excess of 80 seconds/vehicle. This <i>oversaturation</i> , considered to be unacceptable to most drivers, occurs when arrival flow rates exceed the design capacity of the intersection. It may also occur at high v/c ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing factors to such high delay levels. | > 80                    |

Source: Highway Capacity Manual (HCM) 2000

Table 2: Unsignalized Intersection Level of Service Characteristics

| LEVEL OF SERVICE | EXPECTED DELAY TO MINOR STREET TRAFFIC   | AVERAGE CONTROL DELAY 'D' (SEC/VEH) |
|------------------|--|-------------------------------------|
| A                | Little or no delays  | $0 < D \leq 10$                     |
| B                | Short traffic delays   | $10 < D \leq 15$                    |
| C                | Average traffic delays   | $15 < D \leq 25$                    |
| D                | Long traffic delays  | $25 < D \leq 35$                    |
| E                | Very long traffic delays   | $35 < D \leq 50$                    |
| F                | Extreme delays with queuing which may cause congestion affecting other traffic movements in the intersection | $d > 50$                            |

Source: Highway Capacity Manual (HCM) 2000

Roadway corridor operations are generally assessed based on the lane capacity analysis. Lane capacity analysis at the mid-block sections are based on the ratio of the link volumes and theoretical lane capacity (V/C). **Table 3** shows planning level corridor LOS based on estimated V/C values.

Table 3: Lane Capacity Level of Service Characteristics

| VOLUMES TO CAPACITY RATIOS (V/C) | LOS    | GENERAL CONDITIONS                              |
|----------------------------------|--------|---|
| $< 0.75$                         | A to C | Stable flows with acceptable delays             |
| $\geq 0.75 < 0.85$               | D      | Approaching unstable flows and tolerable delays |
| $\geq 0.85 < 1.00$               | E      | Unstable flows and intolerable delays           |
| $\geq 1.00$                      | F      | Forced flows and significant delays             |

## 2.2 EXISTING (2016) TRAFFIC VOLUMES

Existing traffic volumes for the Jane Street and Amusement Drive intersections with Major Mackenzie Drive collected in 2016 provided by the York Region and Hwy 400 NB and Hwy SB Off-ramp intersections with Major Mackenzie Drive collected in May 2015 as received from Ministry of Transportation Ontario (MTO) on August 06, 2017 are included in **Appendix A**. A summary of the existing intersection volumes for the weekday AM and PM peak hours is shown in **Figure 2**.

The existing intersection volumes were collected in different months and years and these were adjusted by increasing through volumes to represent the existing (2016) levels of traffic. Traffic volumes for the Hwy 400 northbound and southbound on-ramps were determined based on the existing northbound and southbound off-

ramps volumes for the AM and PM peak hours. A summary of the adjusted existing (2016) intersection volumes is presented in **Figure 3**.

**Figure 2: Summary of Existing Intersection Volumes, AM and PM Peak Hours**

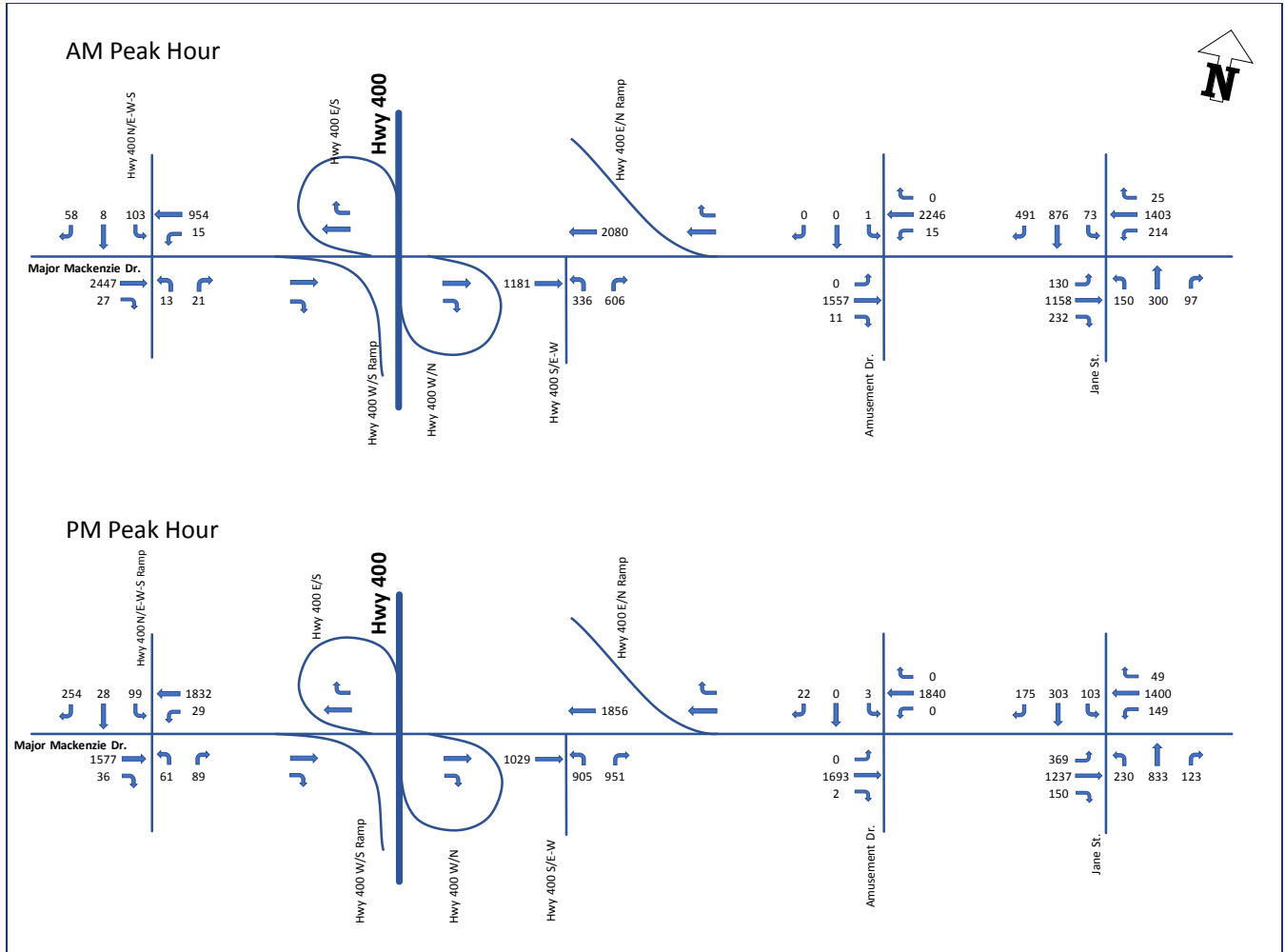
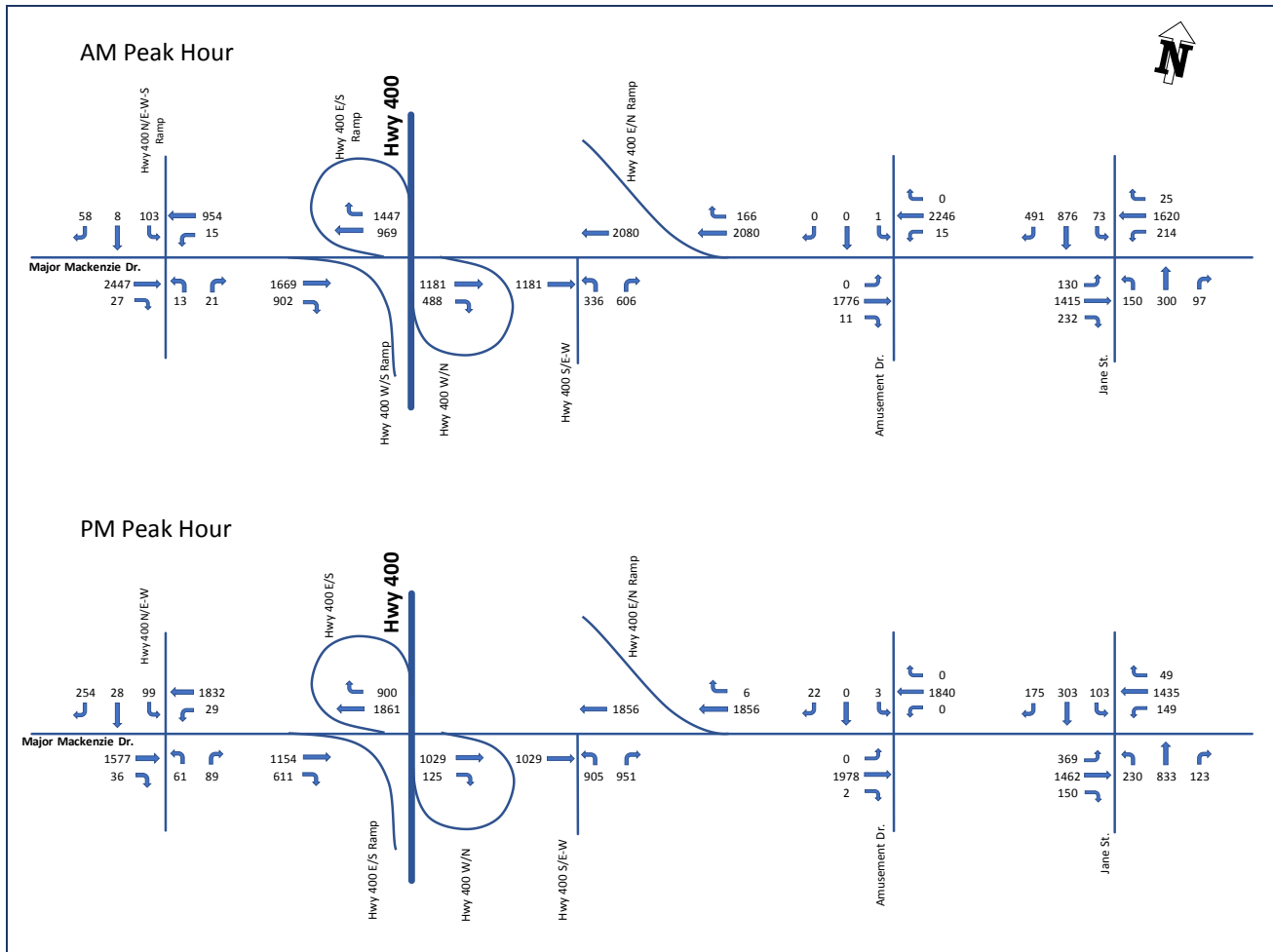
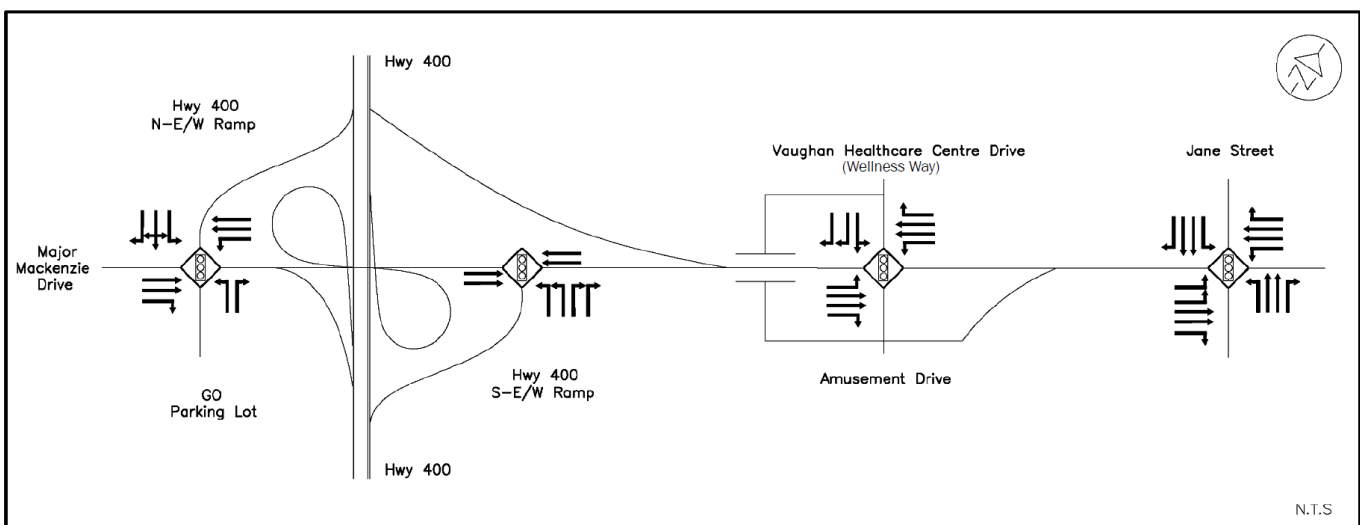


Figure 3: Summary of Adjusted Existing (2016) Intersection Volumes, AM and PM Peak Hours



The existing intersection lane configurations are shown in Figure 4.

Figure 4: Existing Intersection Lane Configurations



N.T.S

### 2.3 EXISTING (2016) TRAFFIC CONDITIONS, LANE CAPACITY ANALYSIS

Link volumes were estimated using the intersection entering and existing volumes at the mid-block sections. Lane capacity analysis for the existing traffic conditions were undertaken using the estimated mid-block link volumes and a theoretical lane capacity of 900 vehicles per hour per lane. The lane capacity analysis results for the existing (2016) conditions is presented in **Table 4**, for the AM and PM peak hours, respectively.

Table 4: Existing (2016) Lane Capacity Analysis, AM & PM Peak Hours

| Major Mackenzie Drive Section                          | Direction | No. of Lanes | Total Capacity | AM Peak Hour |      | PM Peak Hour |      |
|--|-----------|--------------|----------------|--------------|------|--------------|------|
|  |           |              |                | Volume*      | V/C  | Volume*      | V/C  |
| Immediately East of Jane Street                        | EB        | 2            | 1800           | 1590         | 0.88 | 1690         | 0.94 |
|  | WB        | 2            | 1800           | 1860         | 1.03 | 1630         | 0.91 |
| Between Jane Street and Amusement Drive                | EB        | 2            | 1800           | 1780         | 0.99 | 1980         | 1.10 |
|  | WB        | 2            | 1800           | 2260         | 1.26 | 1840         | 1.02 |
| Between Amusement Drive and Hwy 400 NB Off-ramp        | EB        | 2            | 1800           | 1780         | 0.99 | 1980         | 1.10 |
|  | WB        | 2            | 1800           | 2250         | 1.25 | 1980         | 1.10 |
| Between Hwy 400 NB Off-ramp and Hwy 400                | EB        | 2            | 1800           | 1180         | 0.66 | 1030         | 0.57 |
|  | WB        | 2            | 1800           | 2420         | 1.34 | 2760         | 1.53 |
| Between Hwy 400 and Hwy 400 SB Off-ramp/GO Parking Lot | EB        | 2            | 1800           | 2570         | 1.43 | 1770         | 0.98 |
|  | WB        | 2            | 1800           | 970          | 0.54 | 1860         | 1.03 |
| Immediately West of Hwy 400 SB Off-ramp/GO Parking Lot | EB        | 2            | 1800           | 2470         | 1.37 | 1610         | 0.89 |
|  | WB        | 2            | 1800           | 1030         | 0.57 | 2150         | 1.19 |

\* Volumes are rounded to nearest 10

x.xx Approaching Capacity

x.xx At or Above Capacity

As presented in **Table 4**, under the existing (2016) traffic conditions, there are multiple midblock sections within the study area that are operating at or above capacity in both the eastbound and westbound directions. Based on the results, additional capacity is required for the corridor.

### 2.4 EXISTING (2016) INTERSECTION OPERATIONS

Using the existing traffic volumes and signal timings received from the Region, operation analysis for the signalized intersections was completed within the corridor using the Synchro/SimTraffic for the AM and PM peak hours. Existing intersection signal timing plans received from the York Region are provided in **Appendix A**. Heavy vehicles information was used based on the existing volumes and no changes to the Synchro default input parameters such as peak hour factor (PHF = 0.92), lane utilization factor and saturated flow rate were made. Intersection movements with LOS E and worse and/or with V/C greater than 0.85 are presented.

The results of the Synchro analysis completed for the existing (2016) AM and PM peak hours are provided in **Table 5** for the study area signalized intersections. The Synchro output sheets for intersection operation analysis are provided in **Appendix B**.

Table 5: Summary of Existing (2016) Traffic Conditions, AM and PM Peak Hours

| INTERSECTION   | APPROACH / MOVEMENT         |           | AM PEAK HOUR  |             | PM PEAK HOUR  |             |
|--|-----------------------------|-----------|---------------|-------------|---------------|-------------|
|  |                             |           | LOS(DELAY)    | V/C         | LOS( DELAY)   | V/C         |
| Major Mackenzie Drive / Jane Street                          | <b>Overall Intersection</b> |           | <b>F (96)</b> | <b>1.26</b> | <b>E (75)</b> | <b>1.02</b> |
|  | EB                          | 2Left     | E (75)        | 0.64        | F (160)       | 1.14        |
|  |                             | Thru      | F (86)        | 1.06        | E (64)        | 1.00        |
|  |                             | Right     | -             | -           | -             | -           |
|  | WB                          | Left      | F (219)       | 1.31        | F (92)        | 0.93        |
|  |                             | Thru      | F (135)       | 1.19        | F (86)        | 1.06        |
|  |                             | Right     | -             | -           | -             | -           |
|  | NB                          | Left      | F (171)       | 1.17        | -             | -           |
|  |                             | Thru      | -             | -           | E (73)        | 0.95        |
|  |                             | Right     | -             | -           | -             | -           |
|  | SB                          | Left      | -             | -           | E (64)        | 0.78        |
|  |                             | Thru      | E (61)        | 0.90        | -             | -           |
| Right  |                             | E (73)    | 0.91          | -           | -             |             |
| Major Mackenzie Drive / Amusement Drive - Wellness Way       | <b>Overall Intersection</b> |           | <b>A (5)</b>  | <b>0.79</b> | <b>A (5)</b>  | <b>0.73</b> |
|  | EB                          | Thru      | -             | -           | -             | -           |
|  |                             | Right     | -             | -           | -             | -           |
|  | WB                          | Left      | -             | -           | -             | -           |
|  |                             | Thru      | -             | -           | -             | -           |
|  | SB                          | Thru-left | E (64)        | 0.04        | -             | -           |
| Right  |                             | -         | -             | -           | -             |             |
| Major Mackenzie Drive / Hwy 400 NB Off-ramp                  | <b>Overall Intersection</b> |           | <b>C (31)</b> | <b>0.93</b> | <b>D (48)</b> | <b>0.99</b> |
|  | EB                          | Thru      | -             | -           | -             | -           |
|  | WB                          | Thru      | C (29)        | 0.96        | D (39)        | 0.96        |
|  | NB                          | 2Left     | -             | -           | E (58)        | 0.90        |
|  |                             | 2Right    | E (64)        | 0.88        | F (91)        | 1.05        |
| Major Mackenzie Drive / Hwy 400 SB Off-ramp - GO Parking Lot | <b>Overall Intersection</b> |           | <b>E (80)</b> | <b>1.04</b> | <b>C (29)</b> | <b>0.91</b> |
|  | EB                          | Thru      | F (110)       | 1.19        | C (28)        | 0.86        |
|  |                             | Right     | -             | -           | -             | -           |
|  | WB                          | Left      | -             | -           | -             | -           |
|  |                             | Thru      | -             | -           | C (25)        | 0.89        |
|  | NB                          | Left      | -             | -           | -             | -           |
|  |                             | Right     | -             | -           | -             | -           |
|  | SB                          | Left      | -             | -           | -             | -           |
|  |                             | Thru      | -             | -           | -             | -           |
| Right  |                             | -         | -             | -           | -             |             |

As presented in **Table 5**, the intersection of Major Mackenzie Drive and Jane Street is operating at a level of service ‘F’ during the AM peak hour and ‘E’ during the PM peak hour. The overall volume to capacity ratios for this intersection is greater than 1.00 during both peak hours. The majority of both the westbound and eastbound

approaches movements at this intersection are operating over capacity with LOS F. Both Hwy 400 NB and SB Off-ramps are operating at LOS E or better with the exception of the following individual movements at these intersections:

1. Northbound left turn movement in the PM peak hour and northbound right turn movement both in the AM and PM peak hours at the Hwy 400 NB Off-ramp intersection; and
2. Eastbound through movement at the Hwy 400 SB Off-ramp intersection in the AM peak hour.

### 3. SAFETY PERFORMANCE ASSESSMENT – COLLISION ANALYSIS

The Safety Performance Assessment completed as part of this study included a review of intersection and midblock collision data within the study area. The purpose of the review was to determine if there are any discernable collision trends that would require the implementation of mitigation measures or roadway improvements. Historical collision data for the study area intersections and mid-blocks was received from the York Region for the years 2011 to 2017 (7 years). A summary of the data is presented in **Table 6**.

Table 6: 2011 to 2017 Study Area Collision Summary

| INTERSECTION/<br>MIDBLOCK                               | COLLISION TYPE |                       |                        |             |          |           |     |                     |         |       | TOTAL | COLLISION<br>SHARE BY<br>LOCATION |
|---|----------------|-----------------------|------------------------|-------------|----------|-----------|-----|---------------------|---------|-------|-------|-----------------------------------|
|   | ANGLE          | ANGLE TURNING<br>LEFT | ANGLE TURNING<br>RIGHT | APPROACHING | REAR END | SIDESWIPE | SMV | TURNING<br>MOVEMENT | UNKNOWN | OTHER |       |                                   |
| at Hwy 400 SB<br>Off-ramp/Carpool<br>Lot                | 2              | 1                     | 1                      | 2           | 150      | 17        | 9   | 38                  | 26      | 1     | 247   | 91%                               |
| at Hwy 400 NB<br>Off-ramp                               | 2              | 0                     | 1                      | 1           | 35       | 2         | 3   | 2                   | 6       | 0     | 52    |                                   |
| at Amusement<br>Dr.                                     | 0              | 0                     | 0                      | 0           | 0        | 0         | 1   | 0                   | 0       | 0     | 1     |                                   |
| at Jane St.   | 26             | 7                     | 4                      | 2           | 150      | 26        | 11  | 19                  | 47      | 0     | 292   |                                   |
| btwn Hwy 400<br>SB Off-ramp &<br>Hwy 400 NB<br>Off-ramp | 0              | 0                     | 0                      | 1           | 9        | 1         | 3   | 0                   | 0       | 1     | 15    | 9%                                |
| btwn Hwy 400<br>NB Off-ramp &<br>Jane St.               | 1              | 0                     | 0                      | 1           | 33       | 3         | 1   | 1                   | 0       | 1     | 41    |                                   |
| Totals  | 31             | 8                     | 6                      | 7           | 377      | 49        | 28  | 60                  | 79      | 3     | 648   |                                   |
|   | 5%             | 1%                    | 1%                     | 1%          | 58%      | 8%        | 4%  | 9%                  | 12%     | 0%    | 100%  |                                   |

As illustrated in **Table 6**, a total of 648 collisions occurred within the study area based on the 7 years of historical data. Out of total recorded collisions, 592 (91%) occurred at the intersections and the remaining 56 (9%) occurred at midblock sections.

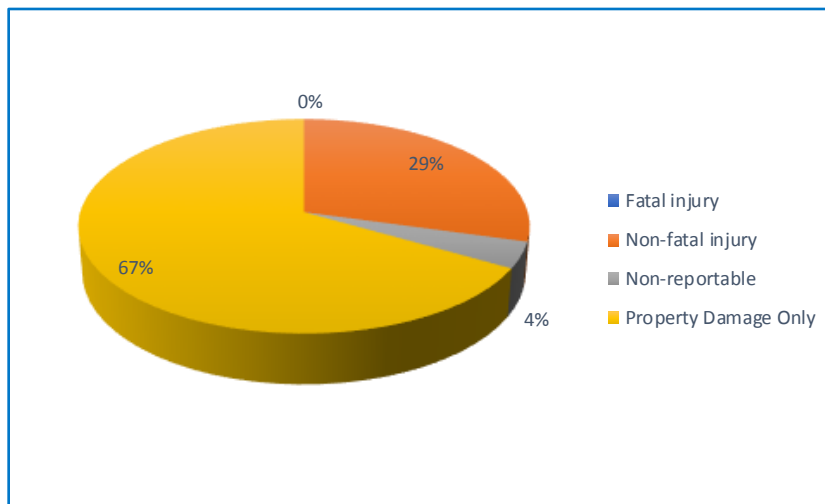
Rear-end collisions accounted for 58% of the total recorded while turning movement collisions accounted for 9%, sideswipe collisions 8%, and angle collisions made up 5% of the total collisions. It was noted that 12% of the collisions were recorded as unknown.



### 3.1 STUDY AREA COLLISIONS BY CLASSIFICATION

Based on the study area collisions by classification shown in **Figure 5**, 67% were recorded as property damage only collisions, 29% were non-fatal injury, and 4% were non-reportable. It should be noted that **Figure 5** provides details for a 3-year period. Within the total 7 years of collision data provided there were no fatal injuries reported.

Figure 5: Study Area Collisions by Classification (2015 to 2017)

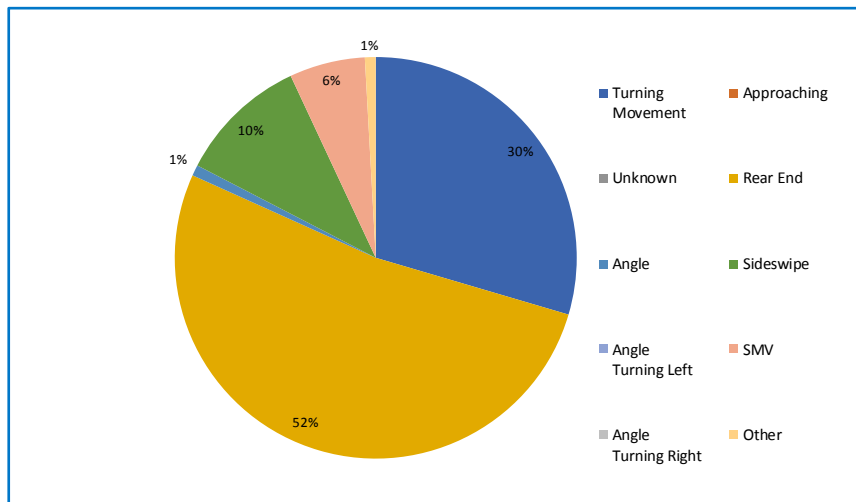


The initial collision review of the study area indicates a large percentage of the collisions occurred at the signalized intersections of Major Mackenzie Drive with the Highway 400 SB Off-ramp/Carpool Lot Entrance and Jane Street. These two intersections contained a significant amount of collisions with 247 (38%) and 292 (45%) collisions, respectively, which accounts for approximately 83% of the overall collisions within the study area. As a result, collisions at these intersections were reviewed in greater detail to identify any discernable collisions that could benefit from mitigation safety measures.

### 3.2 MAJOR MACKENZIE DRIVE AND HWY 400 SB OFF-RAMP/CARPOOL LOT

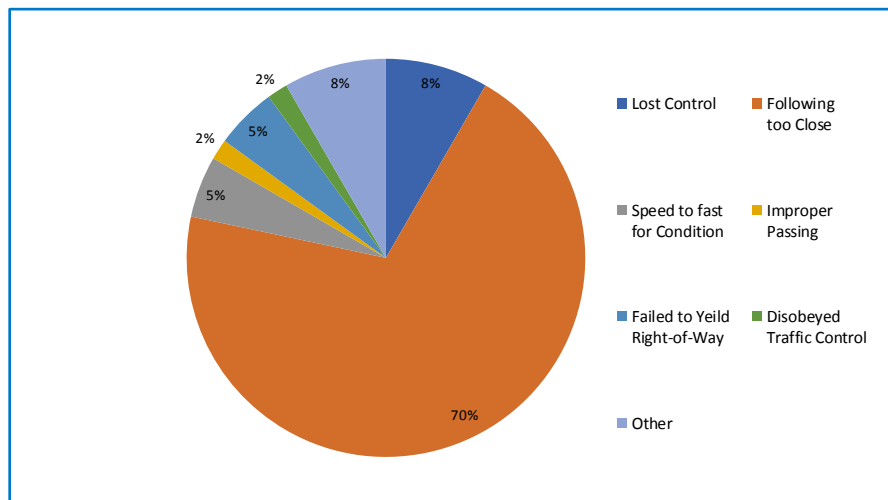
The signalized intersection of Major Mackenzie Drive and the Hwy 400 Off-ramp contained a total of 247 collisions over the 7 years. A review of collision details provided from 2015 to 2017 (3 years) revealed that 155 total collisions were reported for the intersection. Collision details were reviewed from 2015 to 2017 to identify if any collision trends were occurring at this intersection that could be mitigated through any intersection improvements. **Figure 6** presents a summary of the collisions by impact type at the Hwy 400 SB Off-ramp intersection.

Figure 6: Major Mackenzie Dr. & Hwy 400 SB Off-ramp/Carpool Lot - Collisions by Impact Type



As presented in **Figure 6**, 52% (60) of the 115 collisions between 2015 and 2017 were rear-end collisions while 30% (34) were turning movement collisions. 10% (12) of total collisions were sideswipes and 6% (7) were single motor vehicle collisions (SMV). Further investigation on the rear-end collisions that occurred at this intersection was undertaken to examine collisions by driver action as shown in **Figure 7**.

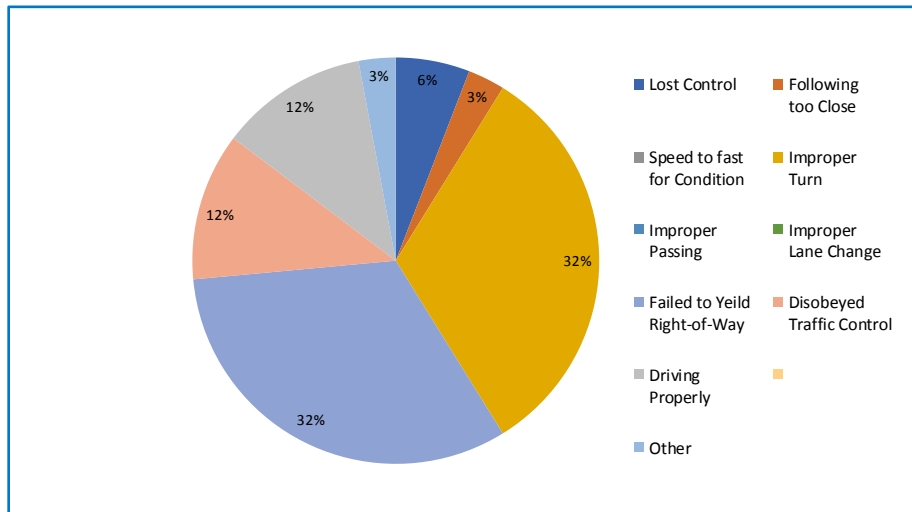
Figure 7: Major Mackenzie Dr. & Hwy 400 SB Off-ramp/Carpool Lot, Rear End Collisions by Driver Action



A closer look at the rear-end collisions presented in **Figure 7** indicates that approximately (70%) of the 60 total rear-end collisions between 2015 and 2017 (3 years) were the result of following too close.

Turning movement collisions at this intersection classified by driver action are shown in **Figure 8**.

Figure 8: Major Mackenzie Dr. & Hwy 400 SB Off-ramp/Carpool Lot, Turning Movement Collisions by Driver Action

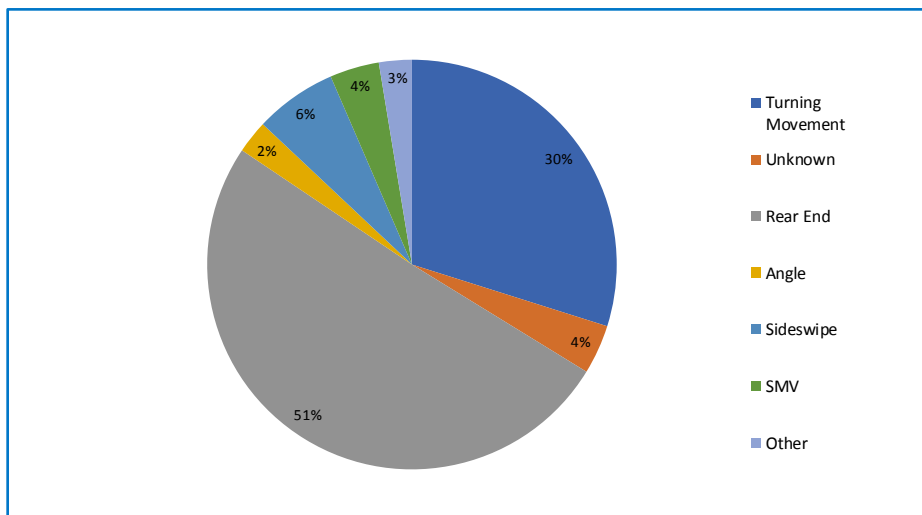


A review of the turning movement collisions by driver action shown in **Figure 8** indicates that 32% were the result of an improper turn at the intersection. 32% were the result of failing to yield right-of-way and only 12% were recorded as driving properly.

### 3.3 MAJOR MACKENZIE DRIVE AND JANE STREET

The signalized intersection of Major Mackenzie Drive and Jane Street experienced 292 collisions over the 7 years of historical data. The collision details available from 2015 to 2017 were reviewed to identify if any collision trends were occurring that could be mitigated through any improvements. There were a total of 77 collisions within the 2015 to 2017 period. **Figure 9** illustrates the details of collisions at this intersection by impact type.

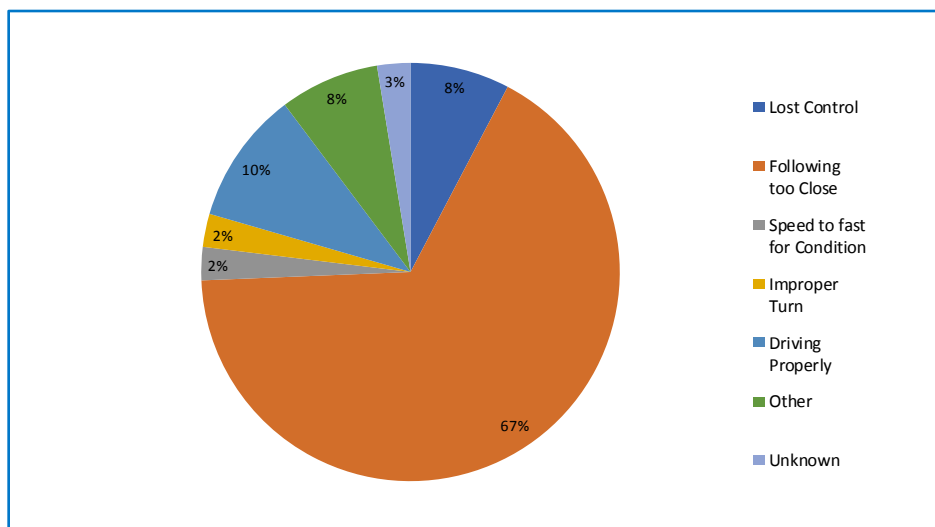
Figure 9: Major Mackenzie Drive & Jane Street – Collisions by Impact Type



As illustrated in **Figure 9**, 51% of the 77 collisions between 2015 and 2017 at the Jane Street intersection were rear-end collisions followed by 30% turning movement collisions. As a result of the high percentage of rear-end

and turning movement collisions, these were explored further to determine any trends which may require mitigation. **Figure 10** shows the details of rear-end collisions at this intersection by driver action.

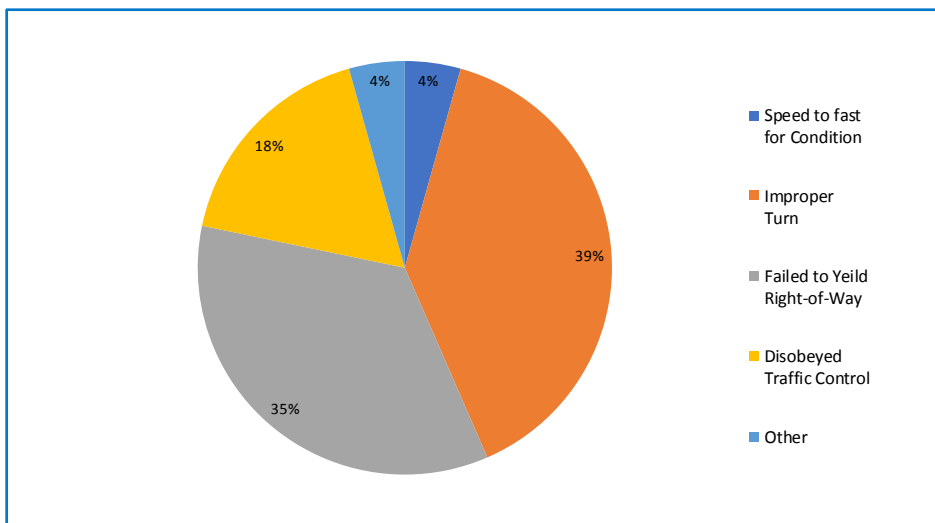
**Figure 10: Major Mackenzie Drive & Jane Street – Rear End Collisions by Driver Action**



A breakdown of the rear-end collisions by driver action presented in **Figure 10** indicates that 67% of those collisions were the result of drivers following too close. 10% of the total collisions were recorded as driving properly, with another 8% classified as lost control.

**Figure 11** illustrates the details of turning movement collisions at the Jane Street intersection by driver action.

**Figure 11: Major Mackenzie Drive & Jane Street – Turning Movement Collisions by Driver Action**



A review of the turning movement collisions by driver action presented in **Figure 11**, indicates that 39% were the result of an improper turn, 35 % were recorded as failing to yield right-of-way, and 18% were the result of disobeying traffic control.

### 3.4 COLLISIONS SUMMARY

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Based on a review of the study area collisions at intersections and midblock sections, it is concluded that there would appear to be a significant amount of congestion experienced within the study area. This congestion would explain the significant amount of rear-end collisions occurring within the study area where drivers are following too close. As drivers become impatient travelling through the study area they may become more aggressive to push through the area leaving little space between them and the vehicles ahead. This combined with frequent stop and go movements may explain these collisions.

Similarly, significant congestion throughout the study area could explain the amount of turning movement collisions where drivers have completed an improper turn. Due to the congestion, drivers could be more aggressive in performing their turn movements at intersections as adequate gaps may not be occurring within the stream of traffic along Major Mackenzie Drive.

Based on this safety analysis, driver behavior is the most significant contributor to the observed collisions. Infrastructure improvements to address existing collision experience are not recommended. However, infrastructure improvements that have the potential to reduce or at least maintain existing congestion levels should be considered for the future.

## 4. FUTURE (2041) TRAFFIC CONDITIONS

### 4.1 SUB-AREA EMME MODEL ANALYSIS AND ESTIMATION OF FUTURE TRAFFIC GROWTH

The Regional Municipality of York currently maintains a Travel Demand Forecasting Model for the AM peak period, based on the Emme software platform. The York Region Transportation Master Plan updated in June 2016 utilized this Emme model for its future forecasting. This forecasting model contains the York Region’s population and employment forecast to the 2041 horizon year. To develop the traffic growth rate for the study area, a subarea Emme model analysis for the Major Mackenzie corridor was undertaken. The Emme model plots from the York Region were requested for the 2016, 2021, 2031, and 2041 horizon years for the area bounded by Teston Road to the north, Rutherford Road to the south, Jane Street to the east and Weston Road to the west. Detailed model plots are provided in **Appendix C**.

In order to calculate the growth rate from the Emme model outputs, screenline analyses were undertaken. A screenline is an imaginary line that defines a broad corridor through which traffic flows. For the purpose of this exercise, a total of six north-south screenlines were assumed to capture the eastbound and westbound volumes for this analysis. The subarea screenline locations chosen were as follows:

- Immediately east of Jane Street;
- Between Jane Street and Amusement Drive;
- Between Amusement Drive and Hwy 400 NB Off-ramp;
- Between Hwy 400 NB Off-ramp and Hwy 400;
- Between Hwy 400 and Hwy 400 SB Off-ramp/GO Parking Lot; and
- Immediately West of Hwy 400 SB Off-ramp/GO Parking Lot.

Traffic growth rate estimation from the Emme model outputs for the screenlines and corridor are shown in **Tables 7** and **8**, respectively.

**Table 7: Screenline Based Traffic Growth Rate Estimation, Emme Model Outputs, AM Peak Hour**

| Year   | EB - Screenline Volumes* | WB - Screenline Volumes* | Total     |
|--|--------------------------|--------------------------|-----------|
| 2016   | 22787                    | 27071                    | 49858     |
| 2021   | 25731                    | 31254                    | 56985     |
| 2031   | 29884                    | 33312                    | 63196     |
| 2041   | 27586                    | 31233                    | 58819     |
| Growth Rate Per Annum btw 2016 & 2021            | 3%                       | 3%                       | 3%        |
| Growth Rate Per Annum btw 2021 & 2031            | 2%                       | 1%                       | 1%        |
| Growth Rate Per Annum btw 2031 & 2041            | -1%                      | -1%                      | -1%       |
| <b>Growth Rate Per Annum btw 2016 &amp; 2041</b> | <b>1%</b>                | <b>0.6%</b>              | <b>1%</b> |

\*North-South Screenlines drawn across Teston Rd, Major Mackenzie Dr and Rutherford Rd

**Table 8: Corridor Based Traffic Growth Rate Estimation, Emme Model Outputs, AM Peak Hour**

| Year   | EB - Screenline Volumes* | WB - Screenline Volumes* | Total     |
|--|--------------------------|--------------------------|-----------|
| 2016   | 7937                     | 9362                     | 17299     |
| 2021   | 10568                    | 11190                    | 21758     |
| 2031   | 10266                    | 10931                    | 21197     |
| 2041   | 9310                     | 10348                    | 19658     |
| Growth Rate Per Annum btw 2016 & 2021            | 7%                       | 4%                       | 5%        |
| Growth Rate Per Annum btw 2021 & 2031            | 0%                       | 0%                       | 0%        |
| Growth Rate Per Annum btw 2031 & 2041            | -1%                      | -1%                      | -1%       |
| <b>Growth Rate Per Annum btw 2016 &amp; 2041</b> | <b>1%</b>                | <b>0.4%</b>              | <b>1%</b> |

The Emme subarea screenline analysis shown in **Tables 7 and 8** indicate that auto volumes beyond a 2031 horizon year have been reduced due to the anticipated implementation of enhanced transit projects along Major Mackenzie Drive and Jane Street including the provision of HOV lanes along Major Mackenzie Drive. York Region is intending to implement enhanced transit service including along the Major Mackenzie Drive and Jane Street corridors to reduce auto volumes beyond 2031.

Based on the screenline analysis, a background growth rate of 1% per annum was used to establish the future (2041) traffic volumes in addition to the traffic volumes to be generated by the Vaughan Healthcare Centre and other developments that have been previously been approved by York Region in the proximity of the study area.

## **4.2 FUTURE APPROVED DEVELOPMENT TRAFFIC**

There are several approved developments planned both within and adjacent the study area which will create new trips along Major Mackenzie Drive. The traffic volumes forecasted for these developments were included in establishing the future total (2041) traffic volumes. The specific developments included are as follows:

- Vaughan Healthcare Centre - A future hospital and medical campus located on the lands north of Major Mackenzie Drive between Jane Street and the Highway 400 corridor;
- 77 Eagle Heights – A future residential development located on the southwest corner of Major Mackenzie Drive and Highway 400 including 202 townhouse units;
- Cicchino Development – A future mixed-use residential and commercial development located on the northwest corner of Major Mackenzie Drive West and Weston Road including 500 condominiums and townhouse units and 2,475 m2 retail GFA;
- Block 39 – A future residential development located on the southwest corner of Major Mackenzie Drive and Weston Road including 357 detached units and condominium units;
- Block 40 - A future mixed-use residential and commercial development located on the northwest corner of Major Mackenzie Drive and Weston Road including 2,157 detached units and condominium units and approximately 6,040 m2 retail GFA; and

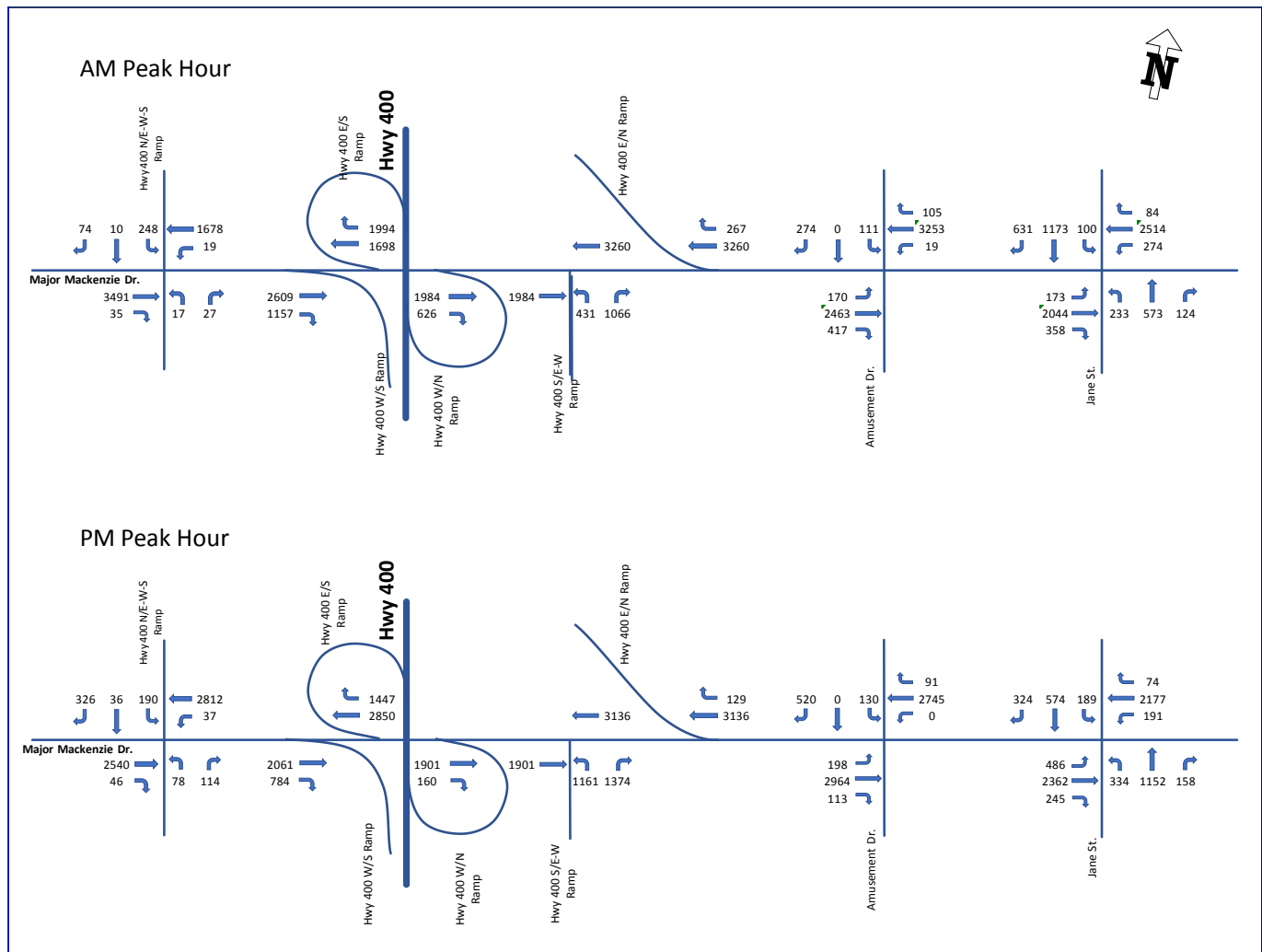
- Cambay Holding Development - A future mixed use retail development located on the northeast corner of Major Mackenzie Drive West and Cityview Boulevard including 6,810 m2 of retail, restaurant, and office GFA.

The site traffic volumes for each of the proposed developments provided by the York Region are presented in **Appendix D** for the weekday AM and PM peak hours.

### 4.3 FUTURE (2041) TOTAL TRAFFIC VOLUMES

The future (2041) traffic volumes were established by applying the 1% growth rate to the existing (2016) traffic volumes to create background (2041) traffic volumes. These volumes were then combined with the traffic generated from the other developments outlined in Section 4.2 (provided in **Appendix D**). It was estimated that the resulted combined traffic growth rate varied from 2% to 2.5% which seems an appropriate growth rate for the study area reflecting both background traffic growth and activity generated by planned local land uses and development. The resulting future total (2041) traffic volumes for the AM and PM peak hours are presented in **Figure 12**.

Figure 12: Future Total (2041) Traffic Volumes, AM and PM Peak Hours





#### 4.4 FUTURE (2041) TRAFFIC CONDITIONS LANE CAPACITY ANALYSIS, DO NOTHING ALTERNATIVE

A corridor lane capacity analysis for the future (2041) do nothing traffic conditions was undertaken using the estimated mid-block link volumes and a theoretical lane capacity of 900 vehicles per hour per lane. The lane capacity analysis results are presented in **Table 9**, for the AM and PM peak hours, respectively.

Table 9: Future (2041) Link Volume Analysis, AM & PM Peak Hours – Do Nothing Alternative

| Major Mackenzie Drive Section                          | Direction | No. of Lanes | Total Capacity | AM Peak Hour |      | PM Peak Hour |      |
|--|-----------|--------------|----------------|--------------|------|--------------|------|
|  |           |              |                | Volume*      | V/C  | Volume*      | V/C  |
| Immediately East of Jane Street                        | EB        | 2            | 1800           | 2290         | 1.27 | 2710         | 1.51 |
|  | WB        | 2            | 1800           | 2870         | 1.59 | 2440         | 1.36 |
| Between Jane Street and Amusement Drive                | EB        | 2            | 1800           | 2570         | 1.43 | 3090         | 1.72 |
|  | WB        | 2            | 1800           | 3380         | 1.88 | 2840         | 1.58 |
| Between Amusement Drive and Hwy 400 NB Off-ramp        | EB        | 2            | 1800           | 3050         | 1.69 | 3270         | 1.82 |
|  | WB        | 2            | 1800           | 3530         | 1.96 | 3270         | 1.82 |
| Between Hwy 400 NB Off-ramp and Hwy 400                | EB        | 2            | 1800           | 1980         | 1.10 | 1900         | 1.06 |
|  | WB        | 2            | 1800           | 3690         | 2.05 | 4300         | 2.39 |
| Between Hwy 400 and Hwy 400 SB Off-ramp/GO Parking Lot | EB        | 2            | 1800           | 3760         | 2.09 | 2850         | 1.58 |
|  | WB        | 2            | 1800           | 1700         | 0.94 | 2850         | 1.58 |
| Immediately West of Hwy 400 SB Off-ramp/GO Parking Lot | EB        | 2            | 1800           | 3530         | 1.96 | 2590         | 1.44 |
|  | WB        | 2            | 1800           | 1770         | 0.98 | 3120         | 1.73 |

\* Volumes are rounded to nearest 10

x.xx Approaching Capacity

x.xx At or Above Capacity

The results of the future (2041) do-nothing corridor lane capacity analysis presented in **Table 9** indicate capacity issues throughout the Major Mackenzie Drive corridor in both the eastbound and westbound directions. These results indicate that additional through lanes are required in order to accommodate future (2041) traffic demands.

#### 4.5 FUTURE TOTAL (2041) INTERSECTION OPERATIONS, DO NOTHING ALTERNATIVE

Capacity analyses for the signalized intersections within the corridor without any improvements were undertaken using the future (2041) traffic volumes for the AM and PM Peak hours. The peak hour factor was modified to 0.95 from 0.92 to represent the intensity of traffic congestion that is expected to be more widespread in the future and prevail over longer periods of time. The signal timing plans were optimized within the existing signal cycle lengths of 150 seconds for Amusement Drive and Jane Street intersections and 140 seconds for both the Hwy 400 NB and SB terminal ramps. The results of the Synchro analysis completed is summarized in **Table 10**. The Synchro output sheets are placed in **Appendix E**.

Table 10: Summary Future (2041) Intersection Operation, AM and PM Peak Hours – Do Nothing Alternative

| INTERSECTION   | APPROACH / MOVEMENT         |         | AM PEAK HOUR   |             | PM PEAK HOUR   |             |
|--|-----------------------------|---------|----------------|-------------|----------------|-------------|
|  |                             |         | LOS(DELAY)     | V/C         | LOS( DELAY)    | V/C         |
| Major Mackenzie Drive / Jane Street                          | <b>Overall Intersection</b> |         | <b>F (230)</b> | <b>1.83</b> | <b>F (230)</b> | <b>1.58</b> |
|  | EB                          | 2Left   | F (190)        | 1.15        | F (393)        | 1.69        |
|  |                             | Thru    | F (210)        | 1.37        | F (270)        | 1.50        |
|  |                             | Right   | -              | -           | -              | -           |
|  | WB                          | Left    | F (461)        | 1.87        | F (274)        | 1.44        |
|  |                             | Thru    | F (324)        | 1.62        | F (279)        | 1.52        |
|  |                             | Right   | -              | -           | -              | -           |
|  | NB                          | Left    | F (422)        | 1.78        | F (289)        | 1.49        |
|  |                             | Thru    | -              | -           | F (171)        | 1.24        |
|  |                             | Right   | -              | -           | -              | -           |
|  | SB                          | Left    | -              | -           | F (312)        | 1.51        |
|  |                             | Thru    | F (181)        | 1.26        | -              | -           |
| Right  |                             | F (226) | 1.35           | -           | -              |             |
| Major Mackenzie Drive / Amusement Drive - Wellness Way       | <b>Overall Intersection</b> |         | <b>F (105)</b> | <b>1.27</b> | <b>F (116)</b> | <b>1.31</b> |
|  | EB                          | Left    | F (249)        | 1.35        | F (264)        | 1.39        |
|  |                             | Thru    | D (40)         | 1.01        | F (105)        | 1.18        |
|  |                             | Right   | -              | -           | -              | -           |
|  | WB                          | Left    | -              | -           | -              | -           |
|  |                             | Thru    | F (168)        | 1.32        | F (137)        | 1.24        |
|  |                             | Right   | -              | -           | -              | -           |
| SB   | Thru-left                   | E (65)  | 0.61           | E (56)      | 0.44           |             |
|  | 2Right                      | E (63)  | 0.62           | E (76)      | 0.88           |             |
| Major Mackenzie Drive / Hwy 400 NB Off-ramp                  | <b>Overall Intersection</b> |         | <b>F (187)</b> | <b>1.52</b> | <b>F (205)</b> | <b>1.58</b> |
|  | EB                          | Thru    | C (34)         | 0.95        | D (38)         | 0.95        |
|  | WB                          | Thru    | F (269)        | 1.53        | F (295)        | 1.58        |
|  | NB                          | 2Left   | -              | -           | F (105)        | 1.10        |
|  |                             | 2Right  | F (277)        | 1.49        | F (317)        | 1.59        |
| Major Mackenzie Drive / Hwy 400 SB Off-ramp - GO Parking Lot | <b>Overall Intersection</b> |         | <b>F (230)</b> | <b>1.46</b> | <b>F (190)</b> | <b>1.29</b> |
|  | EB                          | Thru    | F (354)        | 1.73        | F (225)        | 1.42        |
|  |                             | Right   | -              | -           | -              | -           |
|  | WB                          | Left    | -              | -           | -              | -           |
|  |                             | Thru    | -              | -           | F (199)        | 1.38        |
|  | NB                          | Left    | -              | -           | -              | -           |
|  |                             | Right   | E (56)         | 0.02        | E (55)         | 0.08        |
|  | SB                          | Left    | E (58)         | 0.65        | E (60)         | 0.71        |
| Thru   |                             | E (60)  | 0.68           | E (56)      | 0.61           |             |
|  |                             | Right   | -              | -           | -              |             |

As presented in **Table 10**, all of the study area intersections are forecast to operate at a level of service ‘F’ with several critical movements during both peak hours under the future (2041) do nothing alternative.

#### 4.6 FUTURE (2041) TRAFFIC ANALYSIS SCENARIOS WITH IMPROVEMENTS, 6 LANES

For this analysis, the Major Mackenzie Drive corridor within study area was assumed to be 3 through lanes in each of the eastbound and westbound directions. As per York Region’s Transportation Master Plan recommendations, the additional lane in both the directions (curb lane) was assumed to be a high occupancy vehicle (HOV) and transit lane.

##### 4.6.1 FUTURE (2041) LANE CAPACITY ANALYSIS WITH IMPROVEMENTS, 6 LANES

The theoretical lane capacity of 900 vehicles/hour/lane was reduced to 600 vehicles/hour/lane for the HOV/transit lane. The lane capacity analysis for the link volumes for the future total (2041) traffic volumes were analyzed for the increased total capacity of 2,400 vehicles and the results of this analysis are presented in **Table 11**, for the AM and PM peak hours, respectively.

Table 11: Future (2041) Link Volume Analysis, AM & PM Peak Hours – With Improvements, 6 Lanes

| Major Mackenzie Drive Section                          | Direction | No. of Lanes | Total Capacity** | AM Peak Hour |      | PM Peak Hour |      |
|--|-----------|--------------|------------------|--------------|------|--------------|------|
|  |           |              |                  | Volume*      | V/C  | Volume*      | V/C  |
| Immediately East of Jane Street                        | EB        | 3            | 2400             | 2290         | 0.95 | 2710         | 1.13 |
|  | WB        | 3            | 2400             | 2870         | 1.20 | 2440         | 1.02 |
| Between Jane Street and Amusement Drive                | EB        | 3            | 2400             | 2570         | 1.07 | 3090         | 1.29 |
|  | WB        | 3            | 2400             | 3380         | 1.41 | 2840         | 1.18 |
| Between Amusement Drive and Hwy 400 NB Off-ramp        | EB        | 3            | 2400             | 3050         | 1.27 | 3270         | 1.36 |
|  | WB        | 3            | 2400             | 3530         | 1.47 | 3270         | 1.36 |
| Between Hwy 400 NB Off-ramp and Hwy 400                | EB        | 3            | 2400             | 1980         | 0.83 | 1900         | 0.79 |
|  | WB        | 3            | 2400             | 3690         | 1.54 | 4300         | 1.79 |
| Between Hwy 400 and Hwy 400 SB Off-ramp/GO Parking Lot | EB        | 3            | 2400             | 3760         | 1.57 | 2850         | 1.19 |
|  | WB        | 3            | 2400             | 1700         | 0.71 | 2850         | 1.19 |
| Immediately West of Hwy 400 SB Off-ramp/GO Parking Lot | EB        | 3            | 2400             | 3530         | 1.47 | 2590         | 1.08 |
|  | WB        | 3            | 2400             | 1770         | 0.74 | 3120         | 1.30 |

\* Volumes are rounded to nearest 10

|      |                      |      |                      |
|------|----------------------|------|----------------------|
| x.xx | Approaching Capacity | x.xx | At or Above Capacity |
|------|----------------------|------|----------------------|

As illustrated in **Table 11**, under the future (2041) traffic conditions (ultimate 25-year horizon) there will still be significant capacity issues throughout the Major Mackenzie corridor even with additional lane capacity improvements.

##### 4.6.2 FUTURE TOTAL (2041) INTERSECTION OPERATIONS WITH IMPROVEMENTS, 6 LANES

Intersection capacity analysis for the study area intersections using the future total (2041) traffic volumes and additional lane as HOV/transit along the Major Mackenzie Drive corridor was undertaken. It is a general practice in the York Region that auxiliary right turning lanes at the intersections with 3 through lanes cross section are not provided with the exception where these are warranted based on capacity constraints. Accordingly, shared

eastbound and westbound right turning lanes at the intersections along Major Mackenzie Drive were assumed in the operation analysis. The signal timing plans were optimized with the existing cycle lengths.

To assess the operation of the HOV/transit lane as part of through lane group within the Synchro software, lane utilization factors for the exclusive through and shared through lane with right turn lane groups were modified from 0.95 to 0.84 and from 0.91 to 0.81, respectively based on capacity reduction assumption noted in Section 4.6.1. because of the HOV lane implementation. This reduction in the lane utilization factors reflects the fact that general purpose lanes are expected to have higher volumes of traffic relative to the HOV lane. The results of this analysis are presented in **Table 12**. The Synchro analysis sheets are provided in **Appendix F**.

**Table 12: Intersection Operation – Future (2041) Traffic Conditions, AM and PM Peak Hours – With Improvements, 6 Lanes**

| INTERSECTION   | APPROACH / MOVEMENT         |           | AM PEAK HOUR   |             | PM PEAK HOUR   |             |
|--|-----------------------------|-----------|----------------|-------------|----------------|-------------|
|  |                             |           | LOS(DELAY)     | V/C         | LOS( DELAY)    | V/C         |
| Major Mackenzie Drive / Jane Street                    | <b>Overall Intersection</b> |           | <b>F (219)</b> | <b>1.65</b> | <b>F (206)</b> | <b>1.46</b> |
|  | EB                          | 2Left     | F (190)        | 1.15        | F (393)        | 1.69        |
|  |                             | Thru      | F (248)        | 1.44        | F (242)        | 1.44        |
|  |                             | Right     | -              | -           | -              | -           |
|  | WB                          | Left      | F (353)        | 1.63        | F (229)        | 1.33        |
|  |                             | Thru      | F (250)        | 1.45        | F (200)        | 1.33        |
|  |                             | Right     | -              | -           | -              | -           |
|  | NB                          | Left      | F (304)        | 1.52        | F (206)        | 1.32        |
|  |                             | Thru      | -              | -           | F (186)        | 1.28        |
|  |                             | Right     | -              | -           | -              | -           |
|  | SB                          | Left      | -              | -           | F (256)        | 1.38        |
|  |                             | Thru      | F (196)        | 1.30        | E (56)         | 0.77        |
| Right  |                             | F (173)   | 1.23           | -           | -              |             |
| Major Mackenzie Drive / Amusement Drive - Wellness Way | <b>Overall Intersection</b> |           | <b>D (53)</b>  | <b>1.04</b> | <b>D (46)</b>  | <b>1.01</b> |
|  | EB                          | Left      | F (132)        | 1.03        | F (113)        | 0.99        |
|  |                             | Thru      | C (22)         | 0.94        | C (25)         | 0.95        |
|  |                             | Right     | -              | -           | -              | -           |
|  | WB                          | Left      | -              | -           | -              | -           |
|  |                             | Thru      | E (74)         | 1.11        | E (60)         | 1.05        |
|  | SB                          | Thru-left | E (65)         | 0.61        | E (56)         | 0.45        |
| Right  |                             | E (62)    | 0.56           | E (72)      | 0.84           |             |
| Major Mackenzie Drive / Hwy 400 NB Off-ramp            | <b>Overall Intersection</b> |           | <b>F (116)</b> | <b>1.29</b> | <b>F (136)</b> | <b>1.36</b> |
|  | EB                          | Thru      | -              | -           | -              | -           |
|  | WB                          | Thru      | F (154)        | 1.27        | F (187)        | 1.34        |
|  | NB                          | 2Left     | -              | -           | E (62)         | 0.97        |
|  |                             | 2Right    | F (201)        | 1.32        | F (231)        | 1.40        |
| Major Mackenzie Drive /                                | <b>Overall Intersection</b> |           | <b>F (129)</b> | <b>1.18</b> | <b>E (79)</b>  | <b>1.07</b> |
|  | EB                          | Thru      | F (192)        | 1.37        | F (98)         | 1.14        |
|  |                             | Right     | -              | -           | -              | -           |

| INTERSECTION                         | APPROACH / MOVEMENT |       | AM PEAK HOUR |      | PM PEAK HOUR |      |
|--------------------------------------|---------------------|-------|--------------|------|--------------|------|
|                                      |                     |       | LOS(DELAY)   | V/C  | LOS( DELAY)  | V/C  |
| Hwy 400 SB Off-ramp - GO Parking Lot | WB                  | Left  | -            | -    | -            | -    |
|                                      |                     | Thru  | -            | -    | E (68)       | 1.08 |
|                                      | NB                  | Left  | -            | -    | -            | -    |
|                                      |                     | Right | E (56)       | 0.02 | E (55)       | 0.08 |
|                                      | SB                  | Left  | E (58)       | 0.65 | E (60)       | 0.71 |
|                                      |                     | Thru  | E (60)       | 0.68 | E (56)       | 0.61 |
| Right                                |                     | -     | -            | -    | -            |      |

As shown in **Table 12**, with the future (2041) improvements traffic scenario, the overall intersection operations have improved slightly at each of the study area intersections with the exception of the Jane Street intersection. This intersection will still operate approximately similar to Do Nothing Option in both the AM and PM peak hours. With regard to individual movements, however, several intersection movements are still forecast to operate at an overall level of service ‘F’ in both the peak hours.

**4.6.3 FUTURE (2041) INTERSECTION OPERATIONS WITH RIGHT TURNING LANE IMPROVEMENTS**

The capacity constraints noted for the eastbound and westbound through movements at both the Amusement Drive and Jane Street intersections outline a need for auxiliary right turning lanes at these intersections due to high right turning volumes. The addition of auxiliary right turn lanes would improve through traffic operations and will also help reduce rear-end collisions. Accordingly, future total (2041) traffic capacity analysis was repeated with the inclusion of eastbound and westbound right turning lanes at both the Jane Street and Amusement Drive intersections with Major Mackenzie Drive. The signal timing plans were optimized with the existing cycle lengths. The results of this analysis are presented in **Table 13**. The Synchro analysis sheets are provided in **Appendix G**.

Table 13: Intersection Operation – Future (2041) Traffic Conditions, AM and PM Peak Hours – With Right Turning Lane Improvements

| INTERSECTION                        | APPROACH / MOVEMENT         |       | AM PEAK HOUR   |             | PM PEAK HOUR   |             |
|-------------------------------------|-----------------------------|-------|----------------|-------------|----------------|-------------|
|                                     |                             |       | LOS(DELAY)     | V/C         | LOS( DELAY)    | V/C         |
| Major Mackenzie Drive / Jane Street | <b>Overall Intersection</b> |       | <b>F (160)</b> | <b>1.66</b> | <b>F (158)</b> | <b>1.51</b> |
|                                     | EB                          | 2Left | F (190)        | 1.15        | F (337)        | 1.57        |
|                                     |                             | Thru  | F (118)        | 1.15        | F (138)        | 1.20        |
|                                     |                             | Right | -              | -           | -              | -           |
|                                     | WB                          | Left  | F (253)        | 1.63        | F (328)        | 1.57        |
|                                     |                             | Thru  | F (190)        | 1.32        | F (168)        | 1.26        |
|                                     |                             | Right | -              | -           | -              | -           |
|                                     | NB                          | Left  | F (354)        | 1.63        | F (193)        | 1.29        |
|                                     |                             | Thru  | -              | -           | F (173)        | 1.25        |
|                                     |                             | Right | -              | -           | -              | -           |
| SB                                  | Left                        | -     | -              | F (312)     | 1.51           |             |

| INTERSECTION   | APPROACH / MOVEMENT         |                             | AM PEAK HOUR   |                | PM PEAK HOUR   |               |
|--|-----------------------------|-----------------------------|----------------|----------------|----------------|---------------|
|  |                             |                             | LOS(DELAY)     | V/C            | LOS( DELAY)    | V/C           |
|  |                             | Thru                        | F (196)        | 1.30           | E (58)         | 0.79          |
|  |                             | Right                       | F (174)        | 1.23           | -              | -             |
|  | <b>Overall Intersection</b> |                             | <b>C (32)</b>  | <b>1.17</b>    | <b>C (34)</b>  | <b>0.99</b>   |
| Major Mackenzie Drive / Amusement Drive - Wellness Way       | EB                          | Left                        | F (201)        | 1.23           | F (118)        | 1.00          |
|  |                             | Thru                        | -              | -              | B (18)         | 0.88          |
|  |                             | Right                       | -              | -              | -              | -             |
|  | WB                          | Left                        | -              | -              | -              | -             |
|  |                             | Thru                        | D (37)         | 1.01           | D (38)         | 0.97          |
|  |                             | Right                       | -              | -              | -              | -             |
|  | SB                          | Thru-left                   | E (65)         | 0.61           | E (56)         | 0.45          |
|  |                             | Right                       | E (62)         | 0.57           | E (72)         | 0.85          |
|  | <b>Overall Intersection</b> |                             | <b>F (116)</b> | <b>1.29</b>    | <b>F (136)</b> | <b>1.36</b>   |
| Major Mackenzie Drive / Hwy 400 NB Off-ramp                  | EB                          | Thru                        | -              | -              | -              | -             |
|  | WB                          | Thru                        | F (154)        | 1.27           | F (187)        | 1.34          |
|  | NB                          | 2Left                       | -              | -              | E (62)         | 0.97          |
|  |                             | 2Right                      | F (201)        | 1.32           | F (231)        | 1.40          |
|  |                             | <b>Overall Intersection</b> |                | <b>F (129)</b> | <b>1.18</b>    | <b>E (79)</b> |
| Major Mackenzie Drive / Hwy 400 SB Off-ramp - GO Parking Lot | EB                          | Thru                        | F (192)        | 1.37           | F (98)         | 1.14          |
|  |                             | Right                       | -              | -              | -              | -             |
|  | WB                          | Left                        | -              | -              | -              | -             |
|  |                             | Thru                        | -              | -              | E (68)         | 1.08          |
|  | NB                          | Left                        | -              | -              | -              | -             |
|  |                             | Right                       | E (56)         | 0.02           | E (55)         | 0.08          |
|  | SB                          | Left                        | E (58)         | 0.65           | E (60)         | 0.71          |
|  |                             | Thru                        | E (60)         | 0.68           | E (56)         | 0.61          |
|  |                             | Right                       | -              | -              | -              | -             |

As presented in **Table 13**, the addition of auxiliary right turning lanes has improved the overall intersection performance and also for both the eastbound and westbound through lane operations at the Jane Street and Amusement Drive intersections. However, there are several intersections still forecast to operate at an overall level of service 'F' and critical movements are present at each intersection.

## 5. SENSITIVITY ANALYSIS FOR CONVERSION OF DOUBLE LEFT TURN LANES

A sensitivity analysis for the Jane Street and Major Mackenzie Drive intersection operations using future total (2041) traffic volumes was undertaken to determine if the existing eastbound left turn lane can be converted into a single left turn lane. The existing dual eastbound left turn lane was converted into a single left turn lane and the eastbound left protected phase was converted into protected plus permitted phase for this movement. The results of this analysis compared with the double left turn lane operations are presented in **Table 14**. Synchro output sheets are provided in **Appendix H**.

**Table 14: Sensitivity Analysis for Jane Street Intersection Operation, Double Left Turn Lanes**

| INTERSECTION                        | APPROACH / MOVEMENT                 |                             | AM PEAK HOUR   |                | PM PEAK HOUR   |                |             |
|-------------------------------------|-------------------------------------|-----------------------------|----------------|----------------|----------------|----------------|-------------|
|                                     |                                     |                             | LOS(DELAY)     | V/C            | LOS( DELAY)    | V/C            |             |
| Major Mackenzie Drive / Jane Street | <b>Overall Intersection</b>         |                             | <b>F (160)</b> | <b>1.66</b>    | <b>F (158)</b> | <b>1.51</b>    |             |
|                                     | EB                                  | 2Left                       | F (190)        | 1.15           | F (337)        | 1.57           |             |
|                                     |                                     | Thru                        | F (118)        | 1.15           | F (138)        | 1.20           |             |
|                                     |                                     | Right                       | -              | -              | -              | -              |             |
|                                     | WB                                  | Left                        | F (253)        | 1.63           | F (328)        | 1.57           |             |
|                                     |                                     | Thru                        | F (190)        | 1.32           | F (168)        | 1.26           |             |
|                                     |                                     | Right                       | -              | -              | -              | -              |             |
|                                     | NB                                  | Left                        | F (354)        | 1.63           | F (193)        | 1.29           |             |
|                                     |                                     | Thru                        | -              | -              | F (173)        | 1.25           |             |
|                                     |                                     | Right                       | -              | -              | -              | -              |             |
|                                     | SB                                  | Left                        | -              | -              | F (312)        | 1.51           |             |
|                                     |                                     | Thru                        | F (196)        | 1.30           | E (58)         | 0.79           |             |
|                                     |                                     | Right                       | F (174)        | 1.23           | -              | -              |             |
|                                     | Major Mackenzie Drive / Jane Street | <b>Overall Intersection</b> |                | <b>F (159)</b> | <b>1.65</b>    | <b>F (172)</b> | <b>1.76</b> |
|                                     |                                     | EB                          | Left           | F (211)        | 1.28           | F (440)        | 1.84        |
| Thru                                |                                     |                             | F (118)        | 1.15           | F (122)        | 1.17           |             |
| Right                               |                                     |                             | -              | -              | -              | -              |             |
| WB                                  |                                     | Left                        | F (353)        | 1.63           | F (328)        | 1.57           |             |
|                                     |                                     | Thru                        | F (190)        | 1.32           | F (189)        | 1.31           |             |
|                                     |                                     | Right                       | -              | -              | -              | -              |             |
| NB                                  |                                     | Left                        | F (354)        | 1.63           | F (278)        | 1.48           |             |
|                                     |                                     | Thru                        | -              | -              | F (199)        | 1.31           |             |
|                                     |                                     | Right                       | -              | -              | -              | -              |             |
| SB                                  |                                     | Left                        | -              | -              | F (311)        | 1.51           |             |
|                                     |                                     | Thru                        | F (196)        | 1.30           | -              | -              |             |
|                                     |                                     | Right                       | F (167)        | 1.22           | -              | -              |             |

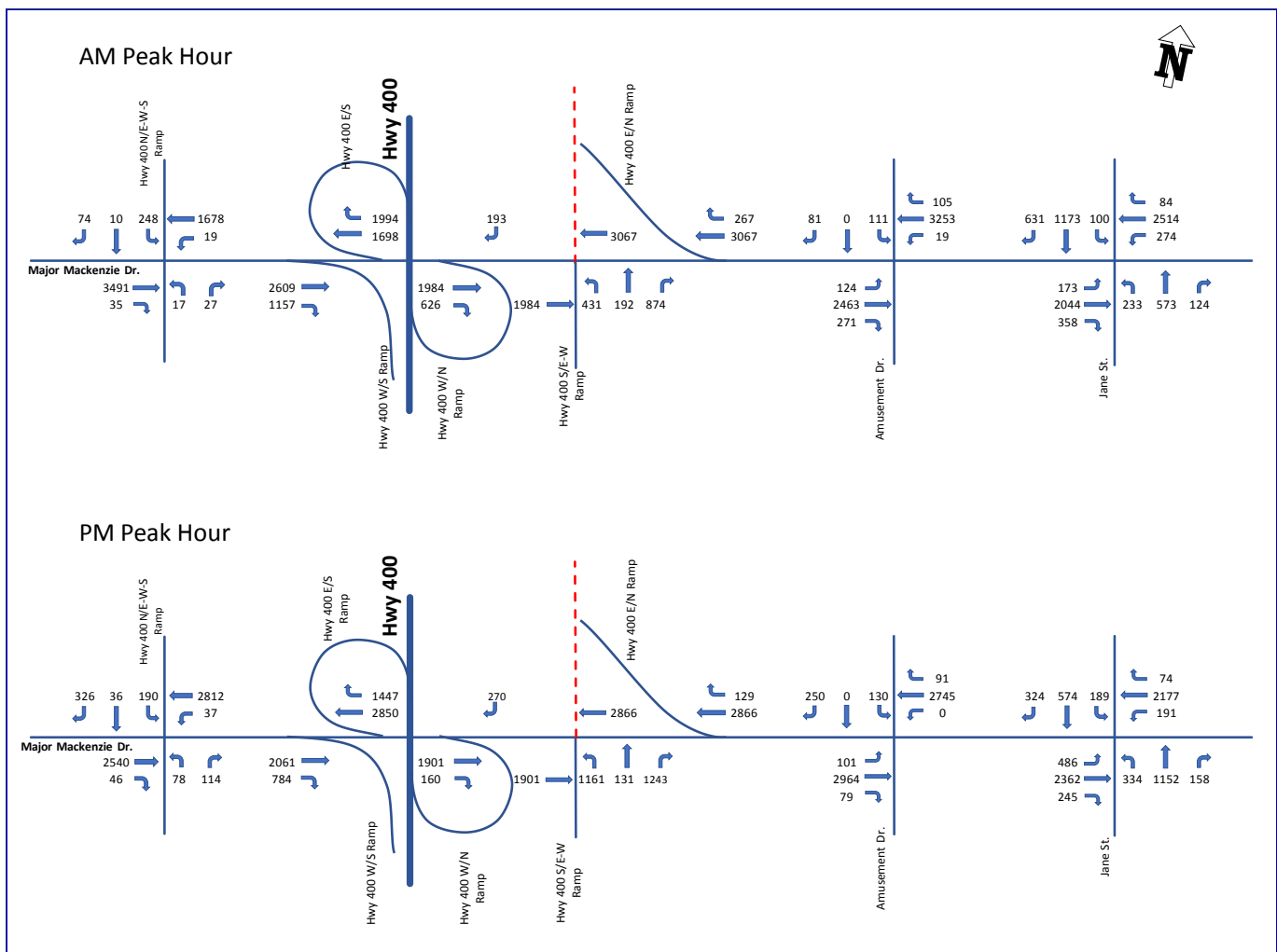
As presented in **Table 14**, the capacity analysis results with the removal of the eastbound double left turn lane indicate that this movement will experience increased delay and greater V/C ratios compared to the double left turn lanes. The overall intersection delay and V/C ratios have also increased specifically in the PM peak hour with the single eastbound left turn lane option compared to the double left lanes.

## 6. SENSITIVITY ANALYSIS FOR HWY 400 NB OFF-RAMP EXTENSION TO HOSPITAL LANDS

The Traffic Impact Study undertaken for the Vaughan Hospital lands located in the northeast quadrant of the Major Mackenzie Drive and Hwy 400 analyzed a future traffic operation option where the Hwy 400 NB Off-ramp extends northerly to the Hospital Lands. The proposed Hwy 400 NB Off-ramp extension would allow for only two movements including a southbound right turn movement from north to west and a northbound inbound movement from south to north. It was assumed that the southbound right turn movement at the Hwy 400 NB Off-ramp intersection will operate under “No Right Turn On Red” with the NB Off-ramp phase.

Sensitivity analysis for the future total (2041) traffic volumes was undertaken incorporating the Hwy 400 NB Off-ramp northerly extension to the Hospital lands. Future total (2041) traffic volumes were re-assigned at both the Major Mackenzie Drive intersections with Hwy 400 NB off-ramp and Amusement Drive as shown in **Figure 13**.

Figure 13: Future Total (2041) Traffic Volumes, With Hwy 400 NB Off-Ramp Extension to Hospital Lands





Intersection capacity analysis for the future (2041) was repeated with the Hwy 400 NB Off-ramp northerly extension to the Hospital lands and the analysis results are shown in **Table 15**. Synchro output sheets are provided in **Appendix I**.

**Table 15: Summary Future (2041) Intersections with Hwy 400 NB Off-Ramp Extension to Hospital Lands**

| INTERSECTION   | APPROACH / MOVEMENT         |           | AM PEAK HOUR   |             | PM PEAK HOUR   |             |
|--|-----------------------------|-----------|----------------|-------------|----------------|-------------|
|  |                             |           | LOS(DELAY)     | V/C         | LOS( DELAY)    | V/C         |
| Major Mackenzie Drive / Jane Street                          | <b>Overall Intersection</b> |           | <b>F (160)</b> | <b>1.66</b> | <b>F (158)</b> | <b>1.51</b> |
|  | EB                          | 2Left     | F (190)        | 1.15        | F (337)        | 1.57        |
|  |                             | Thru      | F (118)        | 1.15        | F (138)        | 1.20        |
|  |                             | Right     | -              | -           | -              | -           |
|  | WB                          | Left      | F (253)        | 1.63        | F (328)        | 1.57        |
|  |                             | Thru      | F (190)        | 1.32        | F (168)        | 1.26        |
|  |                             | Right     | -              | -           | -              | -           |
|  | NB                          | Left      | F (354)        | 1.63        | F (193)        | 1.29        |
|  |                             | Thru      | -              | -           | F (173)        | 1.25        |
|  |                             | Right     | -              | -           | -              | -           |
|  | SB                          | Left      | -              | -           | F (312)        | 1.51        |
| Thru   |                             | F (196)   | 1.30           | E (58)      | 0.79           |             |
| Right  |                             | F (174)   | 1.23           | -           | -              |             |
| Major Mackenzie Drive / Amusement Drive - Wellness Way       | <b>Overall Intersection</b> |           | <b>C (27)</b>  | <b>0.95</b> | <b>B (19)</b>  | <b>0.86</b> |
|  | EB                          | Left      | F (95)         | 0.89        | -              | -           |
|  |                             | Thru      | -              | -           | -              | -           |
|  |                             | Right     | -              | -           | -              | -           |
|  | WB                          | Left      | -              | -           | -              | -           |
|  |                             | Thru      | D (36)         | 1.01        | C (21)         | 0.89        |
|  |                             | Right     | -              | -           | -              | -           |
|  | SB                          | Thru-left | E (66)         | 0.63        | E (64)         | 0.65        |
| Right  |                             | E (56)    | 0.03           | E (55)      | 0.35           |             |
| Major Mackenzie Drive / Hwy 400 NB Off-ramp                  | <b>Overall Intersection</b> |           | <b>E (73)</b>  | <b>1.15</b> | <b>F (106)</b> | <b>1.23</b> |
|  | EB                          | Thru      | -              | -           | -              | -           |
|  | WB                          | Thru      | F (95)         | 1.14        | F (129)        | 1.21        |
|  | NB                          | Left      | -              | -           | F (115)        | 1.11        |
|  |                             | Thru-left | -              | -           | F (120)        | 1.12        |
|  |                             | 2Right    | F (141)        | 1.17        | F (178)        | 1.28        |
|  | SB                          | Right     | -              | -           | -              | -           |
| Major Mackenzie Drive / Hwy 400 SB Off-ramp - GO Parking Lot | <b>Overall Intersection</b> |           | <b>F (129)</b> | <b>1.18</b> | <b>E (79)</b>  | <b>1.07</b> |
|  | EB                          | Thru      | F (192)        | 1.37        | F (98)         | 1.14        |
|  |                             | Right     | -              | -           | -              | -           |
|  | WB                          | Left      | -              | -           | -              | -           |
|  |                             | Thru      | -              | -           | E (68)         | 1.08        |
|  | NB                          | Left      | -              | -           | -              | -           |

| INTERSECTION | APPROACH / MOVEMENT |       | AM PEAK HOUR |      | PM PEAK HOUR |      |
|--------------|---------------------|-------|--------------|------|--------------|------|
|              |                     |       | LOS(DELAY)   | V/C  | LOS( DELAY)  | V/C  |
|              | SB                  | Right | E (56)       | 0.02 | E (55)       | 0.08 |
|              |                     | Left  | E (58)       | 0.65 | E (60)       | 0.11 |
|              |                     | Thru  | E (60)       | 0.68 | E (56)       | 0.09 |
|              |                     | Right | -            | -    | -            | -    |

As presented in **Table 15**, overall intersection operations for Hwy 400 NB Off-ramp and Amusement Drive with Major Mackenzie Drive are forecast to slightly improve with the addition of the north leg into the hospital lands. The improved LOS can be attributed to the re-assignment of traffic volumes between these two intersections under this scenario.

## 7. PREFERRED INTERSECTION AND CORRIDOR LANE CONFIGURATIONS

Based on consultation with the MTO and York Region, several design options for both the Hwy 400 east and west ramp terminals were evaluated to determine potential operational and safety benefits to roadway users including pedestrian and bicycle traffic. Each design option was evaluated both with and without HOV lanes between both the Hwy 400 ramp terminals assuming shared right turning lanes with the through movements at both the intersections of Major Mackenzie Drive with Amusement Drive and Jane Street. Moreover, the focus of this analysis was to evaluate the capacity constraints and queuing issues between both the Hwy 400 east and west terminal ramps including NB and SB off and on-ramps. The proposed options and their operational performance are presented further within this section.

### 7.1 OPTION 1: ON-RAMPS WITH DIRECT RAMP TAPERS AND WITH / WITHOUT HOV LANES

Option 1 includes providing direct tapers to all of the Hwy 400 on-ramps. This scenario was analyzed with the inclusion of HOV lanes over the bridge and was compared to a scenario without HOV lanes. The results of this analysis are presented in **Table 16**. Synchro output sheets are provided in **Appendix J**.

Table 16: Operational Comparison of Hwy 400 Ramp Terminals under Proposed Option 1 Scenario

| Intersection  | Approach / Movement                      | Available/Proposed Storage Length | AM Peak Hour    |         |                   |                  | PM Peak Hour    |         |                   |                   |             |
|---|--|-----------------------------------|-----------------|---------|-------------------|------------------|-----------------|---------|-------------------|-------------------|-------------|
|   |  |                                   | 95th Queues (m) |         | V/C               |                  | 95th Queues (m) |         | V/C               |                   |             |
|   |  |                                   | HOV             | No HOV* | HOV               | No HOV*          | HOV             | No HOV* | HOV               | No HOV*           |             |
| <b>Major Mackenzie Drive / Hwy 400 NB Off-ramp</b>                  | <b>Overall Intersection, V/C (Delay)</b> |                                   | --              | --      | <b>1.29 (116)</b> | <b>1.17 (81)</b> | --              | --      | <b>1.36 (136)</b> | <b>1.25 (103)</b> |             |
| Normalized W-N Ramp<br>(Assumption for Free Flow W-N Ramp)          | EB                                       | Right                             | N/A             | N/A     | N/A               | N/A              | N/A             | N/A     | N/A               | N/A               |             |
|   |  | 3Thru                             | 330m            | 197     | 158               | 0.79             | 0.71            | 200     | 165               | 0.8               | 0.73        |
|   | WB                                       | 3Thru                             | 390m            | #515    | #408              | <b>1.27</b>      | <b>1.14</b>     | #512    | #413              | <b>1.34</b>       | <b>1.22</b> |
|   | NB                                       | 2Left                             | 500m            | 68      | 65                | 0.44             | 0.4             | #216    | 191               | 0.97              | 0.88        |
|   |  | 2Right                            | 500m            | #273    | #261              | <b>1.32</b>      | <b>1.21</b>     | #350    | #334              | <b>1.4</b>        | <b>1.28</b> |
| <b>Major Mackenzie Drive / Hwy 400 SB Off-ramp - GO Parking Lot</b> | <b>Overall Intersection, V/C (Delay)</b> |                                   | --              | --      | <b>1.18 (129)</b> | <b>1.06 (87)</b> | --              | --      | <b>1.07 (79)</b>  | <b>0.98 (41)</b>  |             |
|   | EB                                       | 3Thru                             | 225m            | 604     | 508               | <b>1.30</b>      | <b>1.22</b>     | #407    | #335              | <b>1.14</b>       | <b>1.01</b> |
|   |  | Right                             | -               | N/A     | N/A               | N/A              | N/A             | N/A     | N/A               | N/A               | N/A         |
| Normalized E-S Ramp<br>(Assumption for Free Flow E-S Ramp)          | WB                                       | Right                             | N/A             | N/A     | N/A               | N/A              | N/A             | N/A     | N/A               | N/A               | N/A         |
|   |  | 3Thru                             | 330m            | 145     | 112               | 0.6              | 0.51            | #413    | #309              | <b>1.08</b>       | 0.26        |
|   | NB                                       | Left                              | 35m             | 5       | 5                 | 0.12             | 0.22            | 9       | 9                 | 0.26              | 0.26        |
|   |  | Left                              | 25m             | 9       | 9                 | 0.13             | 0.13            | 38      | 38                | 0.64              | 0.64        |
|   |  | Right                             | 25m             | 0       | 0                 | 0.12             | 0.12            | 19      | 19                | 0.52              | 0.52        |
|   | SB                                       | 2Left-Thru                        | 635m            | 57      | 57                | 0.62             | 0.65            | 71      | 71                | 0.7               | 0.7         |
|   |  | Thru                              | -               | 59      | 59                | 0.66             | 0.68            | 60      | 60                | 0.7               | 0.7         |
|   |  | 2Right-Thru                       | 635m            | 2       | 2                 | 0.24             | 0.05            | 44      | 44                | 0.61              | 0.61        |

\*without HOV Lanes over Hwy 400 structure between ramp terminals, delay is average in seconds per vehicle

As presented in **Table 16**, under the Option 1 scenario, both the ramp terminals will operate above capacity overall. Comparing the scenarios with and without HOV lanes, the scenario without HOV lanes does indicate lower 95<sup>th</sup> percentile queues and improved capacities as compared to the scenario with these lanes. It is noted that estimated 95<sup>th</sup> percentile queues for the EB and WB approaches at the Hwy 400 NB and SB off-ramps, respectively, are within the available storage lengths with the exception of the WB approach at the Hwy 400 SB off with the HOV lane option. Also, the estimated 95<sup>th</sup> queue lengths at both the Hwy 400 NB and SB Off-ramps are anticipated to remain within the available storage lengths. It is noted that both the E-S and W-S on-ramps are estimated to contain significant volumes (Figure 12) ranging from 1,150 to 2,000 vehicles in the peak hours and direct tapers at these on-ramps in the presence of sidewalks could compromise safety of vulnerable road users due to infrequent crossing opportunities during peak times (for the E-S on-ramp) and potential limited predictability of approaching vehicles turning onto the ramps.

## 7.2 OPTION 2: ON-RAMPS WITH SPEED CHANGE LANES AND WITH / WITHOUT HOV LANES

Option 2 looked at providing speed change lanes at all of the Hwy 400 on-ramp locations. Again, this option was analyzed and compared both with and without HOV lanes. The results of this analysis are presented in **Table 17**. Synchro output sheets are provided in **Appendix J**.

Table 17: Operational Comparison of Hwy 400 Ramp Terminals under Proposed Option 2 Scenario

| Intersection  | Approach / Movement                     |             | Available/Proposed Storage Length (m)   | AM Peak Hour    |         |                   |                  | PM Peak Hour    |         |                   |                   |
|---|---|-------------|---|-----------------|---------|-------------------|------------------|-----------------|---------|-------------------|-------------------|
|   |   |             |   | 95th Queues (m) |         | V/C               |                  | 95th Queues (m) |         | V/C               |                   |
|   |   |             |   | HOV             | No HOV* | HOV               | No HOV*          | HOV             | No HOV* | HOV               | No HOV*           |
| <b>Major Mackenzie Drive / Hwy 400 NB Off-ramp</b>                  | <b>Overall Intersection V/C (Delay)</b> |             | <b>Overall Intersection V/C (Delay)</b> | --              | --      | <b>1.26 (108)</b> | <b>1.17 (81)</b> | --              | --      | <b>1.33 (128)</b> | <b>1.25 (103)</b> |
| Normalized W-N Ramp   | EB                                      | Right       | N/A                                     | N/A             | N/A     | N/A               | N/A              | N/A             | N/A     | N/A               | N/A               |
| (Assumption for Free Flow W-N Ramp)                                 |   | 3Thru       | 330m                                    | 144             | 158     | 0.77              | 0.71             | 191             | 164     | 0.78              | 0.73              |
|   | WB                                      | 3Thru       | 390m                                    | #490            | #408    | 1.24              | 1.14             | #488            | #413    | 1.31              | 1.22              |
|   |   | 2Left       | 500m                                    | 67              | 65      | 0.43              | 0.40             | #213            | 190     | 0.95              | 0.88              |
|   | NB                                      | 2Right      | 500m                                    | #270            | #261    | 1.29              | 1.21             | #347            | #334    | 1.37              | 1.28              |
|   |   |             |   |                 |         |                   |                  |                 |         |                   |                   |
| <b>Major Mackenzie Drive / Hwy 400 SB Off-ramp - GO Parking Lot</b> | <b>Overall Intersection V/C (Delay)</b> |             | <b>Overall Intersection V/C (Delay)</b> | --              | --      | 0.92 (37)         | 0.83 (24)        | --              | --      | <b>1.03 (44)</b>  | 0.94 (30)         |
|   | EB                                      | 3Thru       | 225m                                    | #388            | #317    | 1.02              | 0.91             | 229             | 185     | 0.85              | 0.75              |
|   |   | Right       | -                                       | N/A             | N/A     | N/A               | N/A              | N/A             | N/A     | N/A               | N/A               |
| Normalized E-S Ramp   | WB                                      | Right       | N/A                                     | N/A             | N/A     | N/A               | N/A              | N/A             | N/A     | N/A               | N/A               |
| (Assumption for Free Flow E-S Ramp)                                 |   | 3Thru       | 330m                                    | 136             | 112     | 0.58              | 0.52             | #388            | #309    | 1.04              | 0.92              |
|   | NB                                      | Left        | 35m                                     | 5               | 5       | 0.22              | 0.22             | 9               | 9       | 0.26              | 0.26              |
|   |   | Left        | 25m                                     | 9               | 9       | 0.13              | 0.12             | 38              | 38      | 0.64              | 0.64              |
|   | SB                                      | Right       | 25m                                     | 0               | 0       | 0.12              | 0.02             | 19              | 19      | 0.52              | 0.52              |
|   |   | 2Left-Thru  | 635m                                    | 57              | 57      | 0.62              | 0.68             | 71              | 71      | 0.70              | 0.70              |
|   | SB                                      | Thru        | -                                       | 59              | 59      | 0.66              | 0.68             | 60              | 60      | 0.70              | 0.70              |
|   |   | 2Right-Thru | 635m                                    | 2               | 1       | 0.24              | 0.6              | 44              | 44      | 0.61              | 0.61              |

\*without HOV Lanes over Hwy 400 structure between ramp terminals, delay is average in seconds per vehicle

Similar to the Option 1 scenario without HOV lanes, Option 2 without HOV lanes does provide lower 95<sup>th</sup> percentile queues and better capacities compared to the scenario with HOV lanes. As presented in **Table 17**, the addition of the speed change lanes at Hwy 400 on-ramps would provide better vehicular flows between the ramp terminals and the analysis showed improved capacity and delays for the overall intersection and queues, v/c ratios for the individual movements during both the AM and PM peak hours. However, the estimated 95<sup>th</sup> percentile queues for the WB approach at the Hwy 400 SB off-ramp are anticipated to exceed the available storage length with the HOV lane option.

### 7.3 OPTION 3: NORMALIZED W- N AND E - S ON-RAMPS AND WITH / WITHOUT HOV LANES

Option 3 scenario considered the provision of speed change lanes at both the W-S and E-N on-ramps and normalizing both the W-N and E-S on-ramps. This option was considered to reduce the number of separate crossings and exposure to free-flowing traffic for vulnerable road users by incorporating these crossings at the traffic signals. For the purposes of this analysis, pedestrian and cyclist crossing times were adhered to; however signal phasing and timings would be confirmed during the detailed design process. The results of this analysis are presented in **Table 19**. Synchro output sheets are provided in **Appendix J**.

Table 18: Operational Comparison of Hwy 400 Ramp Terminals under Proposed Option 3 Scenario

| Intersection  | Approach / Movement                      |             | Available/Proposed Storage Length (m)   | AM Peak Hour    |         |                   |                   | PM Peak Hour    |         |                   |                   |
|---|--|-------------|---|-----------------|---------|-------------------|-------------------|-----------------|---------|-------------------|-------------------|
|   |  |             |   | 95th Queues (m) |         | V/C               |                   | 95th Queues (m) |         | V/C               |                   |
|   |  |             |   | HOV             | No HOV* | HOV               | No HOV*           | HOV             | No HOV* | HOV               | No HOV*           |
| <b>Major Mackenzie Drive / Hwy 400 NB Off-ramp</b>                  | <b>Overall Intersection, V/C (Delay)</b> |             | <b>Overall Intersection V/C (Delay)</b> | –               | –       | <b>1.26 (101)</b> | <b>1.17 (77)</b>  | –               | –       | <b>1.33 (126)</b> | <b>1.25 (101)</b> |
| Normalized W-N Ramp   | EB                                       | Right       | 150m                                    | 105             | 86      | 0.76              | 0.74              | 16              | 16      | 0.19              | 0.12              |
|   |  | 3Thru       | 330m                                    | 187             | 158     | 0.77              | 0.71              | 191             | 164     | 0.78              | 0.73              |
|   | WB                                       | 3Thru       | 390m                                    | #489            | #408    | 1.24              | 1.14              | #488            | #413    | 1.31              | 1.22              |
|   | NB                                       | 2Left       | 500m                                    | 67              | 65      | 0.43              | 0.40              | #213            | 190     | 0.95              | 0.88              |
|   |  | 2Right      | 500m                                    | #271            | #261    | 1.3               | 1.21              | #347            | #334    | 1.38              | 1.28              |
| <b>Major Mackenzie Drive / Hwy 400 SB Off-ramp - GO Parking Lot</b> | <b>Overall Intersection, V/C (Delay)</b> |             | <b>Overall Intersection V/C (Delay)</b> | –               | –       | <b>1.86 (169)</b> | <b>1.86 (158)</b> | –               | –       | <b>1.17 (61)</b>  | <b>1.14 (47)</b>  |
|   | EB                                       | 3Thru       | 225m                                    | #387            | #317    | 1.04              | 0.92              | 228             | 185     | 0.85              | 0.76              |
|   |  | Right       | –                                       | –               | –       | –                 | –                 | –               | –       | –                 | –                 |
| Normalized E-S Ramp   | WB                                       | Right       | 50m                                     | #769            | #769    | 2.12              | 2.12              | #479            | #452    | 1.23              | 1.18              |
|   |  | 3Thru       | 330m                                    | 136             | 112     | 0.59              | 0.51              | #388            | #309    | 1.04              | 0.92              |
|   | NB                                       | Left        | 35m                                     | 5               | 5       | 0.21              | 0.12              | 9               | 9       | 0.26              | 0.3               |
|   |  | Left        | 25m                                     | 9               | 9       | 0.14              | 0.14              | 38              | 38      | 0.64              | 0.65              |
|   |  | Right       | 25m                                     | 0               | 0       | 0.12              | 0.12              | 19              | 19      | 0.52              | 0.52              |
|   | SB                                       | 2Left-Thru  | 635m                                    | 56              | 56      | 0.62              | 0.62              | 71              | 71      | 0.70              | 0.70              |
|   |  | Thru        | –                                       | 58              | 58      | 0.65              | 0.65              | 60              | 60      | 0.70              | 0.70              |
|   |  | 2Right-Thru | 635m                                    | 1               | 1       | 0.26              | 0.26              | 44              | 44      | 0.61              | 0.61              |

\*without HOV Lanes over Hwy 400 structure between ramp terminals, delay is average in seconds per vehicle

Under the Option 3 scenario presented in **Table 19**, the Hwy 400 SB off-ramp intersection is forecast to operate significantly over capacity with longer delays in the morning peak hour due to significant volumes of approximately 2,000 vehicles heading south from east. The WB right turn movement at this intersection will operate at significant delays and 95<sup>th</sup> percentile queues are estimated to block the Hwy 400 NB off-ramp intersection in the morning peak hour in both with and without HOV lane options. However, normalizing the W-N on-ramp will not have significant negative impacts on the Hwy 400 NB off-ramp operations in the morning peak hour but slightly worsen conditions in the afternoon peak hour.

#### 7.4 PREFERRED DESIGN OPTION 2A: E-S ON-RAMP WITH SPEED CHANGE LANE AND NORMALIZED W-N ON-RAMP AND WITHOUT HOV LANES

Based on operation analysis presented for Options 1 to 3 for the various Hwy 400 on-ramp lane configurations, Option 2A was developed that considered only normalization of the W-N on-ramp and no sidewalk on the north side of the Hwy 400 bridge structure. Positioning pedestrians and cyclists on the south side of the corridor over Highway 400 using a Multi-Use Pathway (MUP) eliminates exposure to high volumes of traffic at the E-S on-ramp during peak times and normalization of the W-N ramp provides an improved crossing environment. All other on ramps will have the speed change lanes and there will be no HOV lane designation at this time between both the Hwy 400 off-ramp terminals, however, implementation would be considered in the future. Queuing analysis for this option was undertaken using SimTraffic software. A 15-minute seeding time was used and five (5) 60-minute runs of the simulation were completed. The 95<sup>th</sup> percentile queues were calculated by taking average of the five 60-minute simulated runs. The results of Synchro and SimTraffic analysis are presented in **Table 18**. SimTraffic output sheets are provided in **Appendix J**.

**Table 19: Operational Comparison of Hwy 400 Ramp Terminals under Proposed Option 2A Scenario**

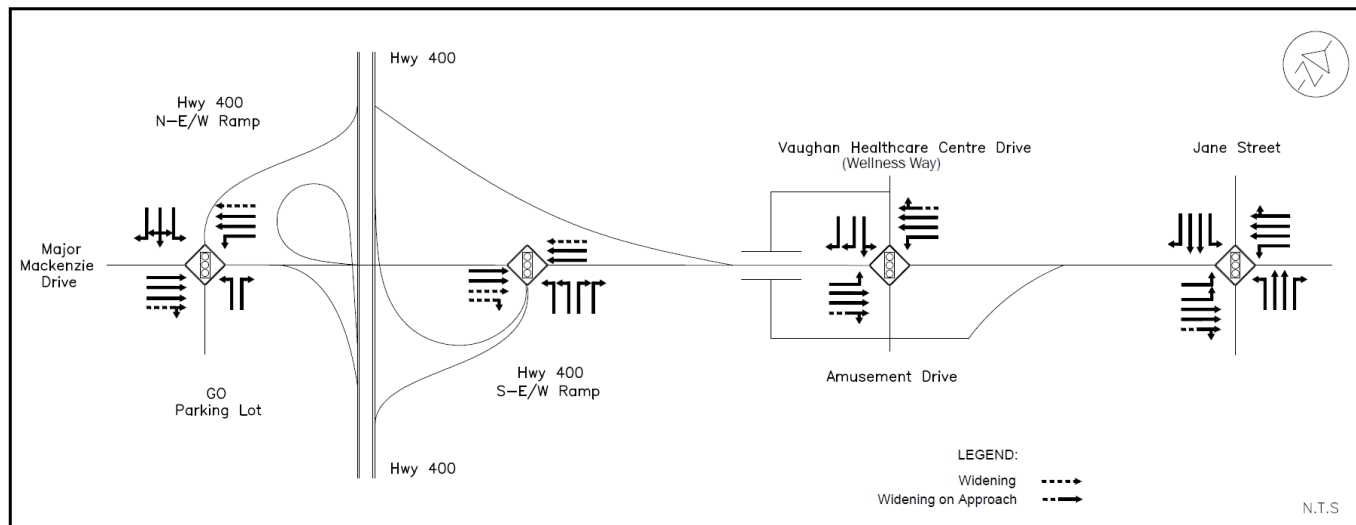
| Intersection   | Approach / Movement                      | Available/Proposed Storage Length (m)   | AM Peak Hour     |                  | PM Peak Hour |                   |             |
|--|--|---|------------------|------------------|--------------|-------------------|-------------|
|  |  |   | 95th Queues (m)* | V/C              | 95th Queues  | V/C               |             |
| <b>Major Mackenzie Drive / Hwy 400 NB Off-ramp</b>                     | <b>Overall Intersection, V/C (Delay)</b> | <b>Overall Intersection V/C (Delay)</b> | --               | <b>1.17 (80)</b> | --           | <b>1.26 (103)</b> |             |
| Normalized W-N Ramp  | EB                                       | Right                                   | 100m             | 33               | 0.41         | <b>228</b>        | 0.12        |
|  |  | 3Thru                                   | 330m             | 73               | 0.72         | 320               | 0.76        |
|  | WB                                       | 3Thru                                   | 390m             | 114              | <b>1.17</b>  | 140               | <b>1.27</b> |
|  | NB                                       | 2Left                                   | 500m             | 137              | 0.40         | 195               | 0.86        |
|  |  | 2Right                                  | 500m             | 146              | <b>1.21</b>  | 180               | <b>1.26</b> |
| <b>Major Mackenzie Drive / Hwy 400 SB Off-ramp - GO Parking Lot</b>    | <b>Overall Intersection V/C (Delay)</b>  | <b>Overall Intersection V/C (Delay)</b> | --               | 0.83 (25)        | --           | 0.95 (30)         |             |
|  | EB                                       | 3Thru                                   | 225m             | 65               | 0.9          | 65                | 0.74        |
|  |  | Right                                   | --               | 43               | --           | 46                | --          |
| E-S Ramp with Acceleration Lane<br>(Assumption for Free Flow E-S Ramp) | WB                                       | Right                                   | 100m             | 152              | --           | 157               | --          |
|  |  | 3Thru                                   | 330m             | 46               | 0.51         | 100               | 0.91        |
|  | NB                                       | Left                                    | 35m              | 13               | 0.2          | 33                | 0.33        |
|  |  | Left                                    | 25m              | 17               | 0.14         | 28                | 0.72        |
|  |  | Right                                   | 25m              | 17               | 0.02         | 41                | 0.08        |
|  | SB                                       | 2Left-Thru                              | 635m             | 43               | 0.68         | 88                | 0.71        |
|  |  | Thru                                    | --               | 43               | 0.68         | 88                | 0.62        |
|  |  | 2Right-Thru                             | 635m             | 43               | 0.68         | 88                | 0.62        |

As presented in **Table 18**, Option 2A provides improved queue lengths and capacity for the Major Mackenzie Drive and Highway 400 Southbound Off-ramp intersection with the introduction of a speed change lane to E-S on ramp. It was noted that SimTraffic showed a queue length of approximately 155m both in the morning and afternoon peak hour for the WB right turn movement at the E-S on ramp. It was noticed in the SimTraffic simulation that there were no queues at this ramp since it is assumed to operate under free flow conditions. However, queues were estimated on the basis that vehicles travelling at less than 11 km/h are considered to be queued. Also, a queue length of approximately 228m in the afternoon peak hour forecasted for the EB right turn movement at the Hwy 400 NB off-ramp intersection is deemed due to congested traffic conditions on Major Mackenzie Drive east of the Hwy 400 NB off ramp with the HOV lane designation, but this queue is not anticipated to block the Hwy 400 SB off ramp.

Based on results of the future total (2041) traffic analysis under the various scenarios analyzed for the Major Mackenzie Drive study area, the preferred intersection and corridor lane configurations have been established to accommodate the forecasted traffic growth within the study area. The preferred intersection and corridor lane configurations are presented in **Figure 14**.

To eliminate the need for property acquisition and improve pedestrian crossing safety, dedicated right turning lanes for the eastbound and westbound movements are not recommended at both the Wellness Way/Amusement Drive and Jane Street intersections. In addition, transit/HOV lanes are not recommended for implementation at this time due to the relatively short segment that would exist from west of Highway 400 to Jane Street, however implementation will be considered at a later stage to address increasing travel demand. Traffic analysis undertaken in this study considered the transit/HOV lanes and represents the conservative analysis scenario.

Figure 14: Preferred Intersection and Corridor Lane Configurations



## 8. CONCLUSIONS AND RECOMMENDATIONS

The results of the Transportation and Traffic Analysis completed for the Major Mackenzie Drive corridor as part of the Major Mackenzie Drive Class Environmental Assessment are summarized below. This included a review of the existing year (2016) and future year total (2041) traffic operations as well as a review of historical collisions from 2011 to 2017.

### Existing (2016) Traffic Conditions

- A review of the existing corridor capacity indicates there are multiple mid-block sections within the study area that are operating at or above capacity in both the eastbound and westbound directions. Based on these results, additional capacity is required for the corridor;
- The intersection of Major Mackenzie Drive and Jane Street is operating at a poor level of service and an overall volume to capacity ratio greater than 1.00 during both the AM and PM peak hours. Majority of both the westbound and eastbound approach movements at this intersection are operating over capacity with LOS F; and
- The Hwy 400 NB and SB Off-ramps are operating at LOS E or better. Critical movements at these locations include:
  1. Northbound left turn movement in the PM peak hour and northbound right turn movement both in the AM and PM peak hours at the Hwy 400 NB Off-ramp intersection; and
  2. Eastbound through moment at the Hwy 400 SB Off-ramp intersection in the AM peak hour.

**Safety Performance Assessment - Collision Analysis**

- A total of 648 collisions occurred within the study area based on the 7 years of historical data. Out of total recorded collisions, 592 (91%) occurred at the intersections and remaining 56 (9%) occurred at midblock sections;
- Rear-end collisions accounted for 58% of the total recorded while turning movement collisions accounted for 9%, sideswipe collisions 8% and angle collisions made up 5% of the total collisions. It was noted that 12% of the collisions were recorded as unknown;
- Based on the review of the study area collisions, there appears to be significant amount of congestion experienced within the study area. This congestion would explain the significant amount of rear-end collisions occurring where drivers are following too close. As drivers become impatient travelling through the study area they may become more aggressive to push through the area leaving little space between them and the vehicles ahead. This combined with frequent stop and go movements may explain these collisions; and
- Similarly, significant congestion throughout the study area could explain the amount of turning movement collisions where drivers have completed an improper turn. As a result of the congestion, drivers could be more aggressive in performing their turn movements at intersections as adequate gaps may not be occurring within the stream of traffic along Major Mackenzie Drive.

**Future Total (2041) Traffic Conditions, Do Nothing Alternative**

- The future (2041) do-nothing corridor lane capacity analysis indicates there will be worsened capacity issues throughout the Major Mackenzie Drive corridor in both the eastbound and westbound directions. These results indicate that additional through lanes are required in order to accommodate future (2041) traffic demands; and
- The future (2041) do-nothing intersection capacity analysis indicates that all of the study area intersections are forecasted to operate at a level of service 'F' with several critical movements during both peak hours.

**Future (2041) Traffic Conditions, With Improvements, 6 Lanes**

- Major Mackenzie Drive will consist of 3 through lanes in both the eastbound and westbound direction from the existing 2 though lanes. For the purposes of this analysis, the additional lane in both directions (curb lane) was assumed to be a high occupancy vehicle (HOV) and transit lane as per York Region's Transportation Master Plan recommendations;
- Under the future (2041) with improvements traffic conditions (ultimate 25-year horizon) there will still be significant capacity issues throughout the Major Mackenzie corridor even with additional lane capacity improvements. The intersection of Jane Street with Major Mackenzie Drive will still operate approximately similar to the Do Nothing Option in both the AM and PM peak hours without auxiliary right turning lanes; and



- The addition of auxiliary right turning lanes at both the Jane Street and Amusement Drive intersections would improve the overall intersection performance (including the eastbound and westbound through lane operations), although implementation is not recommended due to significant property constraints and the resulting increase in pedestrian crossing distances. However, there are several intersections still forecast to operate at an overall level of service ‘F’ and critical movements are present at each intersection.

**Sensitivity Analysis for Conversion of Double Left Turn Lanes**

- The capacity analysis results with the removal of the existing eastbound double left turn lanes at the Major Mackenzie and Jane Street intersection indicate this movement will experience increased delay and greater V/C ratios compared to the double left turn lanes. The overall intersection delay and V/C ratios have also increased specifically in the PM peak hour with the single eastbound left turn lane option compared to the double left lanes.

**Sensitivity Analysis for Hwy 400 NB Off-Ramp Extension to Hospital Lands**

- The overall intersection operations for Hwy 400 NB Off-ramp and Amusement Drive with Major Mackenzie Drive are forecast to slightly improve with the addition of the Hwy 400 NB Off -ramp extension into the hospital lands. The improved LOS can be attributed to the reassignment of traffic volumes between these two intersections under this scenario.

**Preferred Intersection and Corridor Lane Configurations**

- Under the future preferred lane configurations for the study corridor, several 95<sup>th</sup> percentile queue lengths are forecasted to generally exceed the existing storage capacity available, particularly at the intersection of Major Mackenzie Drive with Jane Street; and
- Based on the analysis results presented for the Hwy 400 on-ramps at Major Mackenzie Drive (detail discussion in Section 7) to determine the potential operational and safety benefits to the roadway users including pedestrians and cyclists, it is recommended that:
  - No sidewalk on the north side of Hwy 400 structure be provided;
  - W-N on-ramp be normalized to provide a short and safe crossing path for pedestrians and cyclists; and
  - No HOV lane designation between the Hwy 400 ramp terminals at Major Mackenzie Drive at this time, but to be considered in the future.
- The forecasted 95<sup>th</sup> percentile queue lengths at both the Hwy 400 NB and SB Off-ramps do not exceed the existing available storage lengths under the preferred design option with the future total (2041) traffic volumes.

The preferred intersection and corridor lane configurations for the Major Mackenzie Environmental Assessment study area are displayed in **Figure 14**. To eliminate required property acquisition and improve pedestrian crossing safety, dedicated right turning lanes for the eastbound and westbound movements are not recommended at both the Wellness Way/Amusement Drive and Jane Street intersections. In addition,

transit/HOV lanes are not recommended for implementation at this time due to the relatively short segment that would exist from west of Highway 400 to Jane Street, however implementation would be considered at a later stage in the future to address increasing travel demand. Traffic analysis undertaken in this study considered the transit/HOV lanes and represents the conservative analysis scenario.

# Transportation & Traffic Analysis

## Major Mackenzie Drive Class Environmental Assessment Between Highway 400 & Jane Street

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The Regional Municipality of York  
17250 Yonge Street  
Newmarket, ON, Canada  
L3Y 6Z1

**PARSONS**

