

APPENDIX M

Traffic Analysis Report

MINISTRY OF TRANSPORTATION ONTARIO, EASTERN REGION

PRELIMINARY DESIGN AND CLASS EA STUDY FOR HIGHWAY 401 COLBORNE TO BRIGHTON TRAFFIC REPORT

JULY 28, 2023





PRELIMINARY
DESIGN AND CLASS
EA STUDY FOR
HIGHWAY 401
COLBORNE TO
BRIGHTON
TRAFFIC REPORT

MINISTRY OF TRANSPORTATION
ONTARIO, EASTERN REGION

TRAFFIC REPORT (DRAFT)
FOR INTERNAL USE

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APPENDICES

A GEH SUMMARY

1 INTRODUCTION

1.1 OBJECTIVES

The Ministry of Transportation of Ontario (MTO) has retained WSP to undertake the Preliminary Design and Environmental Assessment for the widening of Highway 401 and replacement/rehabilitation of structures, from 0.8 km east of Percy Street to 0.4 km west of Christiani Road. The key objectives of the traffic analysis for this study are:

- To collect and review required information on traffic operations and safety.
- To evaluate the traffic operational performance under existing (2020) and future (2031 and 2041) planning horizon conditions.
- To identify operational and safety deficiencies and make recommendations on necessary improvements.
- To evaluate construction staging and detour options.

This Traffic Report documents the traffic analysis, which includes the following:

- Review of the existing road network configuration and available traffic data;
- Development of a micro-simulation model in Vissim;
- Evaluation of existing (2020) traffic operational performance using micro-simulation;
- Evaluation of the safety deficiencies;
- Evaluation of future traffic operational performance using micro-simulation for the do-nothing scenarios and the corridor widening scenarios during the (2031 and 2041) planning horizons;
- Evaluation of the construction staging and detour options; and
- Documentation of recommendations on necessary improvements.

1.2 STUDY AREA

The study area for this project covers Highway 401 from 0.8 km east of Percy Street/County Road 25 to 0.4 km west of Christiani Road, for a total of 19.6 km, as presented in Figure 1-1. An earlier Environmental Assessment Study was completed for Highway 401 at the County Road 30 interchange in 2005. This interchange is not part of the current study.

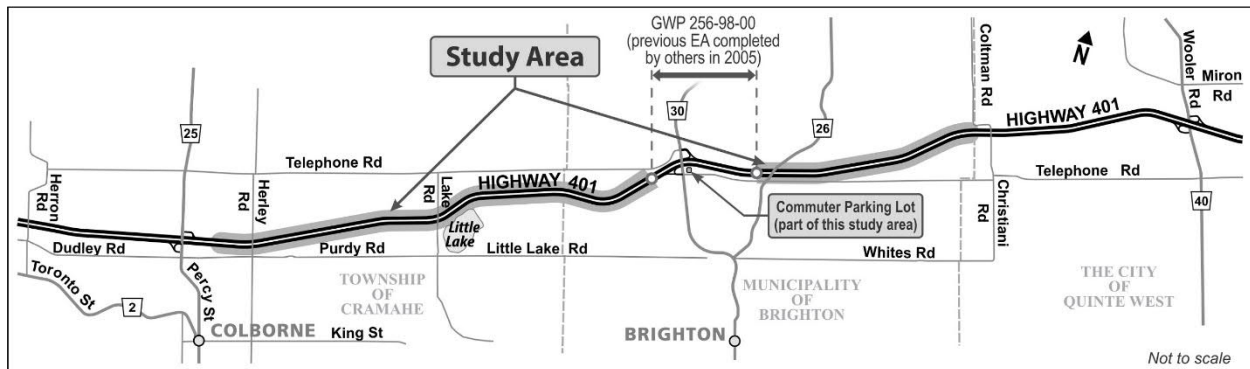


Figure 1-1: Study area for Highway 401

In order to conduct an operational analysis for the Highway 401 and identify impacts on the mainline, ramps, and ramp terminals, a micro-simulation model was developed in Vissim. The model area for the micro-simulation was expanded beyond the study area to include one interchange on either side of the study area corridor (from County Road 25/Percy Street to County Road 40/Wooler Road). County Road 30 was also included in the simulation analysis to ensure network continuity. The micro-simulation model limits are presented in Figure 1-2.



Figure 1-2: Model limits for micro-simulation analysis

1.3 PLANNING HORIZON AND ANALYSIS PERIODS

The Highway 401 corridor through the study area was evaluated under the existing 2020 traffic conditions. Traffic performance under the 2031 and 2041 planning horizons were also assessed as part of this report to determine the long-term operational performance under the do-nothing scenarios and the recommended future configurations.

The analysis periods for this study are weekday AM, PM, as well the weekend mid-day peak periods. Each peak period includes the peak hour and the shouldering hours, for a total of three hours per analysis period. The weekday condition was taken as an average of Tuesday, Wednesday, and Thursday traffic volumes. The critical weekend condition was taken as the higher of Saturday and Sunday traffic volumes. Based on the obtained traffic count data, the weekday AM peak period was assumed to be from 7:00 AM to 10:00 AM and the PM peak period from 3:00 PM to 6:00 PM. The weekend peak period was assumed to extend from 1:00 PM to 4:00 PM.

2 METHODOLOGY

This section describes the assumptions, inputs and methodology used to develop and evaluate the Vissim models.

2.1 MODEL DEVELOPMENT

A micro-simulation model of the study area was developed in PTV Vissim 11 to assess the traffic operations under the existing and future conditions. The model reflects the existing or the proposed road conditions including the lane configurations, posted speed limits, traffic control types, and traffic signal timing plans.

Existing Roadway Geometry

The existing roadway network was built in Vissim based on the virtual imagery of the study area.

- Highway 401 was modelled as a 4-lane freeway with a posted speed limit of 100 km/h.
- County Road 25 was modelled as a 2-lane roadway with a posted speed limit of 60 km/h across Highway 401.
- County Road 30 was modelled as a 2-lane right of way per direction of travel across Highway 401 with a posted speed limit of 60 km/h.
- County Road 40 was modelled as a 4-lane roadway with a posted speed limit of 80 km/h across Highway 401.

Future Roadway Geometry¹

The future conditions were assessed under 2 scenarios: 1) Do-nothing; and 2) Widened. The roadway network was maintained from the existing conditions for the most part under both scenarios. The posted speed limits were maintained from the existing conditions.

The lane configuration was assumed unchanged under the do-nothing scenarios except for the County Road 30 interchange. The modelled roadway network was updated to capture the latest change to the County Road 30 ramp terminals in 2021. The number of northbound lanes was maintained as 2 through lanes with a dedicated left-turn lane at the Highway 401 ramp terminals. Southbound traffic lanes were reduced to one through lane and a dedicated left-turn lane at the Highway 401 ramp terminals. The eastbound highway ramps were also realigned matching the latest roadway configuration as shown in Figure 2-1.



Figure 2-1 Updated roadway configuration at Country Road 30 eastbound ramp

Highway 401 was widened from 4 lanes to 6 lanes between County Road 25 and County Road 40 under the widened scenario. The Highway 401 interchange at County Road 25 was modified based on the proposed plan shown in Figure 2-2. A new connection was added between County Road 25 and Highway 401 for the northbound traffic to travel east on Highway 401. Other ramps were realigned to match the proposed roadway plan in Figure 2-2. County Road 30 was also updated similar to the Do-nothing Scenario.

¹-The lane configuration at County Road 30 South ramp terminal was not updated under the do-nothing fall scenarios; hence, the intersection had not gone under the change at the time when the analyses for the fall conditions were undertaken.

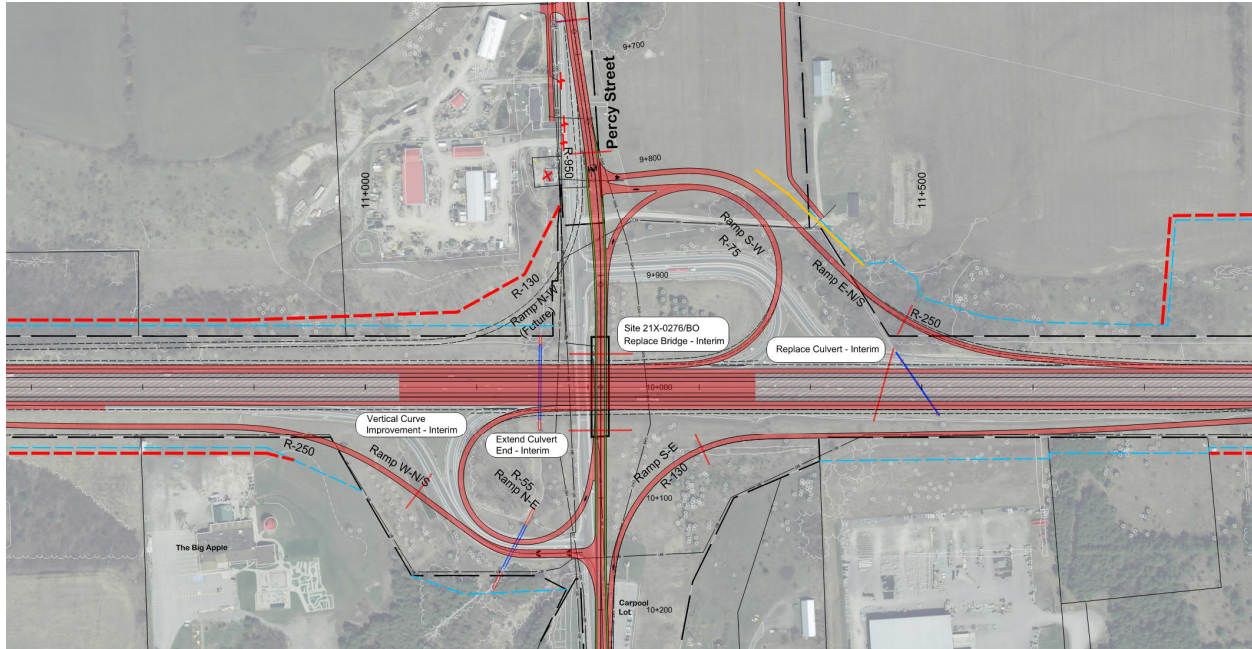


Figure 2-2 Proposed plan Country Road 25 ramps

Simulation Period

The analysis was conducted for 3-hour weekday AM, weekday PM, and weekend peak periods. The peak hour was identified as the second hour in the peak period. A warm-up period of one hour was added to the beginning of the simulation to ensure the network is properly loaded at the beginning of the simulation. The warm-up period demand was estimated by applying a factor based on available Automatic Traffic Recorder (ATR) counts to the peak hour demand.

Existing Traffic Demand

The estimation of existing traffic demand was assessed based on existing travel patterns. The total OD vehicular demand matrices were redistributed for every hour of the analysis period based on the 2020 traffic movement counts and the 2016 ATR counts to capture the existing travel pattern. The redistributed hourly demands were classified into passenger vehicles including light trucks, medium trucks, and heavy trucks based on the observed data in the 2012 Commercial Vehicle Survey at the Bowmanville station.

Future Traffic Demand

The existing hourly OD total demand matrices were forecasted for the planning years, 2031 and 2041, using the annual growth rate of 1.5%, advised by MTO. The growth rate factor was applied linearly. The forecasted hourly OD demand was classified into passenger vehicles, light trucks, medium trucks, and heavy trucks using the proportion factors applied for the existing conditions.

Traffic Assignment

A dynamic assignment was run to establish origin-destination paths through the network. The model was then converted to a static assignment, where five iterations with varying random seeds were simulated to generate the outputs.

Traffic Signal Operation

The study area is comprised of 2 signalized intersections: 1) Country Road 30 N/S-E ramp; and 2) County Road 40 N/S-W ramp. Both intersections were modelled as fully-actuated providing green based on the vehicle demand and operating in a free mode.

2.1.1 TRAFFIC VOLUMES

The following section documents the traffic data obtained to undertake this study. The obtained/collected traffic data can be classified as follows:

1. Highway 401 Mainline Traffic Volumes
2. Highway 401 Ramp Traffic Volumes
3. Crossing Road Traffic Volumes

1. Highway 401 Mainline Traffic Volumes (2016)

MTO provided 2016 ATR counts for the mainline segments of Highway 401 over spring, summer, and fall. The 2016 average weekday and weekend traffic data were compared across the three seasons to select a count data that is a fair estimate of the traffic demand across Highway 401 over the entire year and can be used for the analysis. The average weekday (aggregated) two-way traffic volumes were compared over spring, summer, and fall west of the County Road 30 interchange and west of the County Road 40 interchange.

Comparison of the seasonal ATR counts indicates that the traffic volumes on Highway 401 are the highest in summer. The hourly distributions of traffic volumes are similar in fall and spring. The traffic analyses were carried out using the fall and the summer traffic counts after review of the seasonal ATR counts.

- The fall traffic counts were initially used for the purpose of analysis as they provide a fair estimate of typical traffic demand conditions throughout most of the year and are consistent with the turning movement counts (TMCs) collected at the interchange ramp terminals.
- The summer traffic counts were also used to assess the road network under more stringent conditions. The fall TMCs (at the ramp terminals) were modified using the appropriate seasonality factors.

2. Highway 401 Ramp Traffic Volumes (2020)

Traffic count data were collected across the 12 Highway 401 on/off ramps and 6 ramp terminals (within the study area). The Highway 401 ramp counts were collected by ATR in the Fall of 2020 over 24 Hours and 7 days of a week. The TMCs at ramp terminals were also collected in the Fall of 2020 over a 10-hour period for a typical weekday and a Saturday.

The 2020 TMC and ATR counts were reviewed and balanced to ensure consistency and establish the existing traffic conditions. Schematics of the balanced existing (2020) traffic volumes are presented in Figure 3-10 and Figure 3-12 for the weekday AM and PM peak hours, and in Figure 3-11 and Figure 3-13 for the weekend mid-day peak hour.

Recognizing the potential impact of COVID-19 on travel demand and patterns, available TMCs from Fall of 2018 at the County Road 30 interchange ramp terminals were reviewed and compared to the 2020 counts at the same location to identify any trends. The review showed that the differences in traffic volumes between 2018 and 2020 are inconsistent across hours and turning movements. The overall 8-hour intersection total volumes increased by 1% (25 vehicles) at the north ramp terminal and decreased by 2% (95 vehicles) at the south ramp terminal in 2020. These numbers are relatively small, and there is insufficient evidence that the traffic volume was decreased in 2020 compared to 2018. As a result, the 2020 counts collected were used for the purpose of establishing existing conditions, and a COVID-related traffic factor was not considered for this project.

3. Crossing Road Traffic Volumes (2020)

Vehicular, cyclist and pedestrian counts were obtained across 3 roadways over Highway 401. The crossing roads where the data was collected are Herley Road, Lake Road, and County Road 26. The vehicular traffic counts were collected in Fall of 2020 over 24 hours for 7 days of a week. The cyclist and pedestrian counts were collected during summer and fall of 2020 for a period of 10 hours over a typical weekday and a weekend.

Table 2-1 summarizes the 10-hour 2-way cyclist and pedestrian counts across the crossing roads. It is concluded that the on-foot and the cyclist traffic along these crossing roads (within the study area) are insignificant, with fewer than 10 travellers over the 10-hour period.

Table 2-1: Active transport counts along Highway 401 crossing roads

| | HERLEY ROAD | | LAKE ROAD | | COUNTY ROAD 26 | |
|-----------------------|-------------|------------|-----------|------------|----------------|------------|
| | BICYCLE | PEDESTRIAN | BICYCLE | PEDESTRIAN | BICYCLE | PEDESTRIAN |
| 2020 Summer (weekday) | 0 | 2 | 6 | 1 | 1 | 1 |
| 2020 Summer (weekend) | 4 | 0 | 7 | 0 | 1 | 0 |
| 2020 Fall (weekday) | 5 | 0 | 0 | 0 | 0 | 2 |
| 2020 Fall (weekend) | 0 | 4 | 2 | 4 | 1 | 3 |

2.2 PERFORMANCE METRICS

This section discusses the key performance metrics used for evaluation of the corridor. The model results were averaged over 5 simulation runs with varying random seeds for the peak hours, and traffic performance was assessed under the following metrics.

2.2.1 MAINLINE/FREEWAY LEVEL OF SERVICE (LOS) ANALYSIS

The level of service (LOS) was assessed for basic freeway segments along Highway 401 to establish the traffic operating conditions on the mainline. This analysis reflects the methodology outlined in MTO’s *Capacity Analysis Manual (CAM, 2016)*, which is adopted from the *Highway Capacity Manual (HCM 2000)*. The service measure for basic freeway segments is traffic density. The data used in the LOS analysis includes lane geometry, peak hour volumes, peak hour factors, truck percentages, etc. The level of service criteria for basic freeway segments is presented in Table 2-2.

Table 2-2: Level of service criteria for basic freeway segments

| LEVEL OF SERVICE | DENSITY (PC/KM/LN) |
|------------------|---|
| A | ≤ 7 |
| B | > 7 – 11 |
| C | > 11 – 16 |
| D | > 16 – 22 |
| E | > 22 – 28 |
| F | Demand exceeds capacity OR density > 28 |

Source: Exhibit 5-17, *Capacity Analysis Manual (2016)*

Levels of service from A to D are acceptable operating conditions. LOS A represents free flow conditions, individual users are virtually unaffected by the presence of others in the traffic stream. LOS B is in the range of stable flow, but the presence of other users in traffic stream starts to become noticeable. LOS C is in the range of stable flow but marks the beginning of operation where individual users become significantly affected by interactions with others in the traffic stream. LOS D represents high-density, but stable flow where speed and manoeuvre are severely restricted. LOS E reflects congestion and operating conditions at or near capacity and LOS F reflects unstable traffic operation with high delays.

2.2.2 MAINLINE/FREEWAY SPEED CONTOUR PLOTS AND TRAVEL TIMES

Speed contour plots, developed by dividing the model into 100-metre segments and by gathering average speed information for each 5-minute period of the peak hour, for all highway sections were produced. Average travel times for all highway sections were also summarized along the study corridor.

2.2.3 INTERSECTION LEVEL OF SERVICE ANALYSIS

The Highway 401 ramp terminal operations were assessed using LOS thresholds. The LOS at intersections is based on average control delay, as per the *Capacity Analysis Manual (2016)*. The LOS criteria are summarized in Table 2-3.

Table 2-3: Level of service criteria for intersections

| LEVEL OF SERVICE | CONTROL DELAY PER VEHICLE (S) | |
|------------------|-------------------------------|-------------------------------|
| | Signalized Intersections | Stop-Controlled Intersections |
| A | ≤ 10 | ≤ 10 |
| B | > 10 and ≤ 20 | > 10 and ≤ 15 |
| C | > 20 and ≤ 35 | > 15 and ≤ 25 |
| D | > 35 and ≤ 55 | > 25 and ≤ 35 |
| E | > 55 and ≤ 80 | > 35 and ≤ 50 |
| F | > 80 or $v/c > 1.0$ | > 50 or $v/c > 1.0$ |

Source: Table 7-1, CAM (2016) and Table 6, OTM Book 12

3 EXISTING CONDITIONS

This section will summarize the calibration and validation results for the AM, PM and weekend peak hours and will document the existing conditions along the study area for both summer and fall conditions.

3.1 MODEL CALIBRATION AND VALIDATION

The objective of model calibration is to ensure that the model is a valid representation of typical existing conditions (based on the observed data). Subsequently, the calibrated model is used to measure the effectiveness of future improvements. The Vissim micro-simulation model was calibrated with regards to the obtained traffic counts.

Simulated traffic volumes were measured against traffic counts to determine the accuracy of the model during the AM, PM and weekend peak hours. GEH statistic, a measure of agreement between simulated and observed traffic, is an industry-standard validation measure for simulation models. The formula of GEH statistic is expressed below.

$$GEH = \sqrt{\frac{2(V_s - V_o)^2}{(V_s + V_o)}} \quad \text{where } V_s \text{ is the simulated flow and } V_o \text{ is the observed flow.}$$

The model was considered a good estimate of the field conditions if 85% of the controlled-access highway mainline sections and ramps in the model had a GEH value of less than 5. This threshold was assumed to be 75% for ramp terminal turning movements.

A Vissim micro-simulation model was developed for fall and summer conditions. The traffic data along the corridor was summarized and balanced for both seasons. If summer counts were not available, the fall count data was converted to summer counts to supplement the analysis. The calibration effort compared the simulated volumes to both the observed traffic counts and the balanced volumes. A total of 68 control locations, including 8 mainline segments, 12 ramp roadways, and 48 turning movements at the ramp terminals, were used as part of the model calibration and validation. A detailed summary of the GEH statistics for the peak hours may be found in Appendix A.

The distribution of peak hour GEH values is presented in Figure 3-1 and Figure 3-2 for the fall and the summer, respectively. The simulated volumes fall within GEH < 1 of the balanced volume at most control locations. All control locations have GEH value of less than 5. These results are expected from a one-dimensional network, which offers no alternative path between any OD pair.

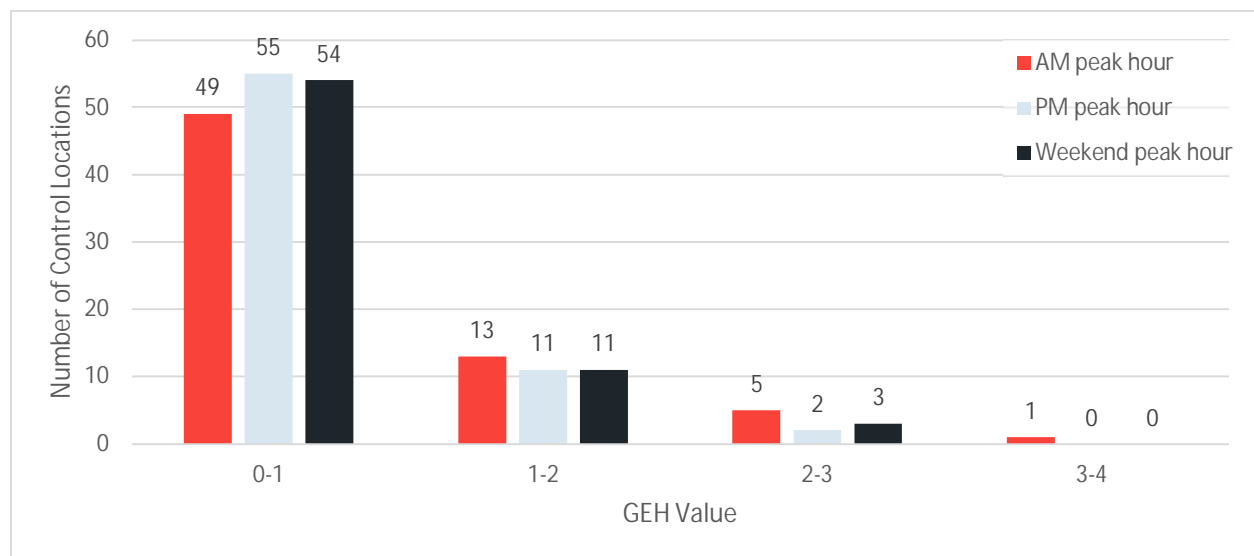


Figure 3-1: Distribution of GEH at control locations during fall

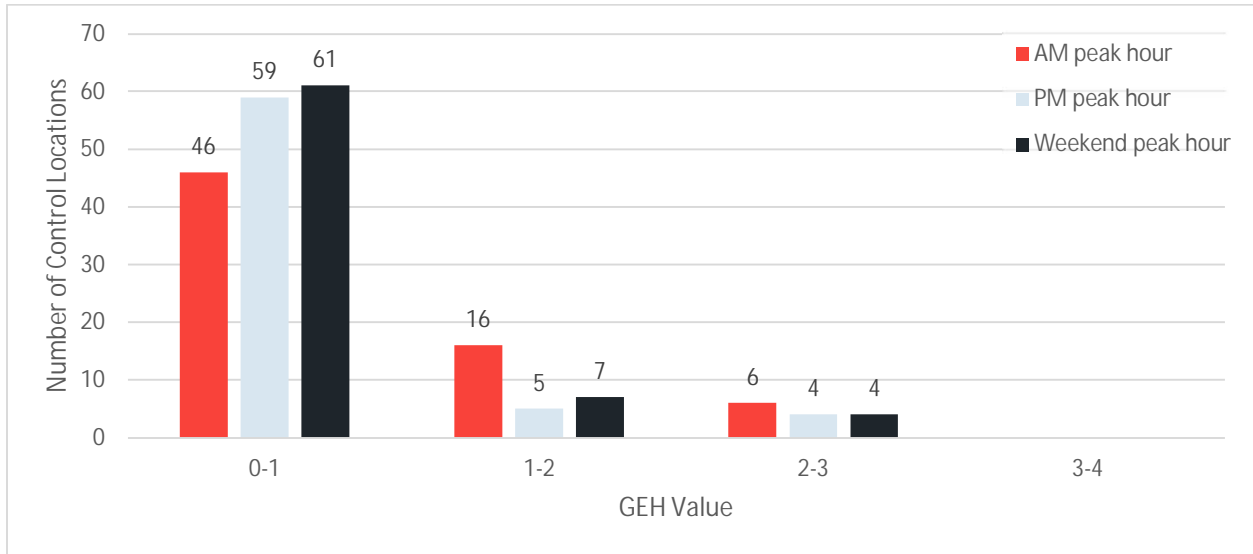


Figure 3-2: Distribution of GEH at control locations during summer

Scatterplots of simulated vs. observed balanced volumes, during fall conditions, are presented in Figure 3-3 and Figure 3-4 for the weekday AM and PM peak hours, and in Figure 3-5 for the weekend mid-day peak hour. The linear regression equations, R^2 values, and GEH = 5 envelope are also displayed. The slopes of the trendlines are near one, suggesting that the traffic volumes are not underrepresented in the model. The R^2 value represents a goodness-of-fit measure of the linear regression analysis. The R^2 values are greater than 0.99 over all peak periods, indicating a good match between the simulated and balanced volumes. It is concluded that the models are well-calibrated to the observed traffic volumes.

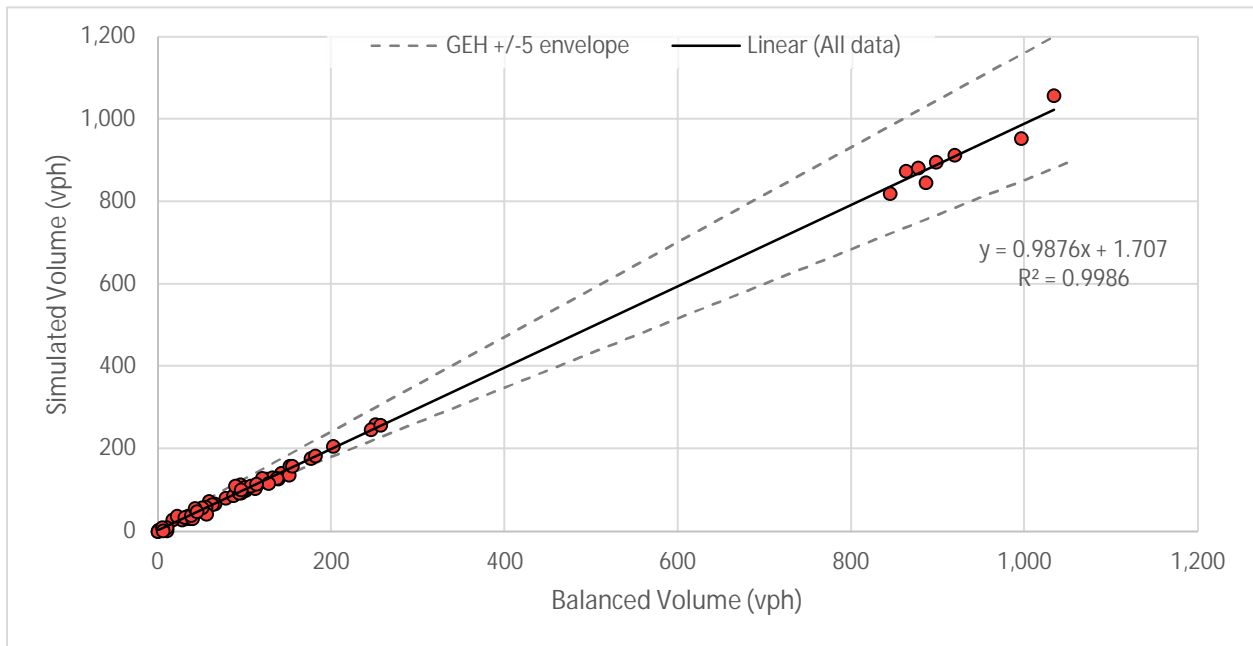


Figure 3-3: AM peak hour simulated flow vs. observed (balanced) flow during fall conditions

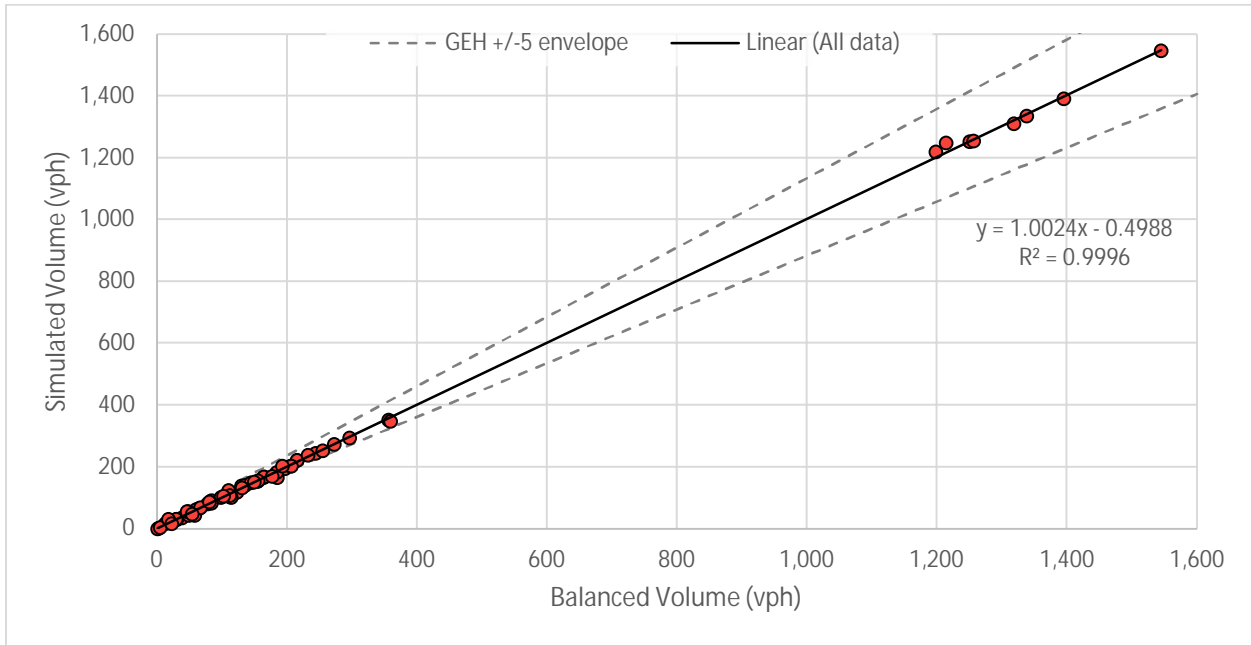


Figure 3-4: PM peak hour simulated flow vs. observed (balanced) flow during fall conditions

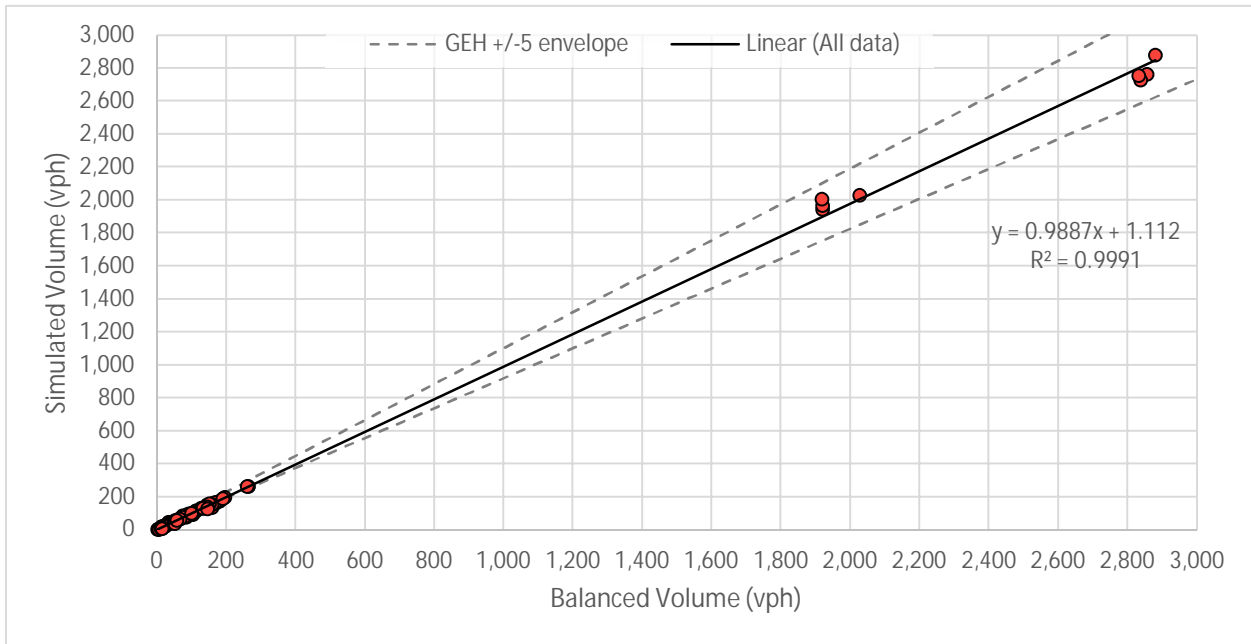


Figure 3-5: Weekend peak hour simulated flow vs. observed (balanced) flow during fall conditions

Simulated vs. observed balanced volumes under the summer conditions were also plotted for the weekday and weekend peak hours in Figure 3-6, Figure 3-7, and Figure 3-8. The trendlines and the R^2 values suggests that the simulated traffic volumes are not underrepresented and are a fair estimate of the balanced traffic volumes.

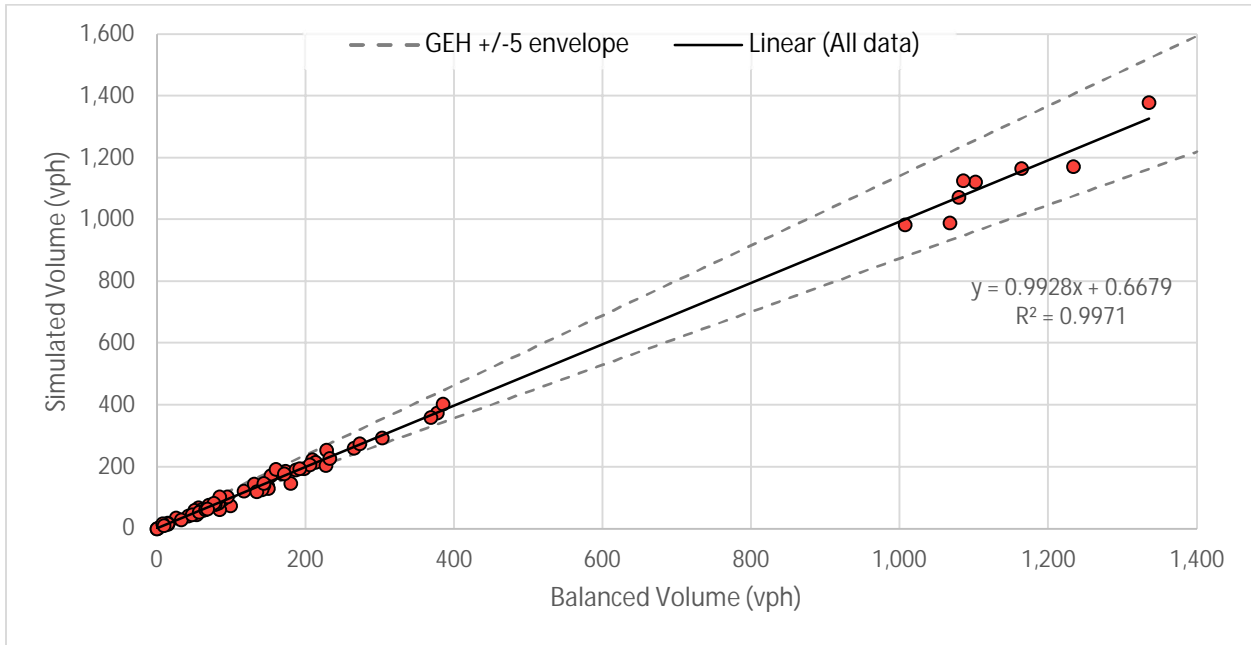


Figure 3-6: AM peak hour simulated flow vs. observed (balanced) flow during summer conditions

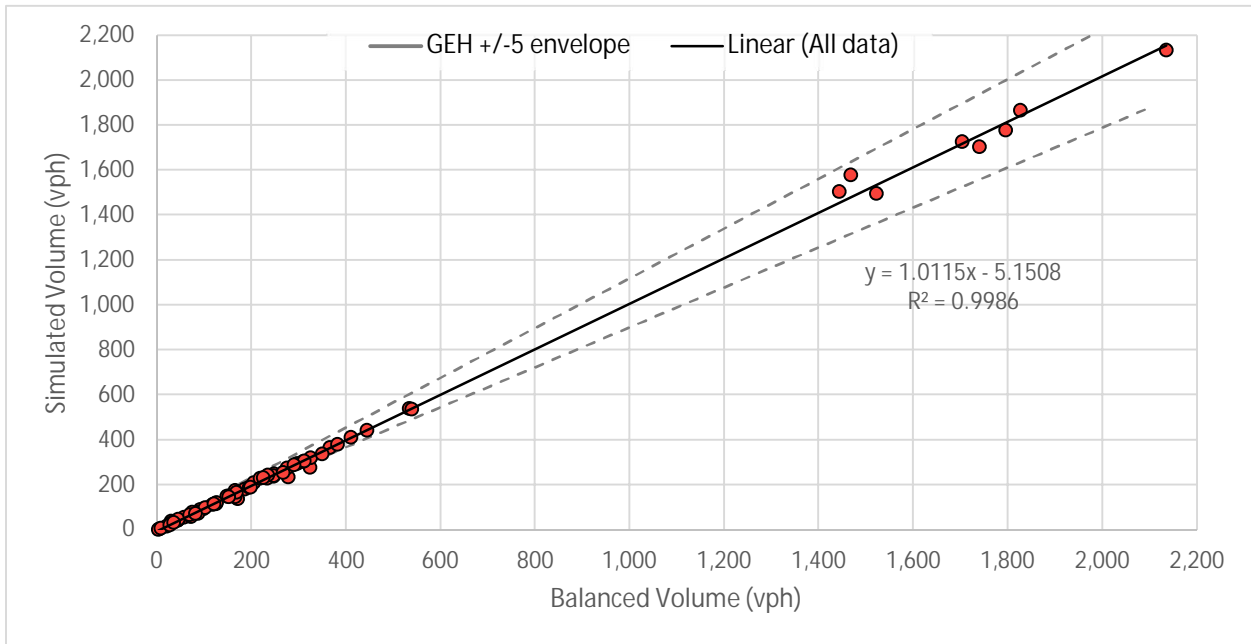


Figure 3-7: PM peak hour simulated flow vs. observed (balanced) flow during summer conditions

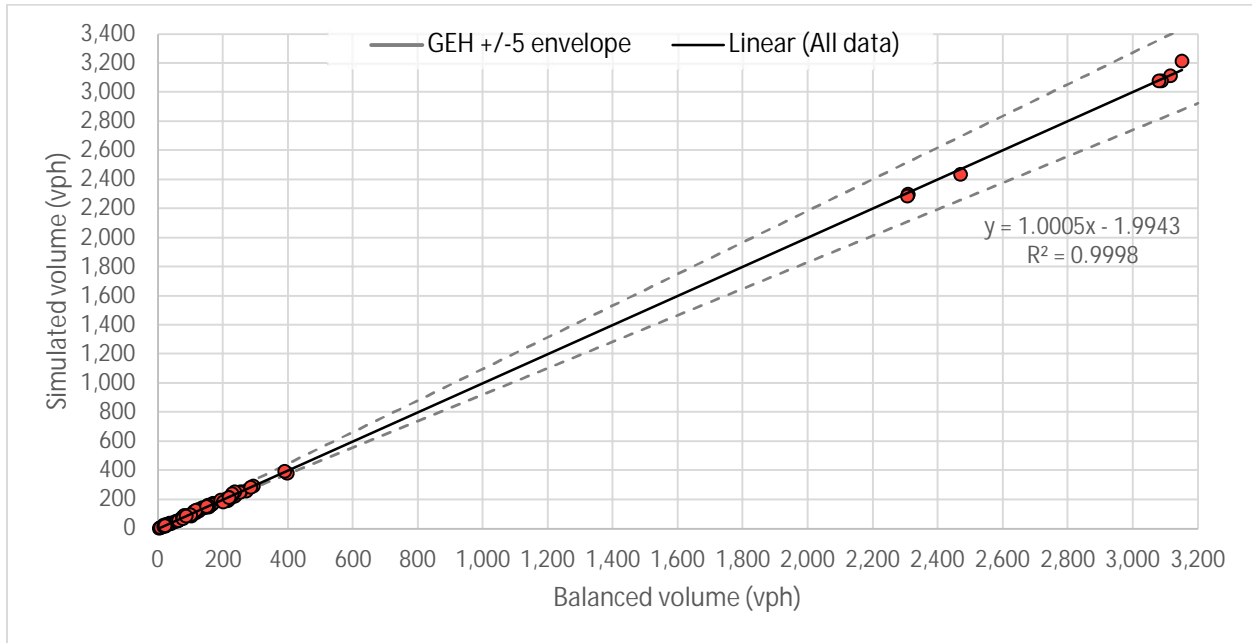


Figure 3-8: Weekend peak hour simulated flow vs. observed (balanced) flow during summer conditions

3.2 TRANSPORTATION NETWORK

The existing Highway 401 corridor, from Colborne to Brighton, is currently a four-lane freeway with a posted speed limit of 100 km/h. There are three interchanges in the vicinity of the study area at County Road 25/Percy Street, County Road 30, and County Road 40/Wooler Road. The lane configurations and traffic controls across the study area are presented in Figure 3-9.

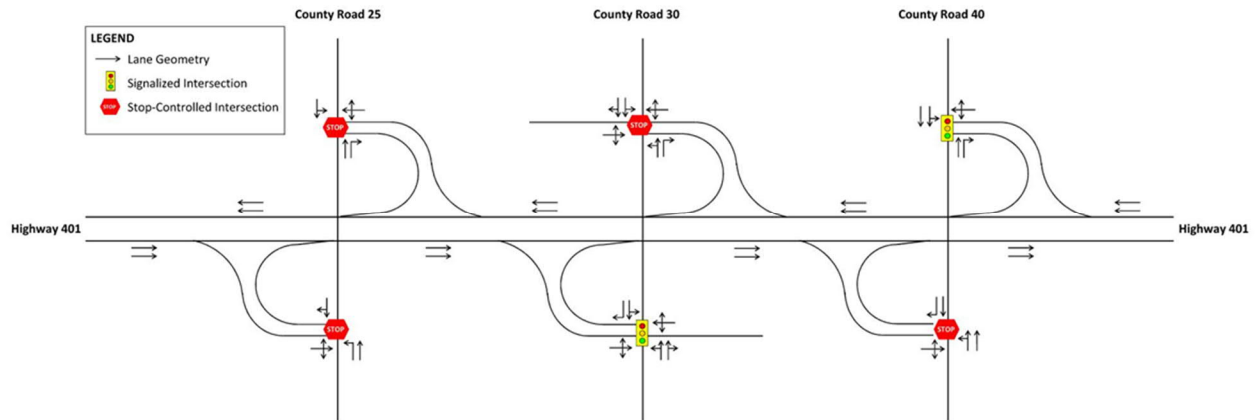


Figure 3-9: Existing intersection lane configurations and traffic controls

3.3 TRAFFIC OPERATIONAL ANALYSIS

This section discusses the performance of the roadway operation under the existing conditions based on the key performance measures specified in Section 2.2.

3.3.1 MAINLINE/FREEWAY LEVEL OF SERVICE

The Highway 401 corridor currently serves Annual Average Daily Traffic (AADT) volumes of 46,000 to 46,500 vehicles between County Road 25 and County Road 40. The 2020 AADT was estimated from available 2016 ATR counts and applying a growth rate of 1.5% per annum, as advised by MTO.

Based on the 2016 TVIS data provided by MTO, the Design Hour Volume (DHV) percentage is 9.8% and the DHV splits are 53% to 54%. The estimated 2020 DHVs are presented in Table 3-1

Table 3-1: Existing (2020) Highway 401 mainline traffic data

| HIGHWAY 401 | BETWEEN CR 25 AND CR 30 | BETWEEN CR 30 AND CR 40 |
|-------------------------------------|-------------------------|-------------------------|
| Annual Average Daily Traffic (AADT) | 46,000 | 46,500 |
| Commercial Vehicle (%) | 26.8 | 26.3 |
| DHV (%) | 9.8 | 9.8 |
| DHV Split | 53 | 54 |
| Design Hour Volume | 2,390 | 2,460 |

The calculated density, volume-to-capacity ratios (v/c), and LOS are presented in Table 3-2 for Highway 401 segments under different peak hour conditions while volume diagrams along the study area are presented in Figure 3-9 through Figure 3-13. The peak-direction LOS analysis indicates that Highway 401 is currently operating with LOS A during the AM peak hour and LOS A to B during the PM peak hour. The weekend peak hour operation is the most critical, with LOS D. Overall, the mainline is operating at acceptable levels of service under the existing traffic demands.

Table 3-2: Existing (2020) Highway 401 Mainline performance

| TRAVEL DEMAND PERIOD | SEASON | BETWEEN CR 25 & CR 30 | | | BETWEEN CR 30 & CR 40 | | |
|-----------------------------------|--------|-----------------------|------|-----|-----------------------|------|-----|
| | | DENSITY (PC/KM/LN) | V/C | LOS | DENSITY (PC/KM/LN) | V/C | LOS |
| AM Peak hour, Peak-Direction | Fall | 4.9 | 0.23 | A | 4.8 | 0.23 | A |
| | Summer | 5.9 | 0.28 | A | 6.1 | 0.28 | A |
| PM Peak hour, Peak-Direction | Fall | 6.8 | 0.32 | A | 7.1 | 0.33 | B |
| | Summer | 9.2 | 0.43 | B | 9.7 | 0.45 | B |
| Weekend Peak hour, Peak-Direction | Fall | 16.2 | 0.75 | D | 16.2 | 0.75 | D |
| | Summer | 18.1 | 0.81 | D | 18.1 | 0.81 | D |

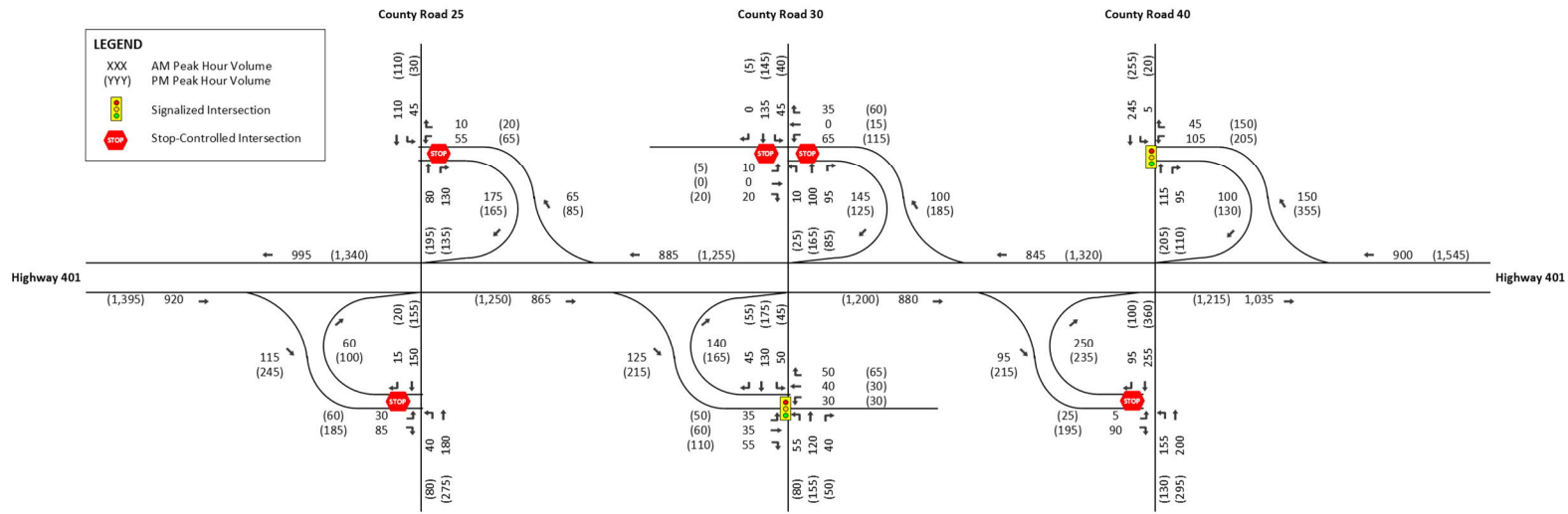


Figure 3-10: Existing (2020) peak hour traffic volumes (fall) – weekday AM and PM peak hours

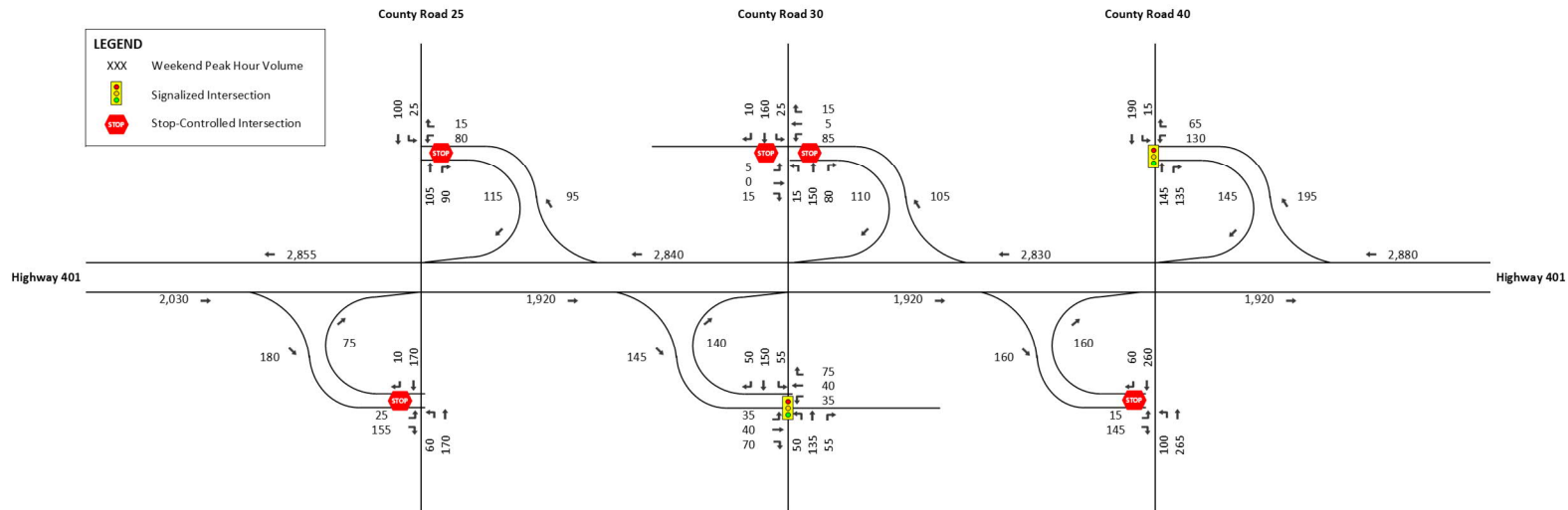


Figure 3-11: Existing (2020) peak hour traffic volumes (fall) – weekend mid-day peak hour

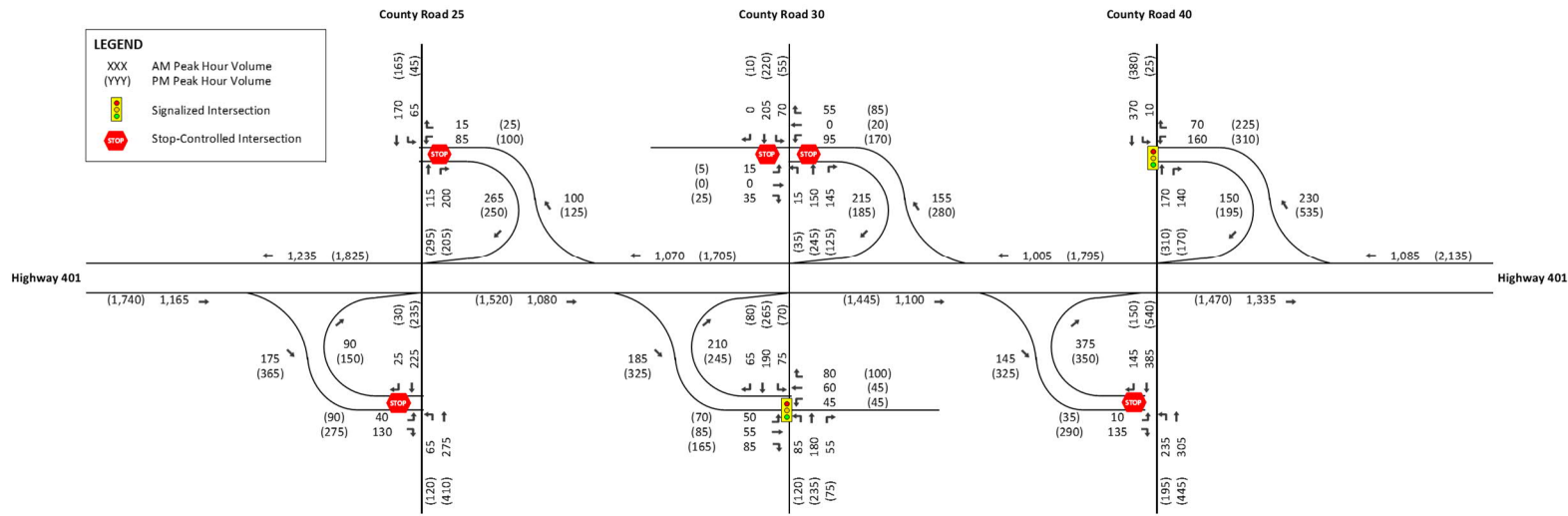


Figure 3-12: Existing (2020) peak hour traffic volumes (summer) – weekday AM and PM peak hours

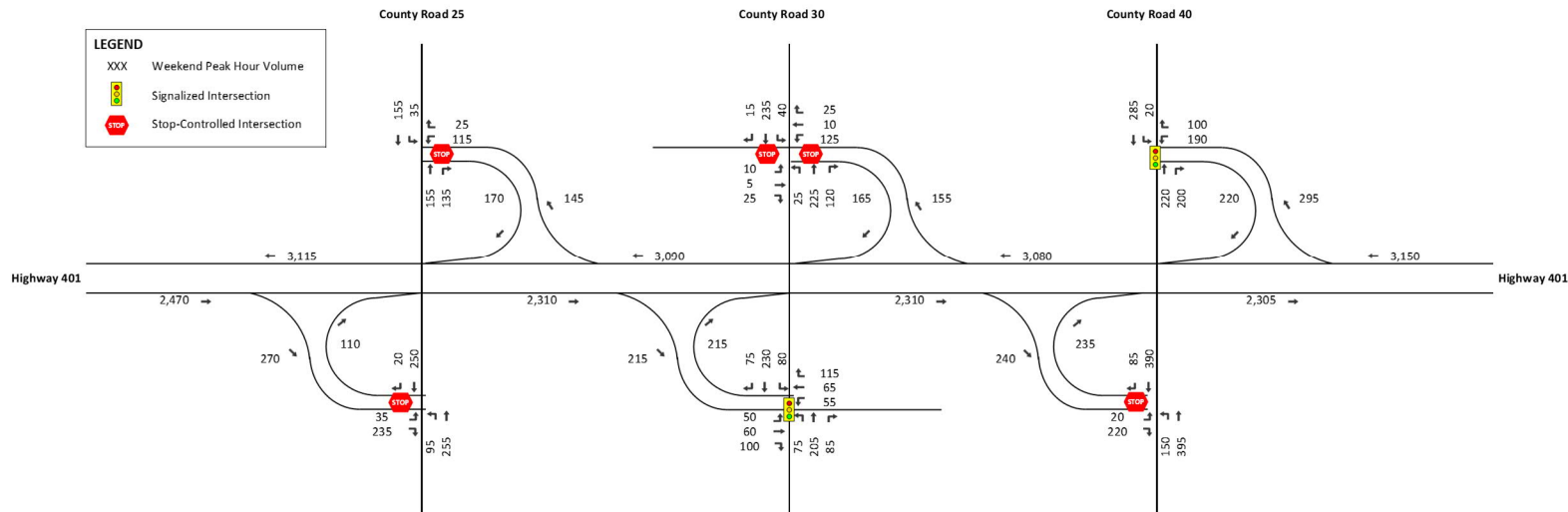


Figure 3-13: Existing (2020) peak hour traffic volumes (summer) – weekend mid-day peak hour

3.3.2 MAINLINE/FREEWAY TRAVEL TIMES AND SPEED

The simulated mainline travel times and speeds for the existing weekday AM, PM, and weekend peak hours are presented on Table 3-3. Highway 401 generally operates under free-flow conditions with simulated speeds of greater than 100 km/h during the weekday AM and PM peak hours. Under the weekend peak hour condition, the simulated speeds fall slightly below 100 km/h due to higher traffic demands.

Table 3-3: Simulated travel times and speeds along Highway 401

| HIGHWAY 401 SEGMENT | TRAVEL TIME (MIN) | | | SPEED (KM/H) | | |
|--------------------------------------|-------------------|---------|-----------|--------------|---------|-----------|
| | AM PEAK | PM PEAK | WKND PEAK | AM PEAK | PM PEAK | WKND PEAK |
| Highway 401 Eastbound: Fall | | | | | | |
| CR 25 to CR 30 | 7.2 | 7.3 | 7.4 | 103.6 | 102.7 | 100.5 |
| CR 30 to CR 40 | 7.2 | 7.3 | 7.5 | 102.9 | 102.1 | 99.6 |
| Highway 401 Westbound: Fall | | | | | | |
| CR 40 to CR 30 | 7.2 | 7.3 | 7.6 | 103.5 | 102.4 | 98.2 |
| CR 30 to CR 25 | 7.2 | 7.3 | 7.7 | 103.1 | 102.0 | 97.1 |
| Highway 401 Eastbound: Summer | | | | | | |
| CR 25 to CR 30 | 7.2 | 7.4 | 7.5 | 103.1 | 101.4 | 99.5 |
| CR 30 to CR 40 | 7.3 | 7.4 | 7.6 | 102.3 | 100.7 | 98.4 |
| Highway 401 Westbound: Summer | | | | | | |
| CR 40 to CR 30 | 7.2 | 7.4 | 7.7 | 104.1 | 101.2 | 97.2 |
| CR 30 to CR 25 | 7.2 | 7.4 | 7.8 | 103.5 | 100.6 | 95.7 |

The speed contour plots along Highway 401 in both directions of travel for the weekday and weekend peak periods are presented in Figure 3-14 to Figure 3-25. The speed contour plots are generated for 100-metre sections along the Highway 401 at five-minute intervals. These plots provide a network-wide view of the mainline traffic operations and help with the identification of any operational constraints, such as queuing. The speed contour plots show that for the weekday peak periods, Highway 401 traffic travels at the posted speed limit of 100 km/h with minor speed reductions around the interchanges, especially at on-ramp merges. The travel speeds during the weekend peak period are slightly lower than the weekday operating speeds, with similar levels of speed reductions around the interchanges.

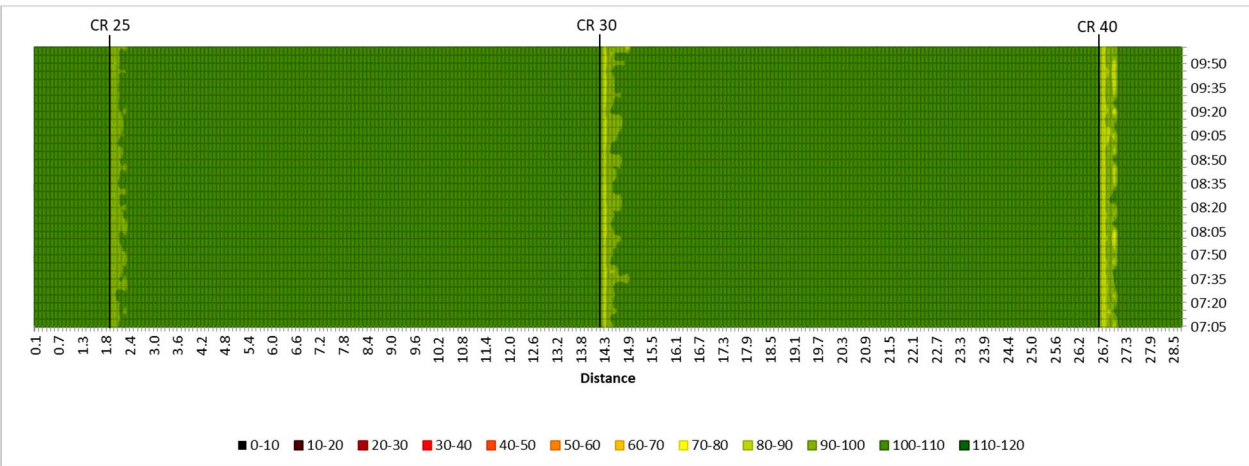


Figure 3-14: Speed plot on Highway 401 eastbound – existing conditions (fall) – AM peak period

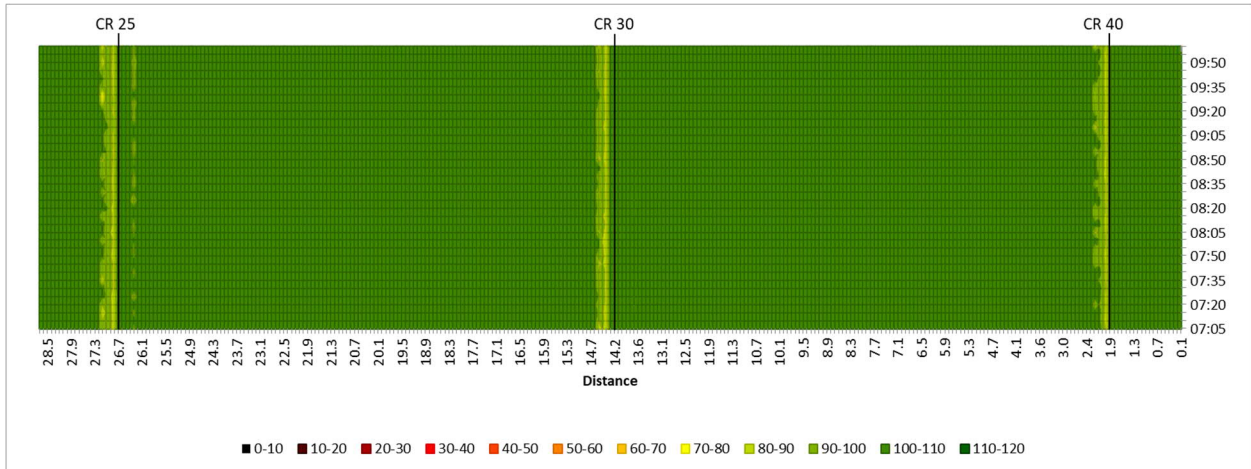


Figure 3-15: Speed plot on Highway 401 westbound – existing conditions (fall) – AM peak period

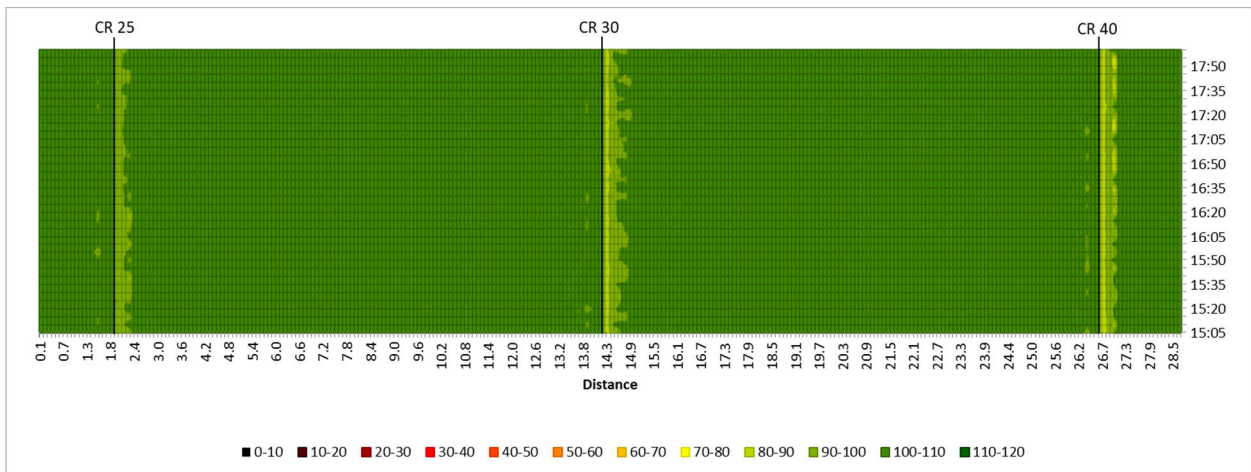


Figure 3-16: Speed plot on Highway 401 eastbound – existing conditions (fall) – PM peak period

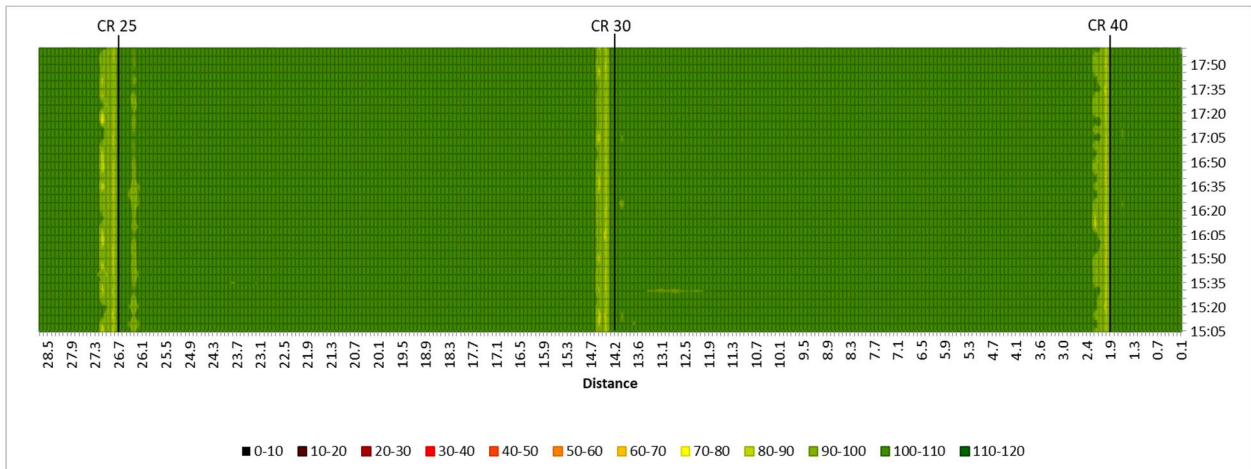


Figure 3-17: Speed plot on Highway 401 westbound – existing conditions (fall) – PM peak period

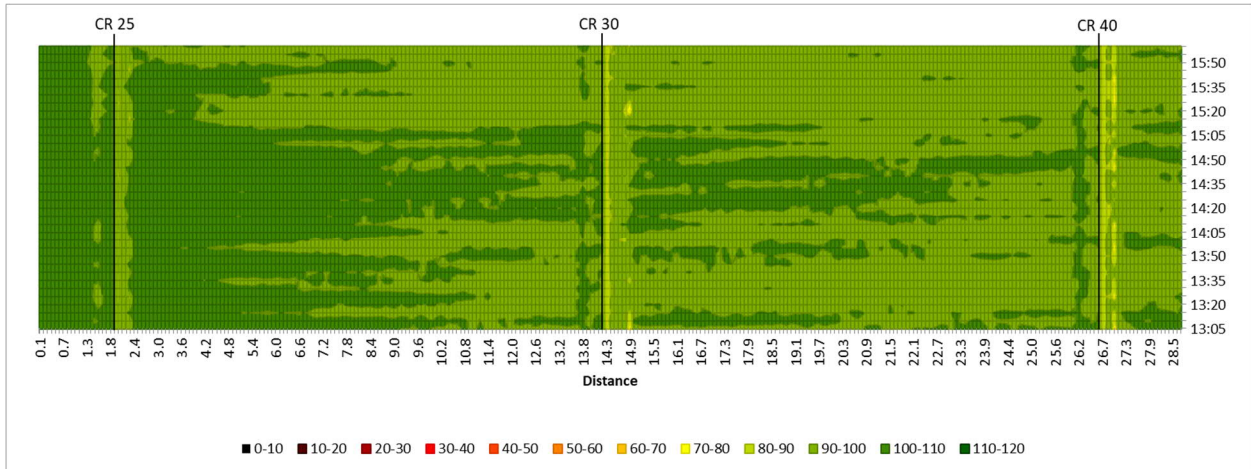


Figure 3-18: Speed plot on Highway 401 eastbound – existing conditions (fall) – weekend peak period

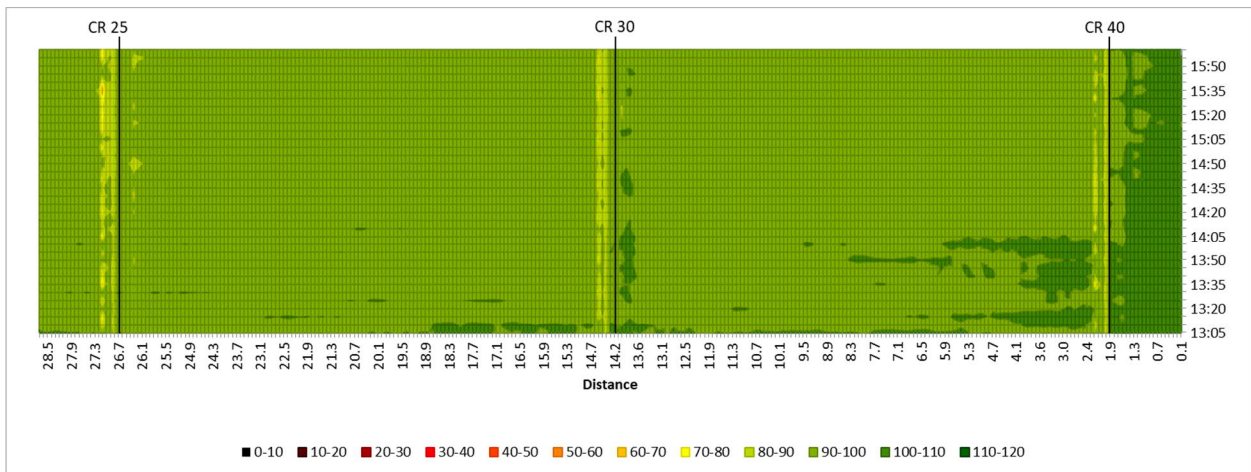


Figure 3-19: Speed plot on Highway 401 westbound – existing conditions (fall) – weekend peak period

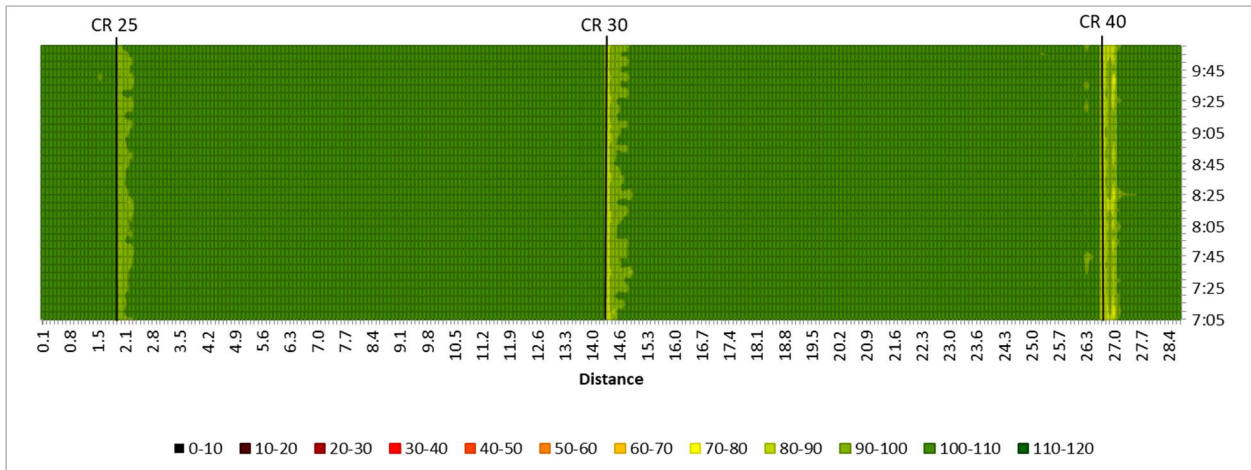


Figure 3-20: Speed plot on Highway 401 eastbound – existing conditions (summer) – AM peak period

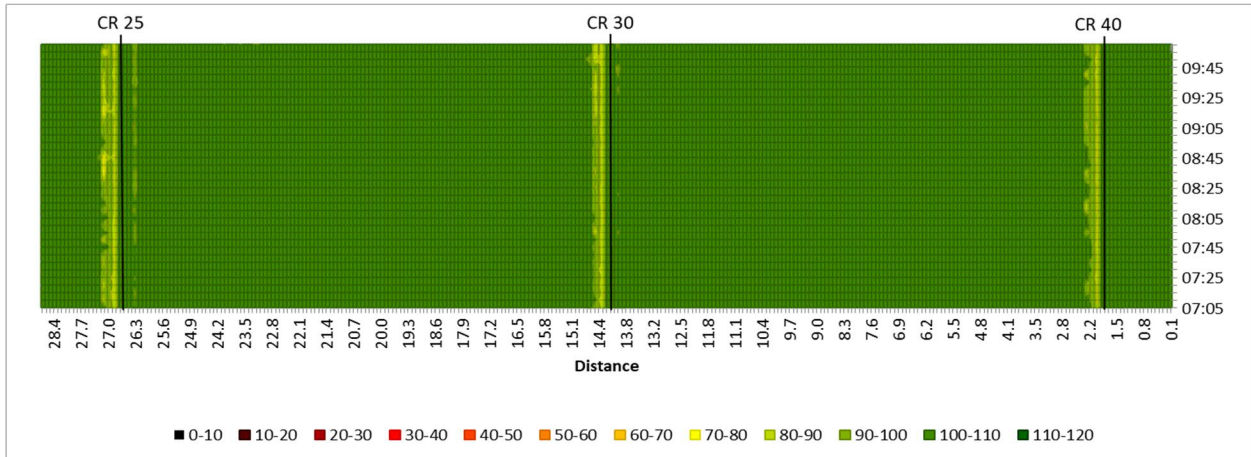


Figure 3-21: Speed plot on Highway 401 westbound – existing conditions (summer) – AM peak period

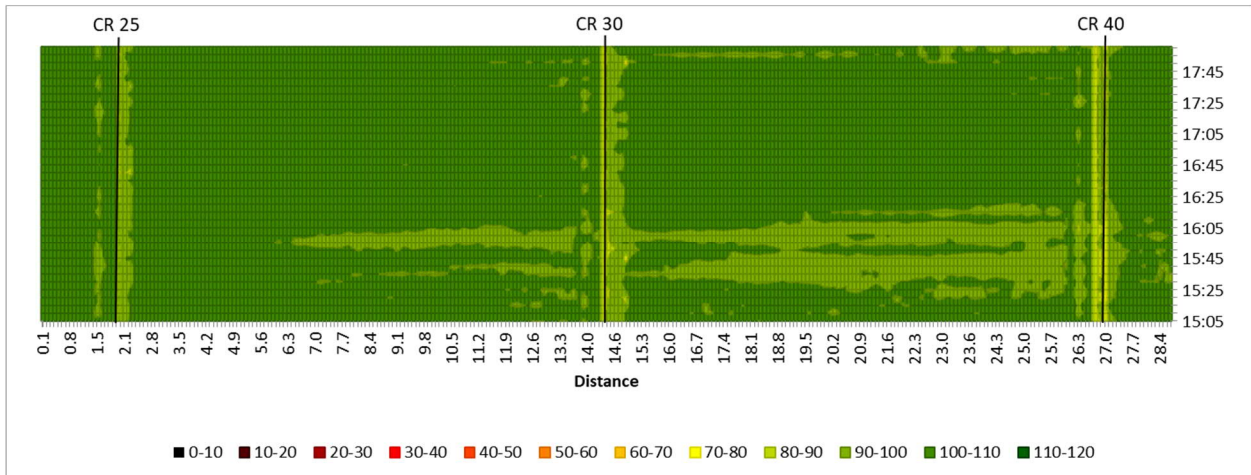


Figure 3-22: Speed plot on Highway 401 eastbound – existing conditions (summer) – PM peak period

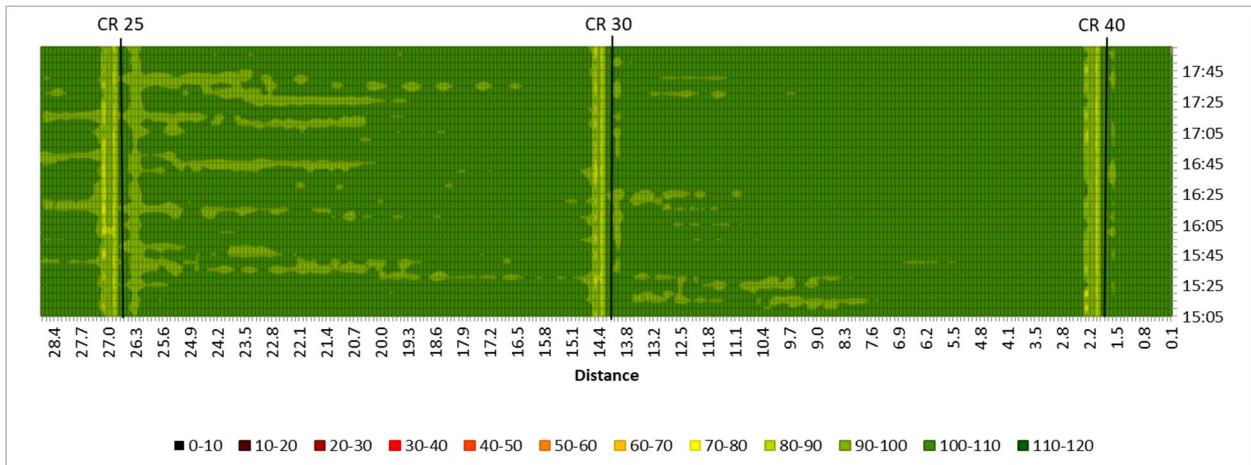


Figure 3-23: Speed plot on Highway 401 westbound – existing conditions (summer) – PM peak period

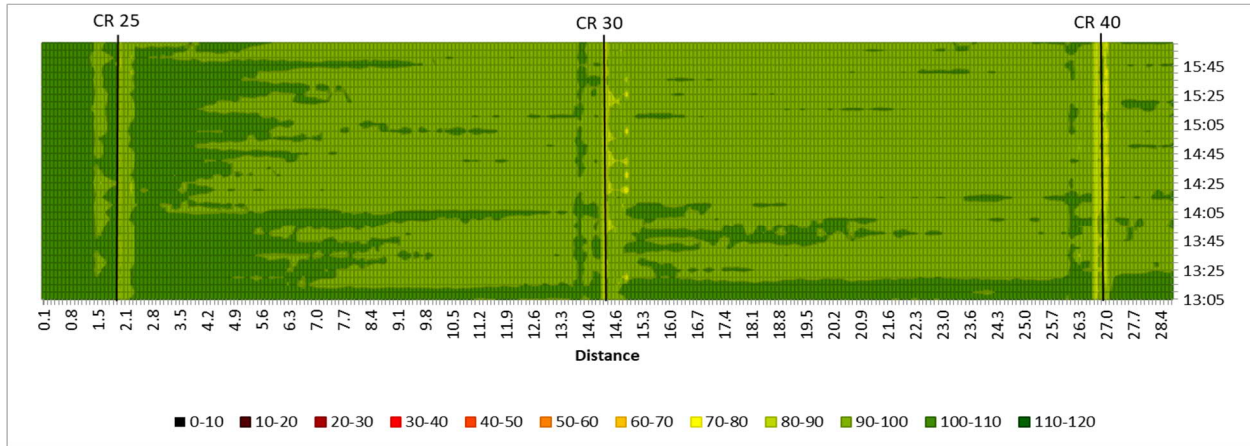


Figure 3-24: Speed plot on Highway 401 eastbound – existing conditions (summer) – weekend peak period

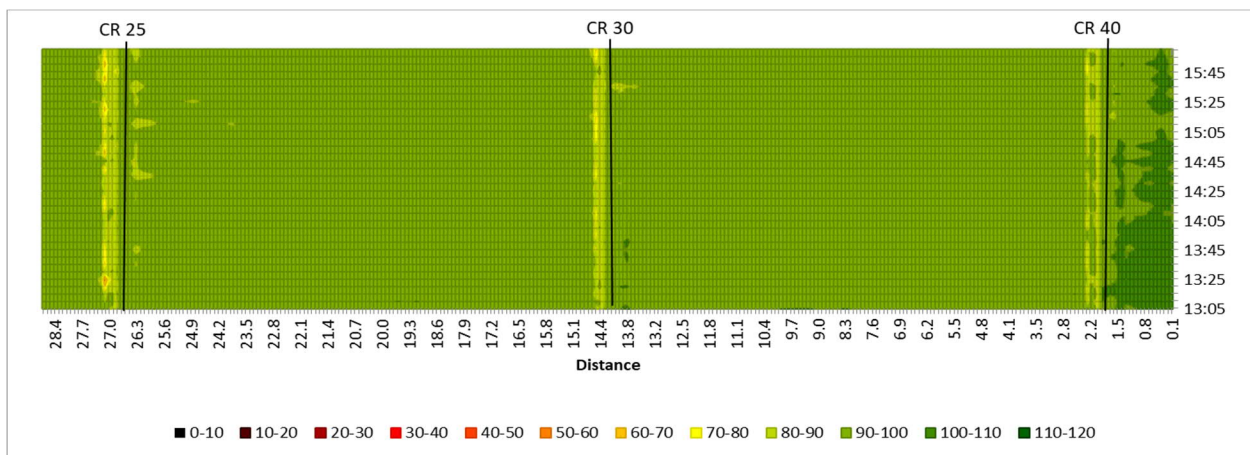


Figure 3-25: Speed plot on Highway 401 westbound – existing conditions (summer) – weekend peak period

3.3.3 RAMP TERMINAL OPERATIONS

Vehicle delay and the resulting LOS, as well as the 95th percentile queue lengths for the ramp terminal turning movements were evaluated based on the micro-simulation model results. The intersection LOS was determined based on average control delay, as per the *Highway Capacity Manual (HCM) 2000*. The traffic operational performance indicators for the study area are summarized in Table 3-4 and Table 3-5.

The traffic operational analysis results indicate that all of the ramp terminals operate at overall LOS A or B during the weekday and weekend peak hours. All turning movements are operating at an acceptable LOS of D or better.

Table 3-4: Existing intersection operational analysis results (fall)

| INTERSECTIONS/ MOVEMENTS | WEEKDAY AM PEAK | | | WEEKDAY PM PEAK | | | WEEKEND PEAK | | |
|---|-----------------|----------|---------------------------|-----------------|----------|---------------------------|--------------|----------|---------------------------|
| | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 2 | A | | 2 | A | | 2 | A | |
| Westbound Left/Right | 8/7 | A | 9 | 10/8 | A | 16 | 9/7 | A | 13 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left/Through | 3/0 | A | 0 | 3/0 | A | 0 | 2/0 | A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 2 | A | | 6 | A | | 3 | A | |
| Eastbound Left/Right | 9/7 | A | 14 | 21/17 | C | 55 | 10/9 | B/A | 21 |
| Northbound Left | 2 | A | 0 | 2 | A | 0 | 2 | A | 0 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Through/Right | 0/1 | A | 0 | 0/1 | A | 0 | 0/1 | A | 0 |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 2 | A | | 3 | A | | 2 | A | |
| Eastbound Left/Through/Right | 4/0/6 | A | 6 | 7/0/7 | A | 5 | 7/9/6 | A | 5 |
| Westbound Left/Through/Right | 8/10/7 | A/B/A | 17 | 9/12/10 | A/B/A | 24 | 8/12/9 | A/B/A | 13 |
| Northbound Left/Through | 2/0 | A | 0 | 2/1 | A | 0 | 2/0 | A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left/Through/Right | 2/0/0 | A | 0 | 2/0/1 | A | 0 | 2/0/1 | A | 0 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 7 | A | | 9 | A | | 8 | A | |
| Eastbound Left/Through/Right | 10/11/6 | B/B/A | 26 | 12/13/9 | B/B/A | 53 | 11/10/7 | B/B/A | 24 |
| Westbound Left/Through/Right | 11/11/5 | B/B/A | 22 | 13/11/6 | B/B/A | 25 | 10/12/6 | B/B/A | 25 |
| Northbound Left/Through/Right | 9/6/4 | A | 21 | 10/8/5 | A | 23 | 9/7/5 | A | 19 |
| Southbound Left/Through | 9/8 | A | 25 | 10/10 | B/A | 35 | 10/10 | B/A | 27 |
| Southbound Right | 5 | A | 7 | 4 | A | 9 | 4 | A | 6 |
| Hwy 401 at CR 40 North ramp terminal (Signalized) | 6 | A | | 8 | A | | 6 | A | |
| Westbound Left/Right | 10/6 | A | 27 | 12/9 | B/A | 55 | 9/6 | A | 26 |
| Northbound Through | 5 | A | 18 | 8 | A | 30 | 5 | A | 17 |
| Northbound Right | 3 | A | 12 | 3 | A | 16 | 3 | A | 14 |
| Southbound Left/Through | 5 | A | 21 | 11/7 | B/A | 24 | 8/6 | A | 16 |
| Hwy 401 at CR 40 South ramp terminal (Stop-controlled) | 2 | A | | 5 | A | | 3 | A | |
| Eastbound Left/Right | 12/7 | B/A | 0 | 13/10 | B/A | 0 | 12/7 | B/A | 0 |
| Northbound Left/Through | 3/1 | A | 0 | 4/1 | A | 0 | 3/0 | A | 0 |
| Southbound Through | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |

Note 1: Queue length reflects the 95th percentile queue length

Table 3-5: Existing intersection operational analysis results (summer)

| INTERSECTIONS/ MOVEMENTS | WEEKDAY AM PEAK | | | WEEKDAY PM PEAK | | | WEEKEND PEAK | | |
|---|-----------------|----------|---------------------------|-----------------|----------|---------------------------|--------------|----------|---------------------------|
| | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 2 | A | | 2 | A | | 3 | A | |
| Westbound Left/Right | 10/7 | A/A | 12 | 11/8 | B/A | 17 | 11/8 | B/A | 17 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left/Through | 4/1 | A/A | 0 | 5/1 | A/A | 0 | 3/0 | A/A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 3 | A | | 9 | A | | 4 | A | |
| Eastbound Left/Right | 13/10 | B/A | 25 | 28/27 | D/D | 77 | 14/12 | B/B | 31 |
| Northbound Left | 3 | A | 0 | 3 | A | 0 | 3 | A | 0 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Through/Right | 0/1 | A/A | 0 | 1/1 | A/A | 0 | 0/1 | A/A | 0 |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 3 | A | | 4 | A | | 2 | A | |
| Eastbound Left/Through/Right | 7/0/7 | A/A/A | 6 | 7/9/7 | A/A/A | 6 | 6/7/7 | A/A/A | 6 |
| Westbound Left/Through/Right | 9/7/8 | A/A/A | 21 | 13/15/11 | B/C/B | 37 | 8/11/9 | A/B/A | 18 |
| Northbound Left/Through | 3/1 | A/A | 0 | 3/1 | A/A | 0 | 3/1 | A/A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left/Through/Right | 3/0/0 | A/A/A | 1 | 4/0/1 | A/A/A | 1 | 3/0/1 | A/A/A | 0 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 9 | A | | 10 | B | | 10 | A | |
| Eastbound Left/Through/Right | 12/14/8 | B/B/A | 32 | 13/14/9 | B/B/A | 43 | 13/13/8 | B/B/A | 30 |
| Westbound Left/Through/Right | 12/13/7 | B/B/A | 31 | 15/13/7 | B/B/A | 31 | 14/14/8 | B/B/A | 33 |
| Northbound Left/Through/Right | 10/8/5 | B/A/A | 26 | 13/8/6 | B/A/A | 31 | 10/8/6 | B/A/A | 28 |
| Southbound Left/Through | 10/11 | B/B | 35 | 13/12 | B/B | 47 | 11/11 | B/B | 37 |
| Southbound Right | 5 | A | 13 | 5 | A | 12 | 5 | A | 10 |
| Hwy 401 at CR 40 North ramp terminal (Signalized) | 8 | A | | 12 | B | | 7 | A | |
| Westbound Left/Right | 12/7 | B/A | 36 | 17/14 | B/B | 85 | 12/7 | B/A | 33 |
| Northbound Through | 7 | A | 26 | 11 | B | 40 | 7 | A | 23 |
| Northbound Right | 3 | A | 15 | 4 | A | 17 | 4 | A | 16 |
| Southbound Left/Through | 9/7 | A/A | 23 | 18/10 | B/A | 27 | 11/7 | B/A | 22 |
| Hwy 401 at CR 40 South ramp terminal (Stop-controlled) | 3 | A | | 5 | A | | 3 | A | |
| Eastbound Left/Right | 12/7 | B/A | 19 | 22/16 | C/C | 58 | 15/10 | C/A | 30 |
| Northbound Left/Through | 6/1 | A/A | 12 | 8/1 | A/A | 21 | 4/1 | A/A | 4 |
| Southbound Through | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 1 | A | 0 | 2 | A | 0 | 1 | A | 0 |

Note 1: Queue length reflects the 95th percentile queue length

4 SAFETY ANALYSIS

As part of the study, a safety analysis was conducted for the Highway 401 mainline, ramps, and ramp terminals within the study area, with the following objectives:

- To review the collision history of along the corridor and to identify any collision-prone locations on Highway 401 from Percy Street/County Road 25 to Wooler Road/County Road 40;
- To evaluate and recommend potential improvements to improve safety at the collision-prone locations.

Collision records were reviewed for the five-year period from January 4, 2012, to December 31, 2016. For the purposes of the safety evaluation, the corridor is divided into interchange influence zones (1 km on either side of an interchange or half the distance to the next interchange, whichever is shorter), mainline sections (outside the influence zones), ramps, and ramp terminal intersections. Note the terms “mainline” and “interchange influence zones” will be used to refer to the combined eastbound and westbound directions.

4.1 COLLISION CHARACTERISTICS

The collision records were reviewed and summarized according to various characteristics that may have contributed to the incident occurrence. The characteristics evaluated are as follows:

- severity;
- impact type;
- driver action – indicates the percentage of recorded collisions in which at least one of the drivers involved displayed a particular action. “Driving properly” is reported as a percentage of collisions in which all involved drivers were reported as driving properly;
- driver condition – indicates the percentage of recorded collisions in which at least one of the drivers involved displayed a particular condition. “Normal” is reported as a percentage of collisions in which all involved drivers were reported as being under no impairment of driving ability;
- light conditions;
- weather conditions;
- road surface conditions; and,
- an absence of adverse lighting, weather, or road surface conditions – indicates the percentage of collisions that occur in daylight with clear weather and dry road surface conditions.

Within the study area, Highway 401 were divided into different sections according to the Linear Highway Referencing System (LHRS). The mainline sections considered for this study are specified below:

- Wooler Road/County Road 40 interchange partial influence zone – from 0 to 0.9 km west of County Road 40 (LHRS 47494) – length 1.0 km;
- Mainline segment – from 1.0 km to 11.3 km west of County Road 40 (LHRS 47494) – length 10.4 km;
- County Road 30 interchange influence zone – from 11.4 km west of County Road 40 (LHRS 47494) to 0.9 km west of County Road 30 (LHRS 47500) – length 2.0 km;
- Mainline segment – from 1.0 to 11.3 km west of County Road 30 (LHRS 47500) – length 10.4 km; and
- Percy Street/County Road 25 partial interchange influence zone – from 11.4 to 12.3 km west of County Road 30 (LHRS 47500) – length 1.0 km.

Mainline

A total of 586 collisions occurred on the Highway 401 mainline (both directions) within the study area from 2012 to 2016. Over this period of time, 18.1% (106 collisions) resulted in injury, and 81.7% (479 collisions) resulted in property damage only. A majority of the collisions involved single-vehicle impacts (66.2% or 388 collisions), followed by rear end (17.1% or 100 collisions) and sideswipe (14.5% or 85 collisions). It is noted that 79.0% (463 collisions) involved an improper driving action on the part of one or more drivers, 61.3% (359 collisions) occurred under normal driver condition, and 79.3% (433 collisions) occurred under adverse lighting, weather, and/or road surface conditions.

Summaries of collision characteristics for the five-year period are shown in Figure 4-1 to Figure 4-5 for highway mainline segments and interchange influence zones.

Wooler Road / County Road 40 interchange partial influence zone (1km) - from 0.0 km to 0.9 km west of Wooler Road / County Road 40

Summaries of collision characteristics for the five-year period are shown on Figure 4-1.

- 18.2% of incidents (8 of 44 incidents) resulted in injury.
- 59.1% of incidents (26 of 44 incidents) involved only a single vehicle.
- 20.5% of incidents (9 of 44 incidents) involved sideswipes.
- 36.4% of incidents (16 of 44 incidents) involved excess speed.
- 27.3% of incidents (12 of 44 incidents) involved drivers losing control of the vehicle.
- 77.3% of incidents (34 of 44 incidents) involved drivers who exhibited normal driving behaviour.
- 47.7% of incidents (21 of 44 incidents) occurred under conditions of darkness.
- 63.6% of incidents (28 of 44 incidents) occurred under adverse weather conditions, including snow and rain.
- 68.2% of incidents (30 of 44 incidents) occurred under adverse road surface conditions, including wet, icy, loose snow, pack snow, and slush.

Wooler Road / County Road 40 mainline segment (9.3 km) – from 1.0 km to 11.3 km west of Wooler Road/County Road 40

Summaries of collision characteristics for the five-year period are shown on Figure 4-2.

- 0.5% of incidents (1 of 208 incidents) resulted in a fatality.
- 16.8% of incidents (35 of 208 incidents) resulted in injury.
- 61.5% of incidents (128 of 208 incidents) involved only a single vehicle.
- 20.2% of incidents (42 of 208 incidents) involved rear-end impacts.
- 29.3% of incidents (61 of 208 incidents) involved excess speed.
- 68.3% of incidents (142 of 208 incidents) involved drivers who exhibited normal driving behaviour.
- 34.1% of incidents (72 of 208 incidents) occurred under conditions of darkness.
- 50.5% of incidents (105 of 208 incidents) occurred under adverse weather conditions, including snow and rain.
- 55.8% of incidents (116 of 208 incidents) occurred under adverse road surface conditions, including wet, icy, loose snow, pack snow, and slush.

County Road 30 interchange influence zone (2.0 km) - from 11.4 km west of Wooler Road/ County Road 40 to 0.9 km west of County Road 30

Summaries of collision characteristics for the five-year period are shown on Figure 4-3.

- 17.1% of incidents (21 of 123 incidents) resulted in injury.
- 69.9% of incidents (86 of 123 incidents) involved only a single vehicle.
- 35.8% of incidents (44 of 123 incidents) involved excess speed.
- 22.0% of incidents (27 of 123 incidents) involved drivers losing control of the vehicle.
- 58.7% of incidents (72 of 123 incidents) involved drivers who exhibited normal driving behaviour.
- 32.5% of incidents (40 of 123 incidents) involved inattentive drivers.

- 33.3% of incidents (41 of 123 incidents) occurred under conditions of darkness.
- 57.7% of incidents (71 of 123 incidents) occurred under adverse weather conditions, including snow and rain.
- 63.4% of incidents (78 of 123 incidents) occurred under adverse road surface conditions, including wet, icy, loose snow, pack snow, and slush.

County Road 30 mainline segment (10.3 km) – from 1.0 km to 11.3 km west of County Road 30

Summaries of collision characteristics for the five-year period are shown on Figure 4-4.

- 19.5% of incidents (37 of 190 incidents) resulted in injury.
- 69.5% of incidents (132 of 190 incidents) involved only a single vehicle.
- 28.4% of incidents (54 of 190 incidents) involved excess speed.
- 55.3% of incidents (105 of 190 incidents) involved drivers who exhibited normal driving behaviour.
- 22.6% of incidents (43 of 190 incidents) involved inattentive drivers.
- 33.2% of incidents (63 of 190 incidents) occurred under conditions of darkness.
- 44.2% of incidents (84 of 190 incidents) occurred under adverse weather conditions, including snow and rain.
- 50.5% of incidents (96 of 190 incidents) occurred under adverse road surface conditions, including wet, icy, loose snow, pack snow, and slush.

Percy Road / County Road 25 interchange partial influence zone (1.0 km) - from 11.4 to 12.3 km west of County Road 30

Summaries of collision characteristics for the five-year period are shown on Figure 4-5.

- 23.8% of incidents (5 of 21 incidents) resulted in injury.
- 76.2% of incidents (16 of 21 incidents) involved only a single vehicle.
- 28.6% of incidents (6 of 21 incidents) involved excess speed.
- 57.1% of incidents (12 of 21 incidents) involved drivers who exhibited normal driving behaviour.
- 28.6% of incidents (6 of 21 incidents) involved inattentive drivers.
- 38.1% of incidents (8 of 21 incidents) occurred under conditions of darkness.
- 38.1% of incidents (8 of 21 incidents) occurred under adverse weather conditions, including snow and rain.
- 47.6% of incidents (10 of 21 incidents) occurred under adverse road surface conditions, including wet, icy, loose snow, pack snow, and slush.

Interchange

A total of 21 collisions occurred around the Highway 401 interchanges within the study area from 2012 to 2016. This includes 10 collisions (47.6%) across the ramps and 11 collisions (52.4%) at the ramp terminals. Ramp collisions are defined to include only non-intersection-related collisions, while ramp terminal collisions include only intersection-related collisions. A total of 7 collisions (33.3%) occurred at the Wooler Road/County Road 40 interchange, while the remaining 14 collisions (66.7%) occurred at the County Road 30 interchange. Over the 5-year period, 5 collisions (23.8%) resulted in injury and 16 collisions (76.2%) resulted in property damage with no reported fatality. The most common impact type involved single-vehicle impacts with 11 collisions (52.4%), followed by turning (5 collisions or 23.8%). All of the recorded collisions were associated with improper driving actions on the part of one or more drivers involved, 57.1% (12 collisions) involving drivers without any adverse personal conditions (such as impairment or inattention), and 42.9% (9 collisions) occurred in the absence of adverse lighting, weather, or road surface conditions.

Typically, ramps and ramp terminals were evaluated separately. Ramps and ramp terminals with fewer than 10 collisions over five years were grouped for a given interchange, as an analysis with less than 10 collisions generally does not produce meaningful results. Within the Highway 401 study area, no ramp or ramp terminal have more than 10 collisions; therefore, they are presented together by interchange.

In addition, eleven interchange-related incidents were not classifiable and were removed from the analysis after a review of available collision data for Highway 401 and discussion with MTO. Out of those collisions, the following issues were observed:

- 8 collisions occurred away from the interchanges (LHRS/offset 47494/10.2 and 47500/10.8).
- 3 collisions occurred on the County Road 30 interchange (47500/0) ramps; however, the recorded ramp numbers (11 and 30) do not match any existing ramp at this location.

Summaries of collision characteristics for the five-year period are found on Figure 4-6 for interchange ramps and ramp terminals.

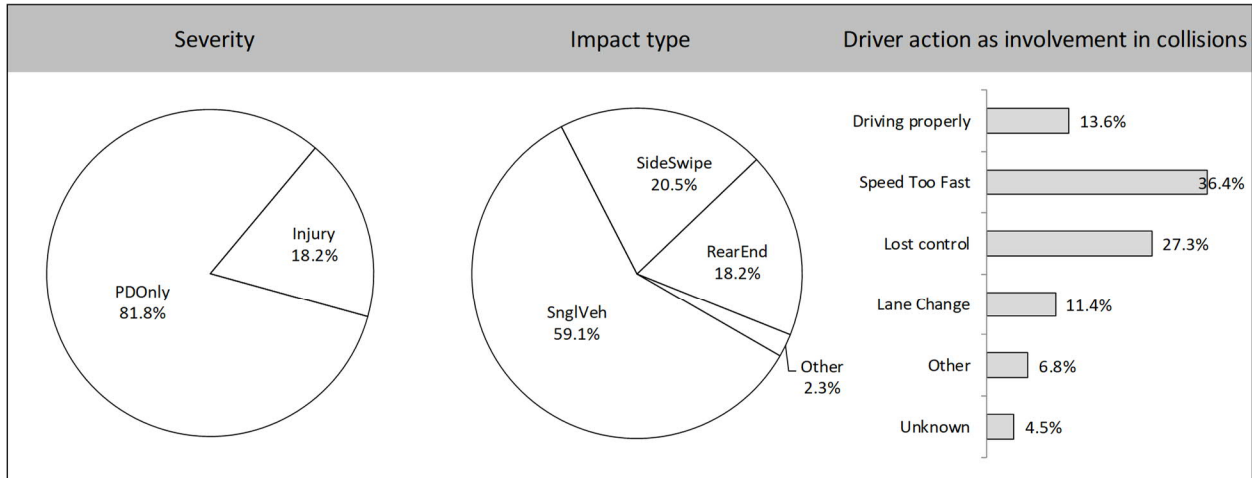
Interchange ramps and ramp terminals – County Road 30 at Highway 401

Summaries of collision characteristics for the five-year period are shown on Figure 4-6.

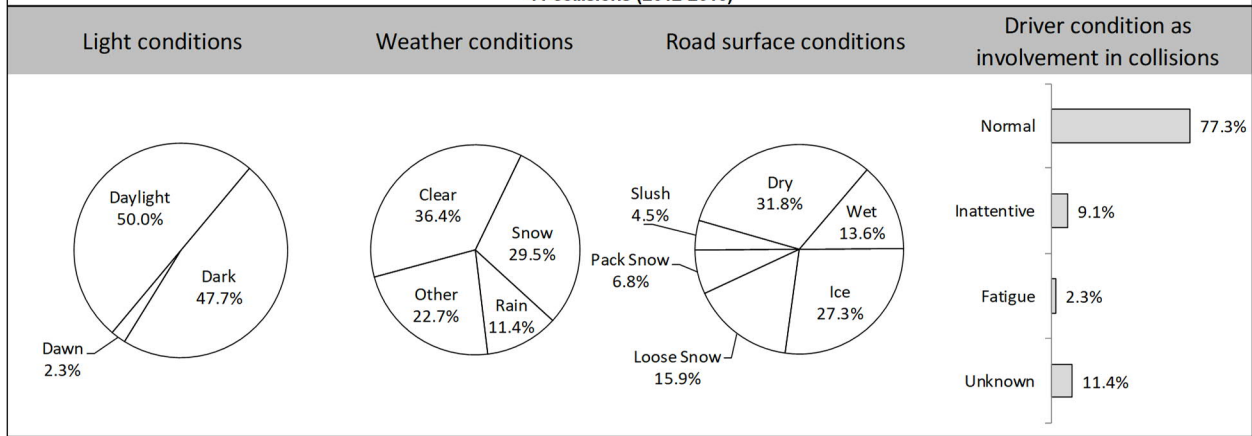
- 35.7% of incidents (5 of 14 incidents) occurred on ramp number 61 (westbound off-ramp).
- 28.6% of incidents (4 of 14 incidents) occurred on ramp number 51 (eastbound off-ramp).
- 14.3% (2 of 14 incidents) involved in injury.
- 64.3% of incidents (9 of 14 incidents) involved only a single vehicle.
- 100% of incidents (14 of 14 incidents) involved improper action from one or more of the drivers.
- 35.7% of incidents (5 of 14 incidents) involved excess speed.
- 28.6% of incidents (4 of 14 incidents) involved drivers losing control of the vehicle.
- 21.4% of incidents (3 of 14 incidents) involved drivers failing to yield.
- 50.0% of incidents (7 of 14 incidents) involved drivers who exhibited normal driving behaviour.
- 28.6% of incidents (4 of 14 incidents) involved inattentive drivers.
- 28.6% of incidents (4 of 14 incidents) occurred under conditions of darkness.
- 57.1% of incidents (8 of 14 incidents) occurred under adverse weather conditions, including snow and rain.
- 64.3% of incidents (9 of 14 incidents) occurred under adverse road surface conditions, including wet, icy, loose snow, pack snow, and slush.

County Road 40 at Highway 401

- A collision characteristics summary is not presented for this interchange as this location has less than 10 collisions over the five-year period from 2012 to 2016.



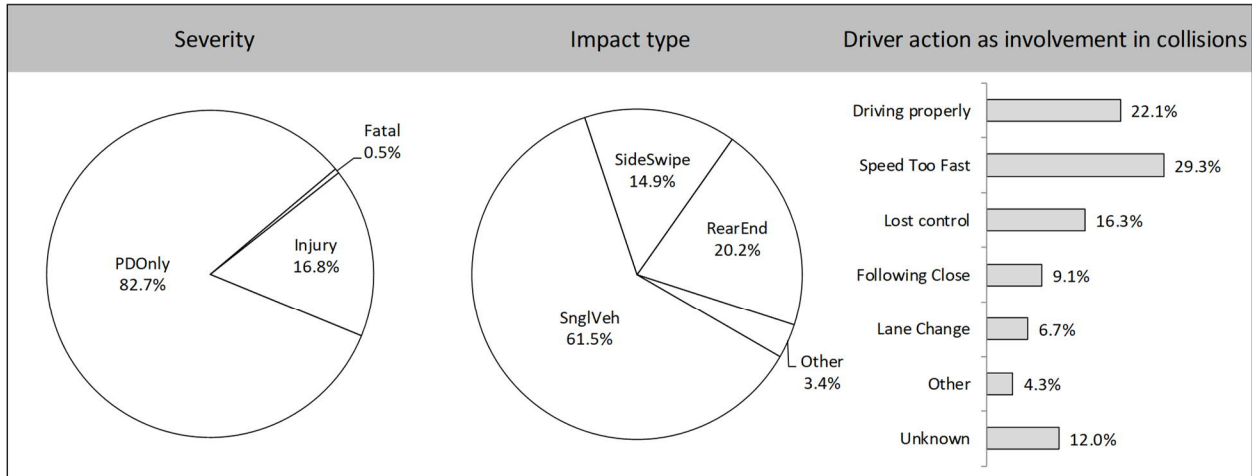
44 collisions (2012-2016)



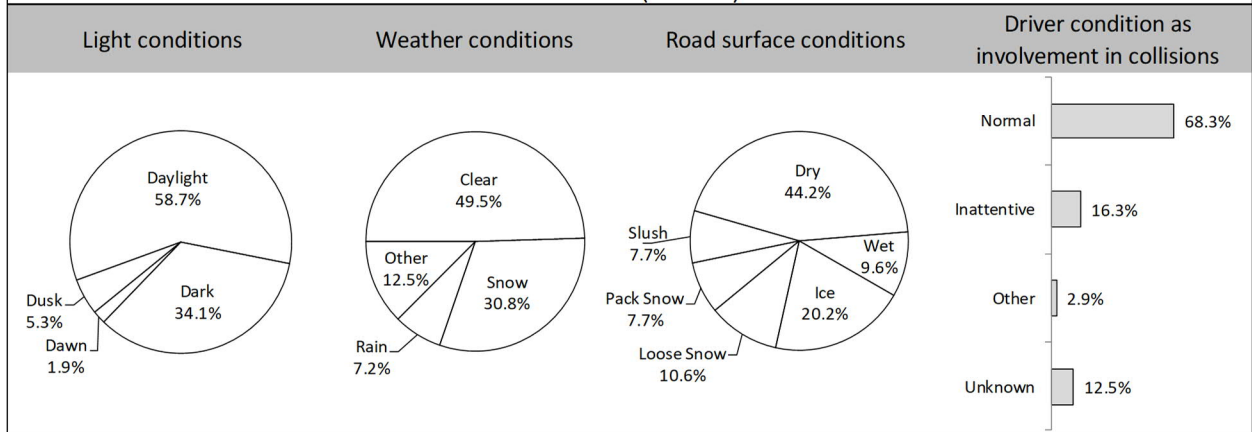
20.5% in daylight, dry & clear conditions



Figure 4-1: Collision characteristics – Interchange partial influence zone Wooler Road/County Road 40



208 collisions (2012-2016)



21.6% in daylight, dry & clear conditions

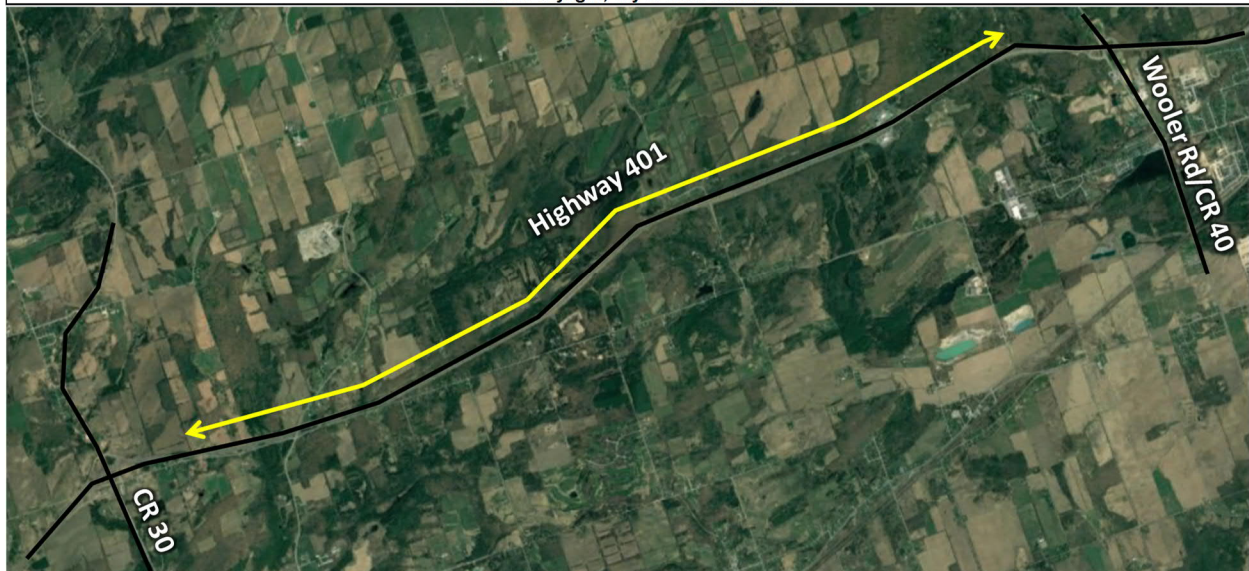


Figure 4-2: Collision characteristics – Mainline segment from 1.0 km to 10.3 km west of Wooler Road / County Road 40

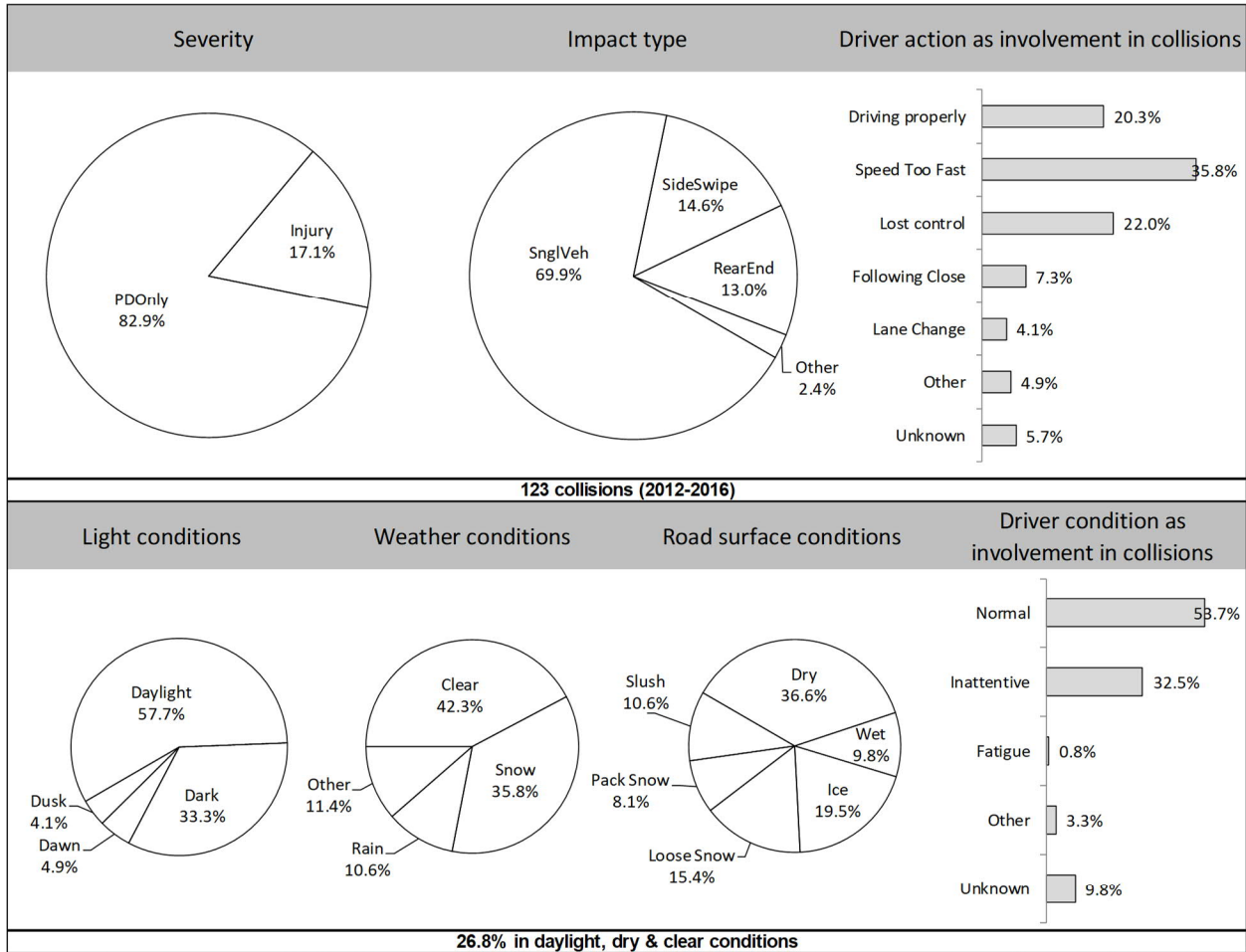
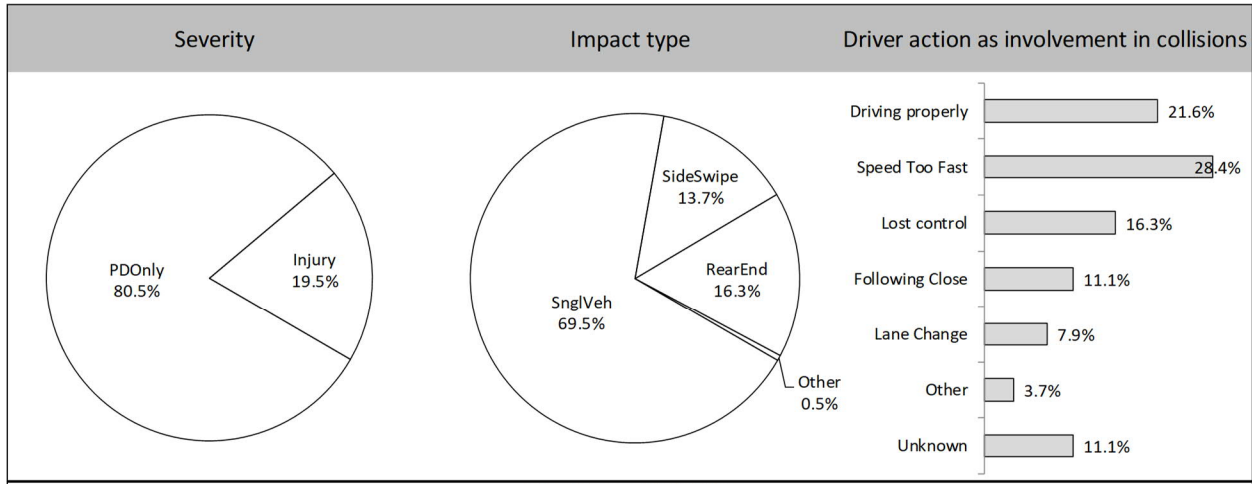
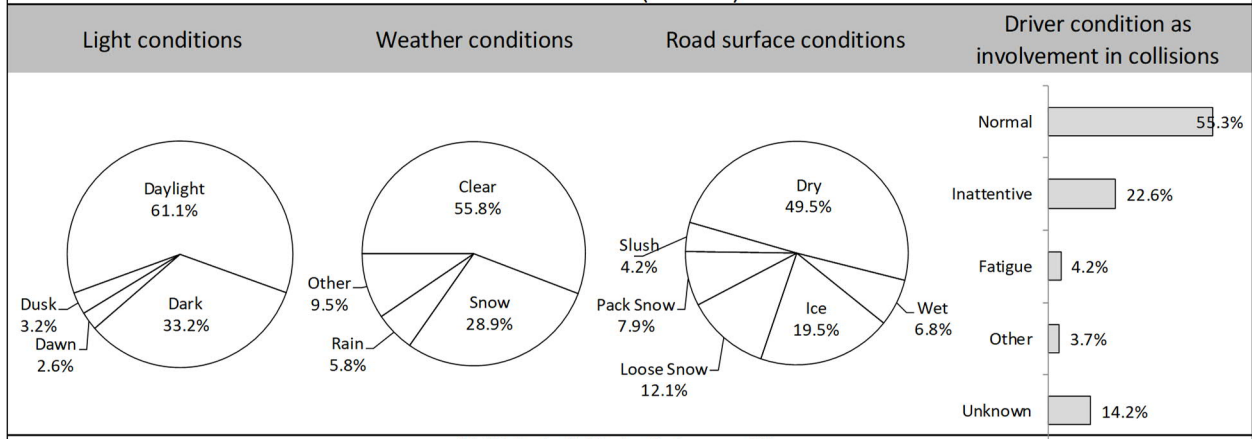


Figure 4-3: Collision characteristics – Interchange influence zone County Road 30



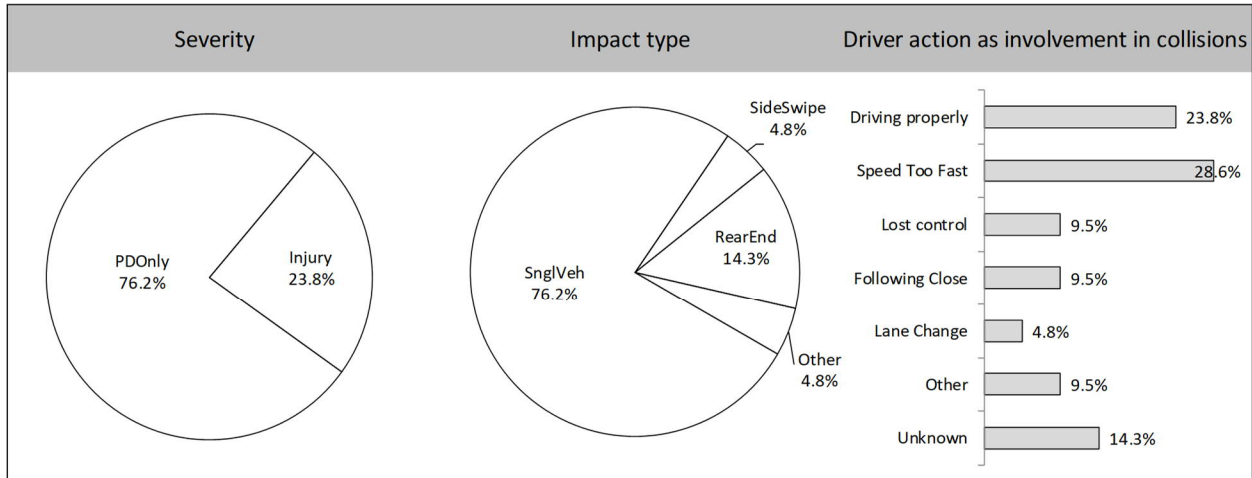
190 collisions (2012-2016)



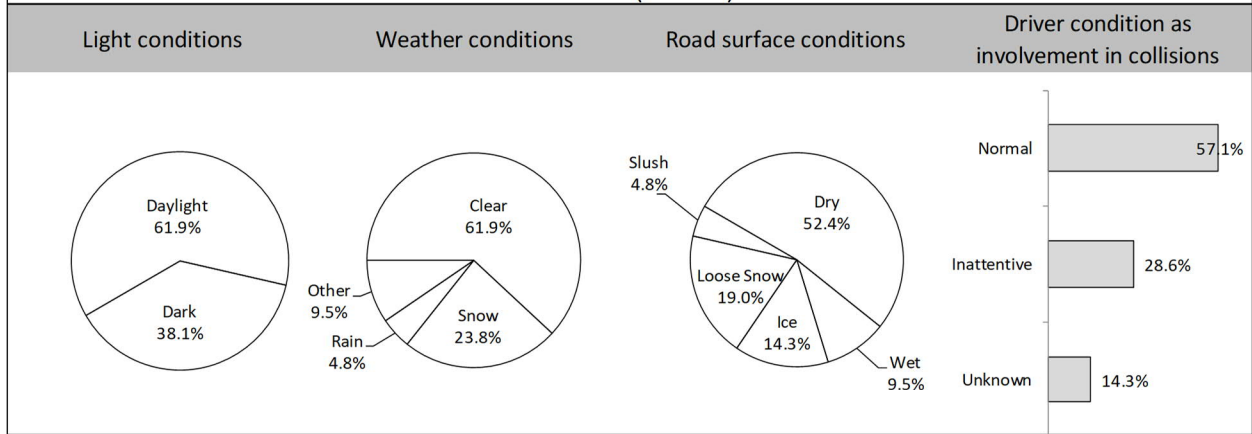
31.1% in daylight, dry & clear conditions



Figure 4-4: Collision characteristics – Mainline segment from 1.0 km to 11.3 km west of County Road 30



21 collisions (2012-2016)



33.3% in daylight, dry & clear conditions



Figure 4-5: Collision characteristics – County Road 25 influence zone

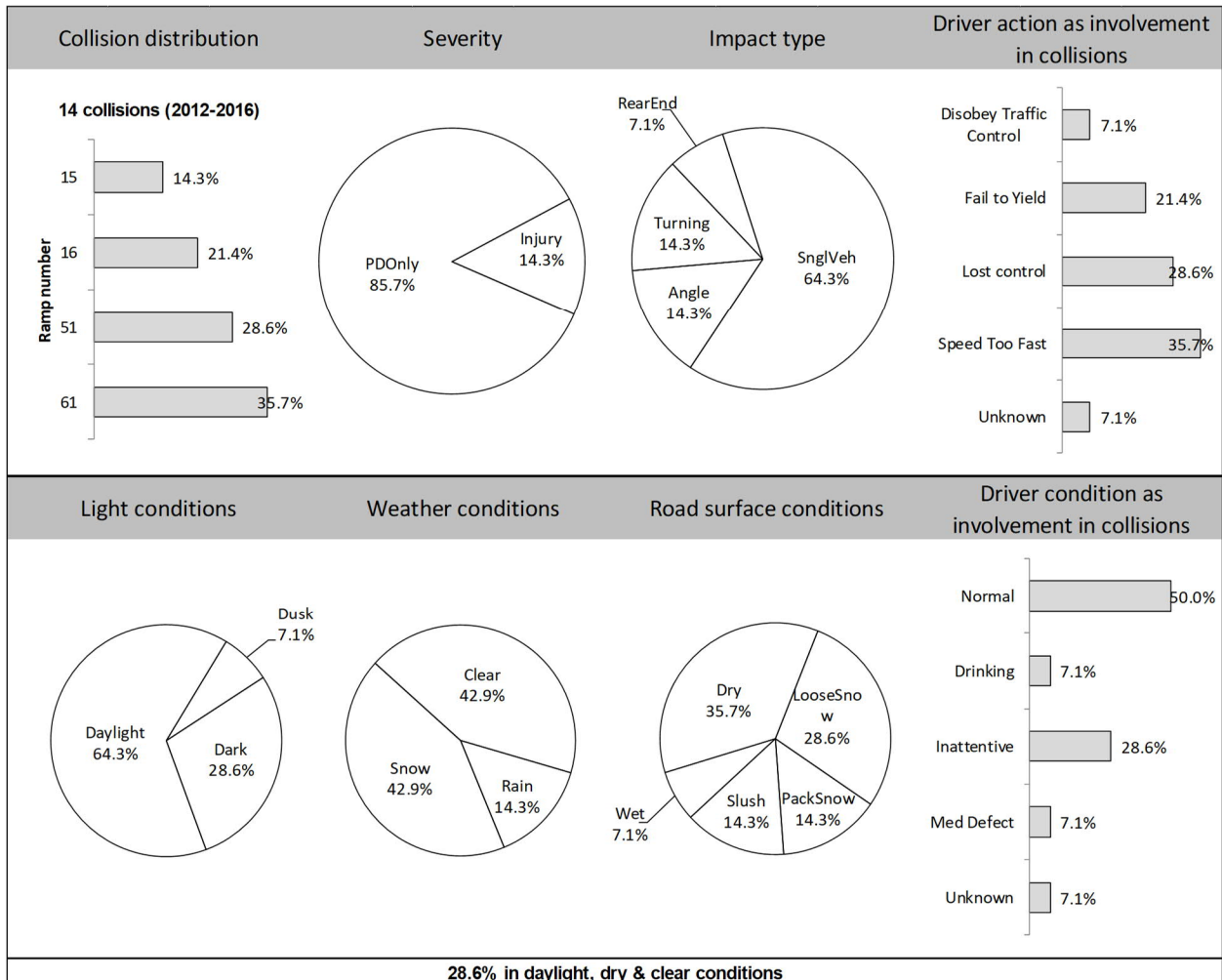


Figure 4-6: Collision characteristics –County Road 30 interchange ramps

4.2 LEVEL OF SERVICE SAFETY (LOSS)

A network screening analysis was undertaken to evaluate the safety of highway mainline sections, ramps and ramp terminals. The process estimates the expected number of collisions for a particular highway section, ramp, or ramp terminal, and compares this to actual number of collisions. The level of service of safety (LOSS) identifies how a specific site is performing in regard to its Expected Collision Frequency at a specific level of AADT. However, it only describes the magnitude of the safety problem; it does not provide any information related to the nature of the problem itself. The LOSS ranking method uses +1.5 standard deviation from the Predicted Collision Frequency as the dividing line between LOSS I and LOSS II and -1.5 standard deviation separating LOSS III and LOSS IV entities. The LOSS II and LOSS III entities are separated by the Operation Performance Function (OPR).

The results of the screening process are indicated by four Levels-of-service-safety (LOSS), with LOSS I having the best safety performance and LOSS IV having the worst safety performance:

- LOSS I – indicates low potential for accident reduction
- LOSS II – indicates better than expected safety performance
- LOSS III – indicates less than expected safety performance
- LOSS IV – indicates high potential for accident reduction

Overall, the Highway 401 corridor have an acceptable safety performance. No collision-prone location was identified on the Highway 401 mainline: collision-prone locations have been defined by MTO in the context of previous studies as those locations identified at LOSS IV. Three ramps at the County Road 30 interchange were identified to operate with less than expected safety performance (LOSS III). However, we do not intent to propose improvements around the County Road 30 and County Road 40 interchanges, as they are outside the study limits for the current assignment. An Environmental Assessment study for the County Road 30 interchange was previously completed by others in 2005 (GWP 256-98-00). Figure 4-7 shows the schematic of Highway 401 mainline, ramps, and ramp terminals, colour-coded according to their LOSS.

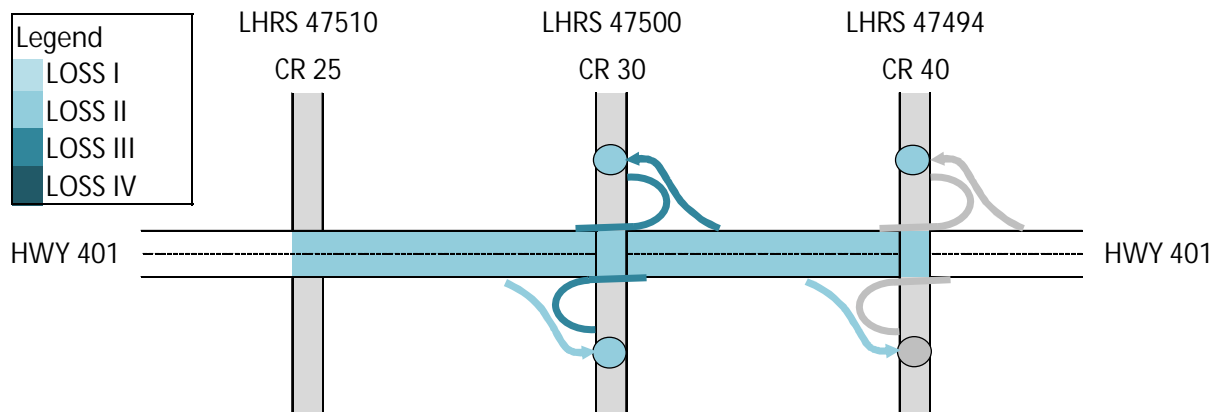


Figure 4-7: Highway 401 LOSS schematic

A number of geometry deficiencies associated with vertical or horizontal curves were identified along the Highway 401 mainline and presented in Table 4-1. Between 2012 and 2016, a total of 34 collisions were recorded along horizontal curve H4. The substandard radius on H4 may have contributed to the higher-than-average number of collisions (7.5 collisions per 100 m versus corridor average of 2.4 collisions per 100 m). However, it is difficult to identify correlation between geometric deficiencies and frequency of collisions since a) the collisions are associated with a number of other contributing factors such as adverse weather, light, and road surface conditions, and b) other locations with similar deficiencies (H5, H7) are not associated with higher observed number of collisions. It is noted that the LOSS analysis presented above identified no collision-prone locations requiring geometry improvements along the study area corridor. The deficiencies will be taken into consideration in the evaluation and design of alternatives.

Table 4-1: Summary of mainline deficiencies and collisions

| MAINLINE DIRECTION | DEFICIENCY TYPE | ID | LOCATION | | # OF COLLISIONS |
|-----------------------------------|---|-------------|----------|--------|-----------------|
| | | | FROM | TO | |
| Highway 401 Eastbound & Westbound | In-field horizontal curve radius (873 metres) less than desirable horizontal curve radius (1,700 metres) ¹ | H4 | 17+107 | 17+559 | 34 |
| | | H5 | 18+150 | 18+571 | 8 |
| | | H7 | 11+051 | 11+695 | 10 |
| Highway 401 Eastbound & Westbound | In-field vertical curve K-value (80 metres) less than desirable vertical curve K-value (100 metres) ¹ | V19 (Crest) | 11+541 | 11+811 | 1 |
| | In-field vertical curve K-value (40 metres) less than desirable vertical curve K-value (70 metres) ¹ | V24 (Sag) | 16+786 | 16+908 | 1 |
| Highway 401 Westbound | In-field vertical curve K-value (90 metres) less than desirable vertical curve K-value (100 metres) ¹ | V34 (Crest) | 19+663 | 19+907 | 0 |

Note 1: MTO Supplement to TAC (2020)

Collision Rate

The collision rate, defined as the number of reportable accidents occurring annually for every million vehicle kilometres (MVKM) travelled on a particular highway section, was calculated for the Highway 401 mainline. The collision rate is compared to network averages to better understand the safety performance of the highway within and adjacent to the study area. It should be noted that the MTO has recently phased out the collision rate and replaced it with the LOSS evaluation presented above. As a result, historical averages for the collision rate is only available up to 2010.

Based on available collision data from 2012 to 2016, the average five-year two-way collision rates on Highway 401 were 0.29 between County Road 40 and County Road 30, and 0.32 between County Road 30 and County Road 25. These rates were calculated using 2014 AADT. The average collision rates reported by MTO in the *King's Highway Volumes* for the same sections generally range from 0.3 to 0.4 between 2005 and 2010. The calculated average five-year collision rates are in line with average values from previous years, indicating that the safety performance did not deteriorate over time. The average vehicle collision rate reported by MTO for freeways (excluding collisions on ramps) throughout the province was 0.5 for Year 2006, 0.6 for Year 2007 and 2008 and 0.5 for Year 2009. The overall collision rate within the project limits is lower than the provincial average.

4.3 FATAL COLLISIONS

Between 2012 and 2016, a single incident involving fatality was recorded within the study area. The incident involved a rear-end collision between a stopped truck and a passenger vehicle. The incident occurred in 2013 on the westbound lanes of Highway 401, 2.3 km west of County Road 40. This section of Highway 401 was identified as LOSS II. Conditions of darkness were associated with the incident. Table 4-2 summarizes the collision characteristics of the sections involving a fatality.

Table 4-2: Characteristics of fatal collisions

| LOCATION | YEAR | # OF VEHICLES | IMPACT TYPE | DRIVER ACTION | CONDITION | | | |
|--|------|---------------|-------------|---------------|-----------|-------|---------|------|
| | | | | | DRIVER | LIGHT | WEATHER | ROAD |
| 47494+2.3 Mainline btw County Road 40 and County Road 30 westbound | 2013 | 2 | Rear-end | Other | Normal | Dark | Clear | Dry |

4.4 COLLISIONS INVOLVING MORE THAN FIVE VEHICLES

Over the five-year period from 2012 to 2016, a total of four incidents involving more than five vehicles were recorded on Highway 401 within the study area. These collisions are identified and characterized in Table 4-3. The number of vehicles involved in the collisions ranged from 6 vehicles up to 39 vehicles. One out of four collisions resulted in injury and the remaining collisions resulted in property damage only. Three of the collisions involved rear-end impacts, one of the collisions involved side-swipe impacts. Three out of the four collisions involved one or more drivers losing control of their vehicles, while excess speed was involved in the remaining incident. Adverse weather conditions and icy road surface were found to be contributing factors in all of the incidents. All of the collisions occurred on the Highway 401 mainline (LOSS II), with three of the collisions having occurred on the westbound lanes within 1-km of the County Road 40 interchange. No collisions involving more than five vehicles were recorded around the County Road 30 interchange.

Table 4-3: Characteristics of collisions involving more than 5 vehicles

| LOCATION | YEAR | # OF VEH. | SEVERITY | IMPACT TYPE | DRIVER ACTION | CONDITION | | | |
|--|------|-----------|----------------------|-------------|----------------|-----------|----------|---------------|------|
| | | | | | | DRIVER | LIGHT | WEATHER | ROAD |
| 47494+0.2 (CR 40 interchange influence zone WB) | 2013 | 6 | Injury | Rear-end | Speed too fast | Normal | Dark | Freezing rain | Ice |
| 47494+0.2 (CR 40 interchange influence zone WB) | 2013 | 6 | Property damage only | Side swipe | Lost control | Normal | Daylight | Freezing rain | Ice |
| 47494+0.8 (CR 40 interchange influence zone WB) | 2015 | 39 | Property damage only | Rear-end | Lost control | Normal | Dark | Freezing rain | Ice |
| 47494+9.2 (Mainline between CR 40 & CR 30 EB) | 2014 | 10 | Property damage only | Rear-end | Lost control | Normal | Daylight | Drifting snow | Ice |

4.5 COLLISION PLOTS

The location and frequency of collisions along the corridor within the study area were plotted according to mainline LHRS/offset, ramp, or ramp terminals for the following collision types and factors:

- total collisions
- collisions causing injury
- rear-end impacts
- side-swipe impacts
- single-vehicle impacts
- collisions under conditions of darkness
- collisions involving speed too fast
- collisions involving lane change maneuvers

The collision plots are presented on Figure 4-8 to Figure 4-22. Note that the legend on each of the plots represents the number of collisions usually grouped within a range with the corresponding number of instances for that range in brackets. These plots illustrate that most mainline collisions occur in the vicinity of the interchanges.

4.5.1 MAINLINE

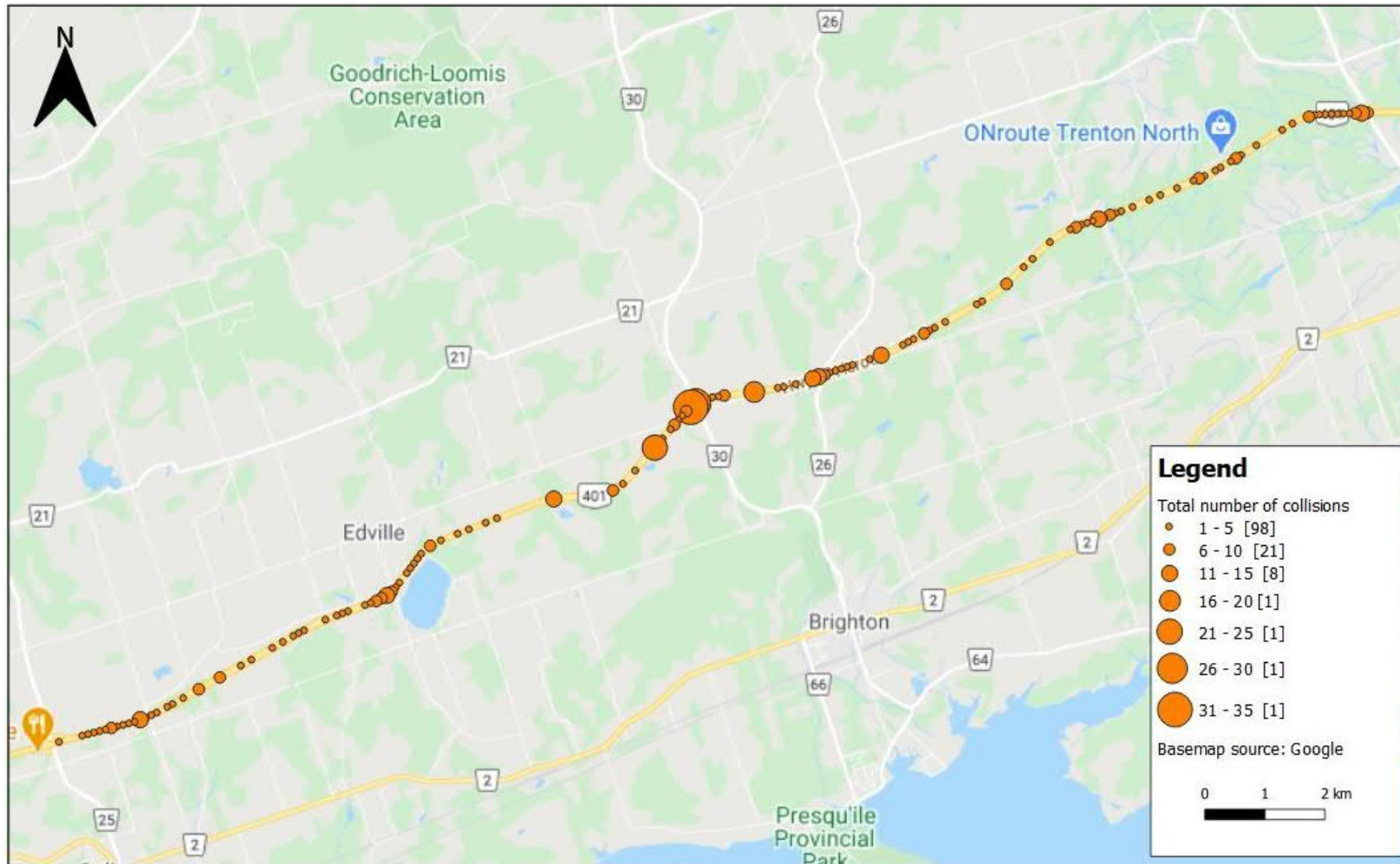


Figure 4-8: Distribution of total collisions on Highway 401 mainline within study area

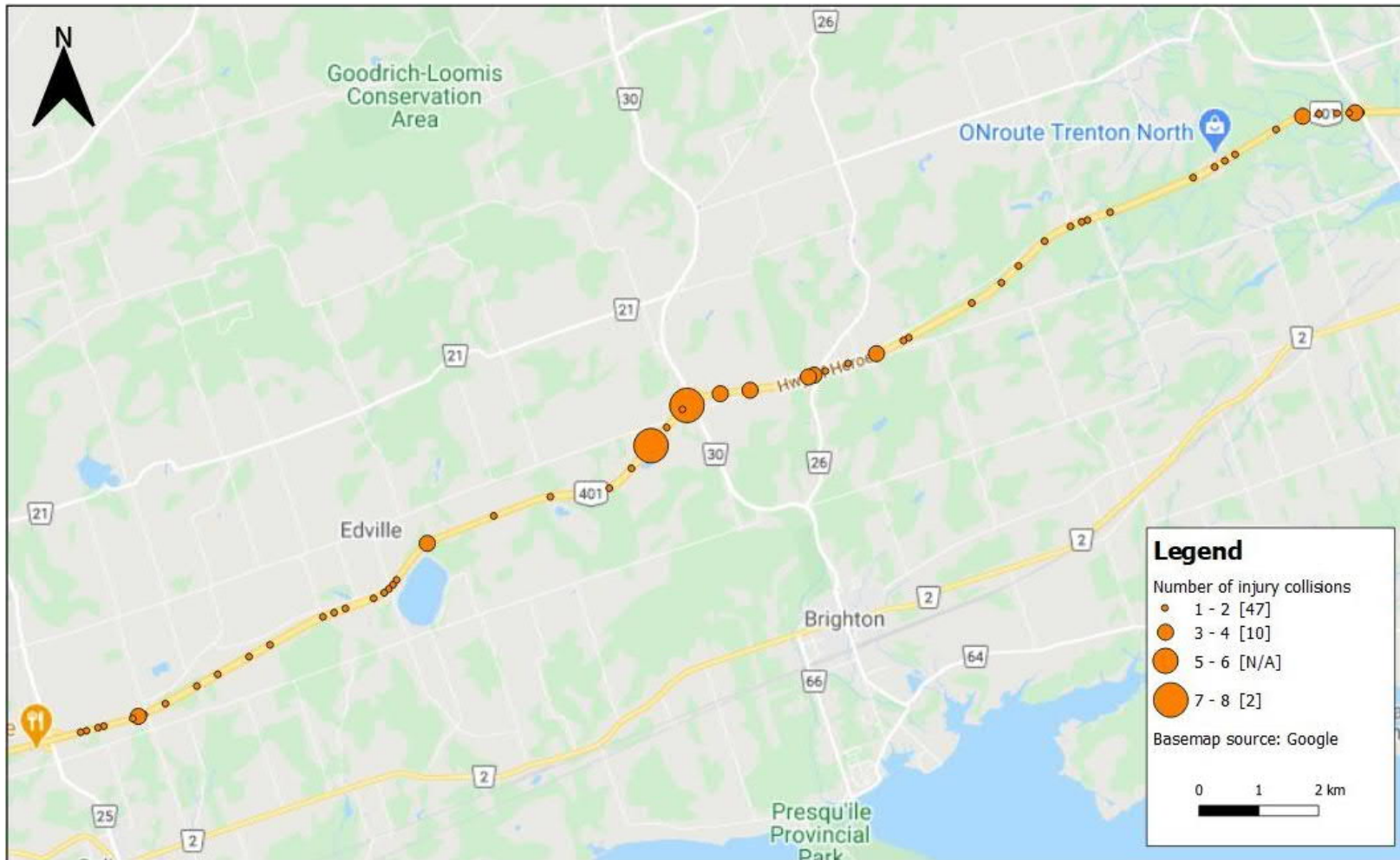


Figure 4-9: Distribution of collisions involving injury on Highway 401 mainline within study area

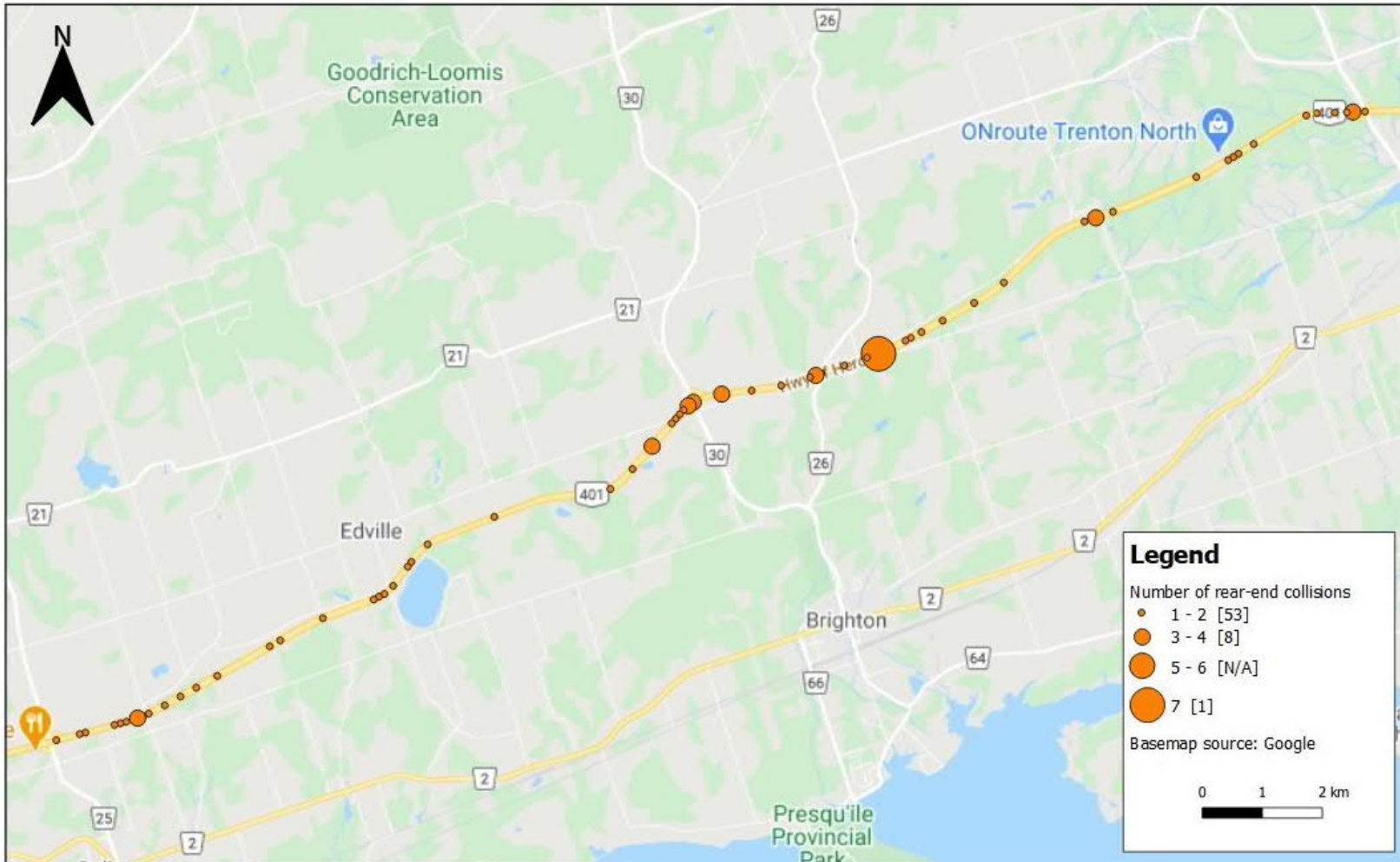


Figure 4-10: Distribution of rear-end collisions on Highway 401 mainline within study area

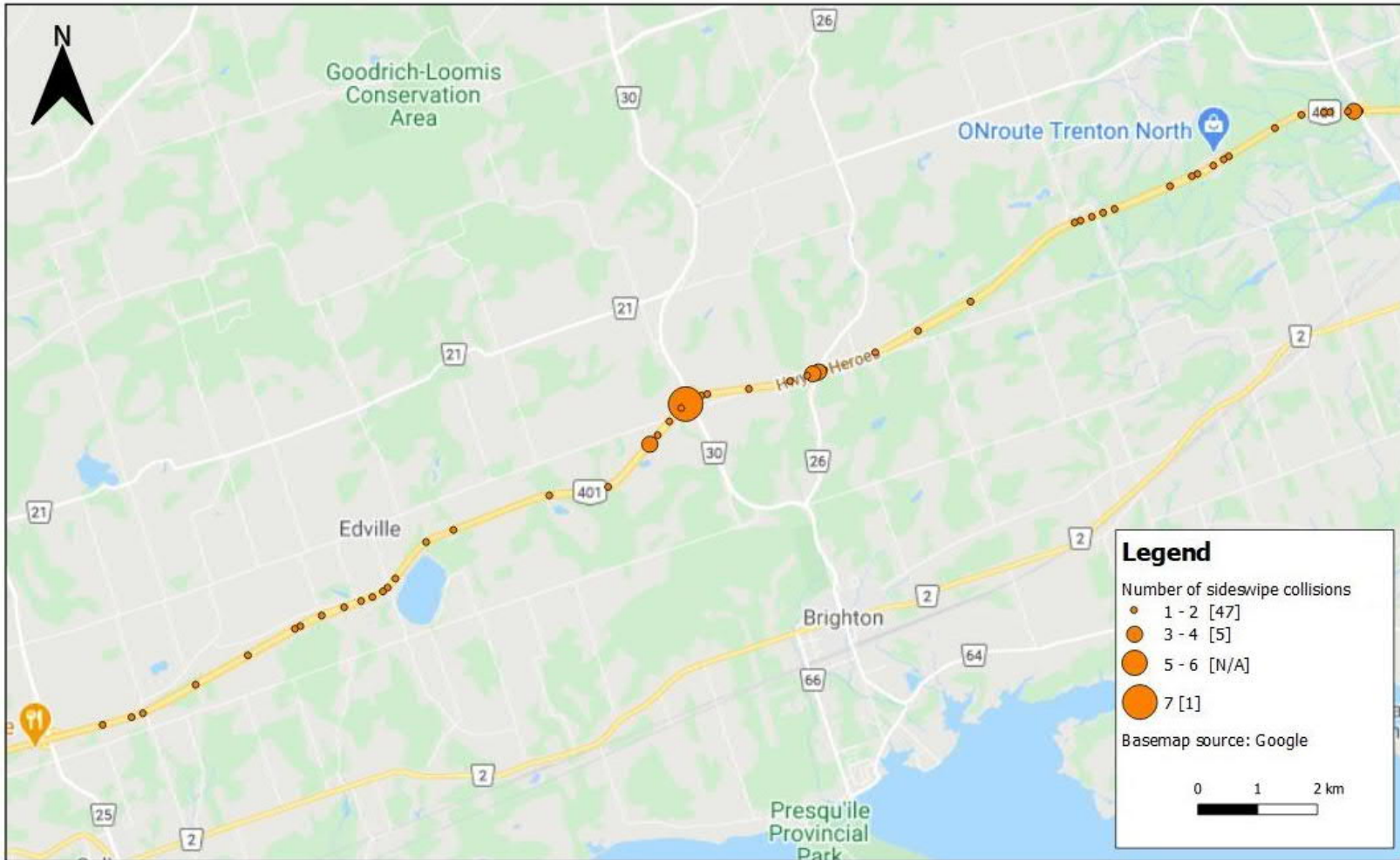


Figure 4-11: Distribution of side-swipe collisions on Highway 401 mainline within study area

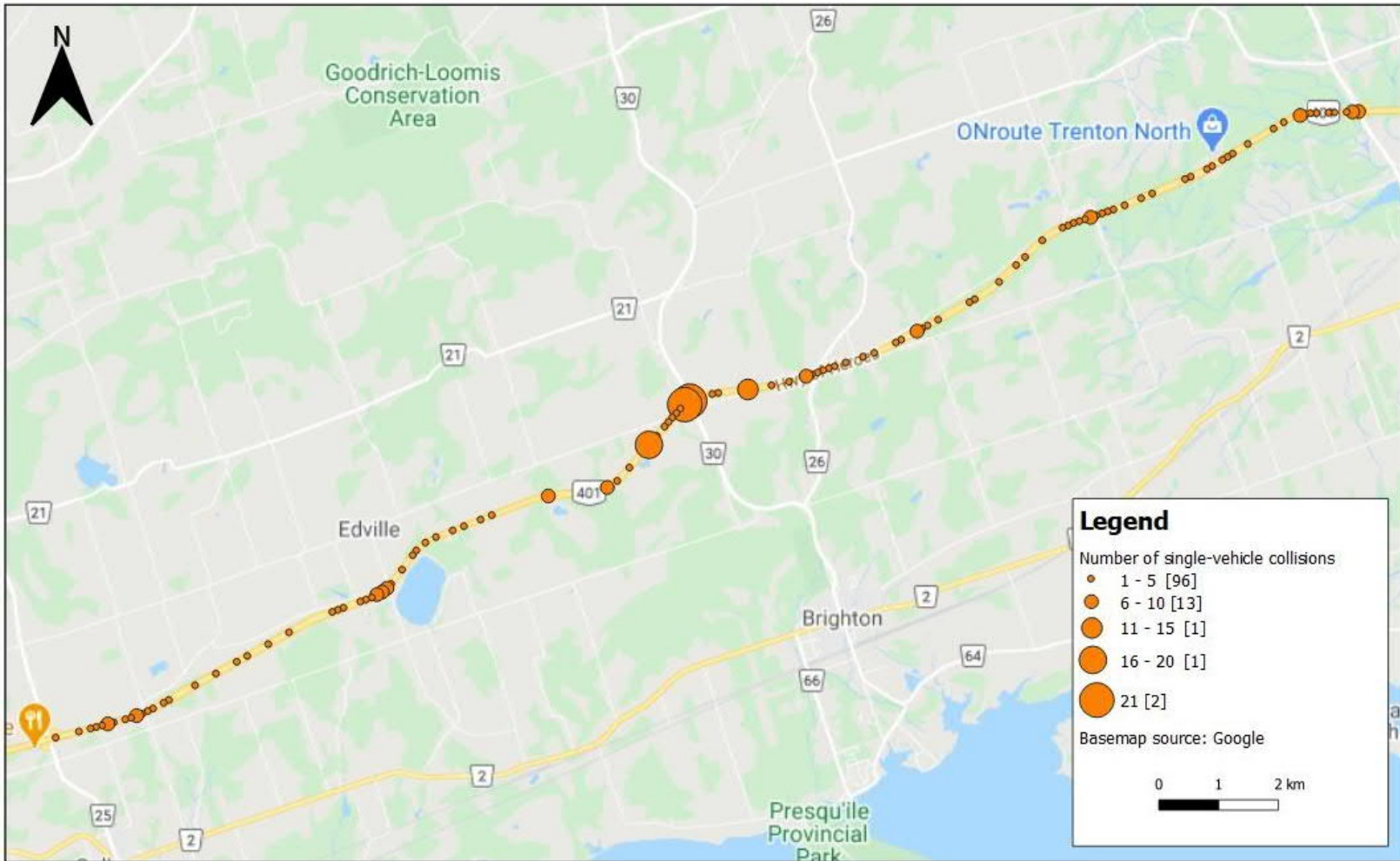


Figure 4-12: Distribution of single-vehicle collisions on Highway 401 mainline within study area

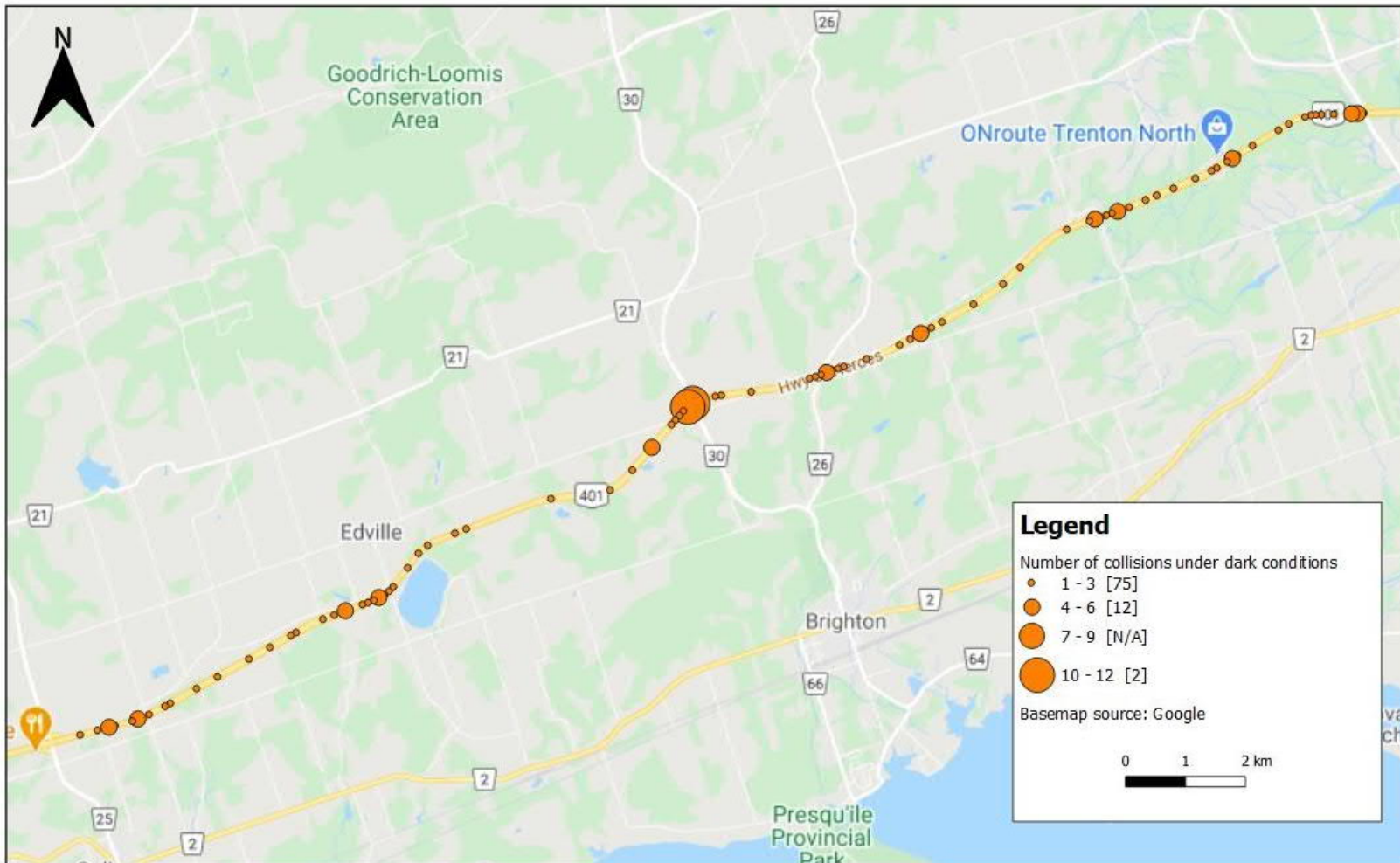


Figure 4-13: Distribution of collisions under conditions of darkness on Highway 401 mainline within study area

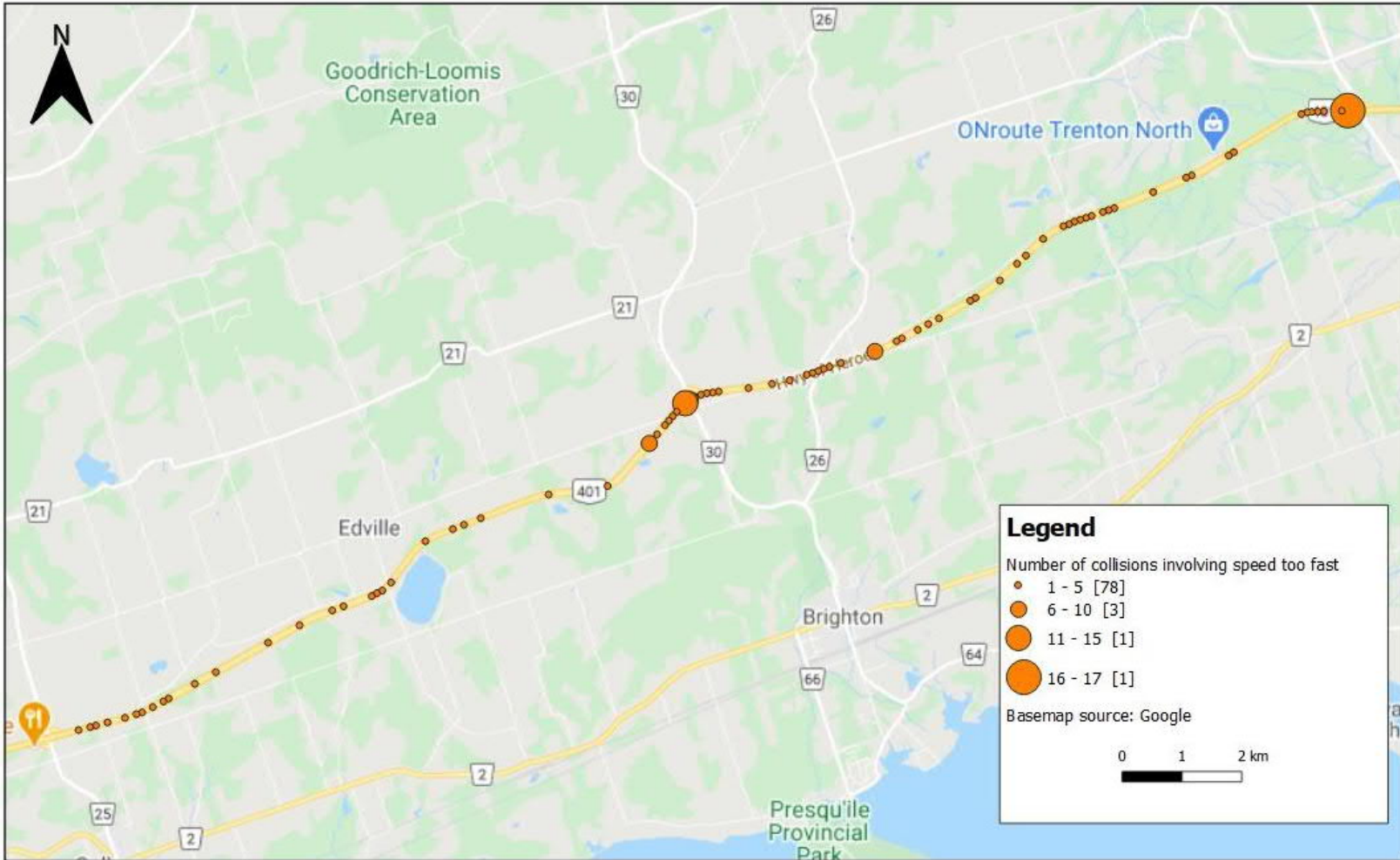


Figure 4-14: Distribution of collisions involving speed too fast on Highway 401 mainline within study area

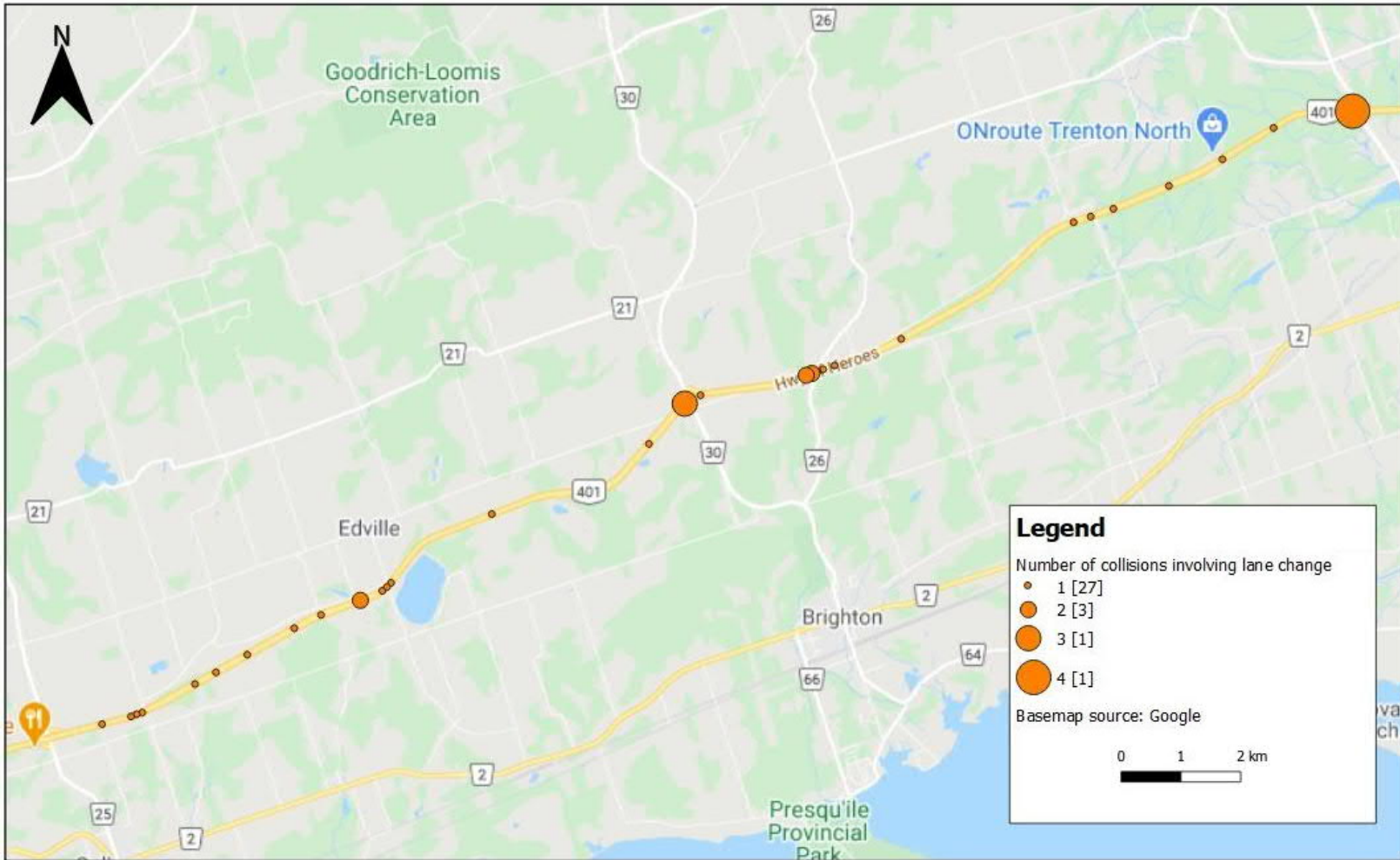


Figure 4-15: Distribution of collisions involving lane change on Highway 401 mainline within study area

4.5.2 INTERCHANGE

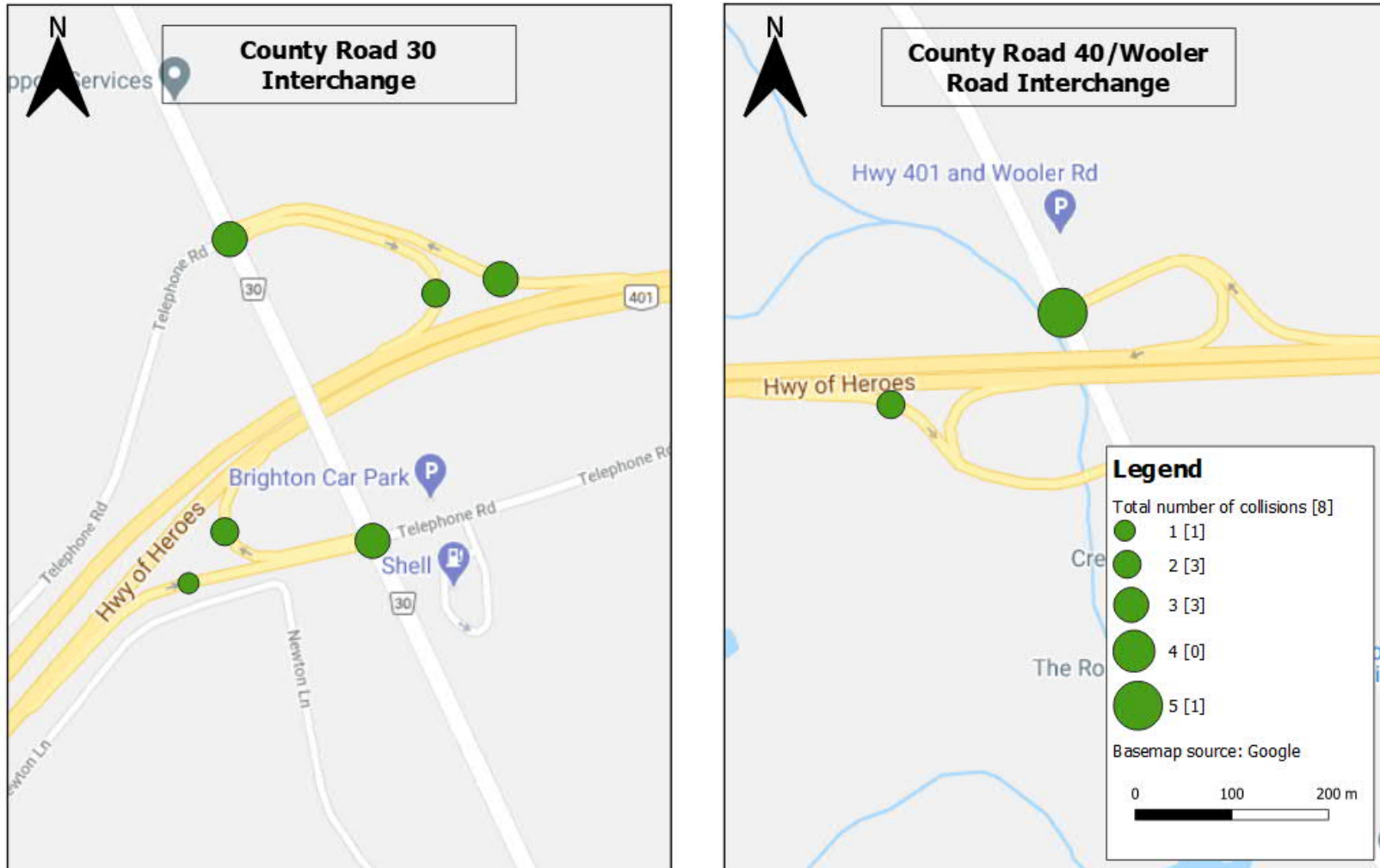


Figure 4-16: Distribution of total collisions on Highway 401 ramps and ramp terminals within study area

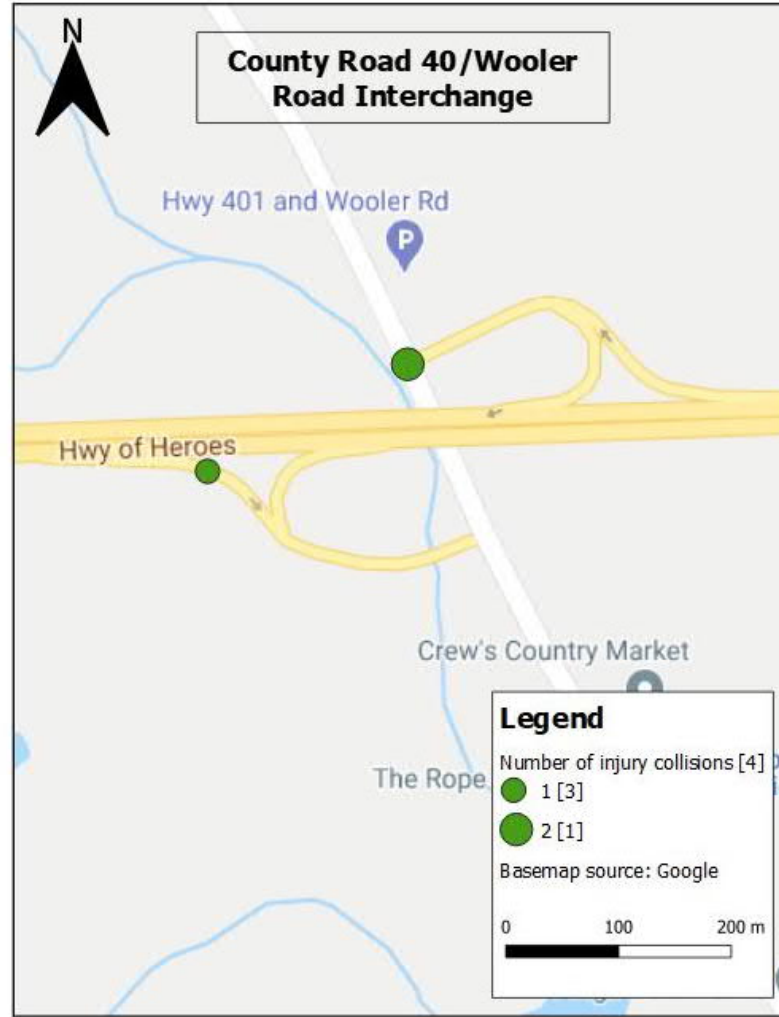
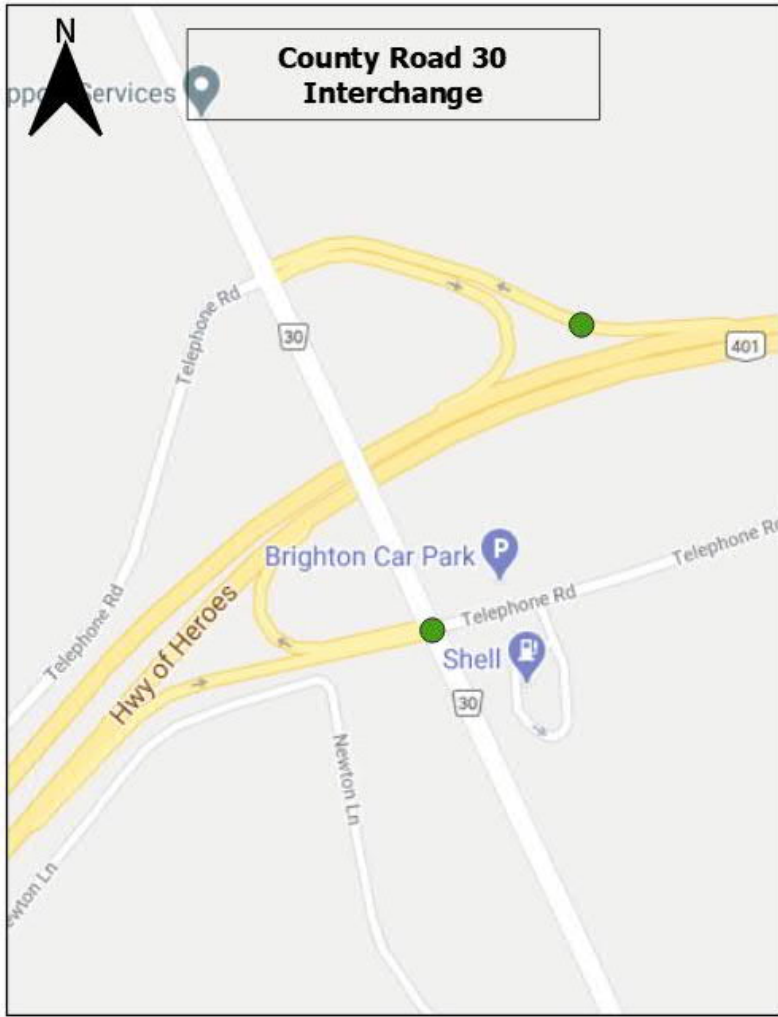


Figure 4-17: Distribution of injury collisions on Highway 401 ramps and ramp terminals within study area

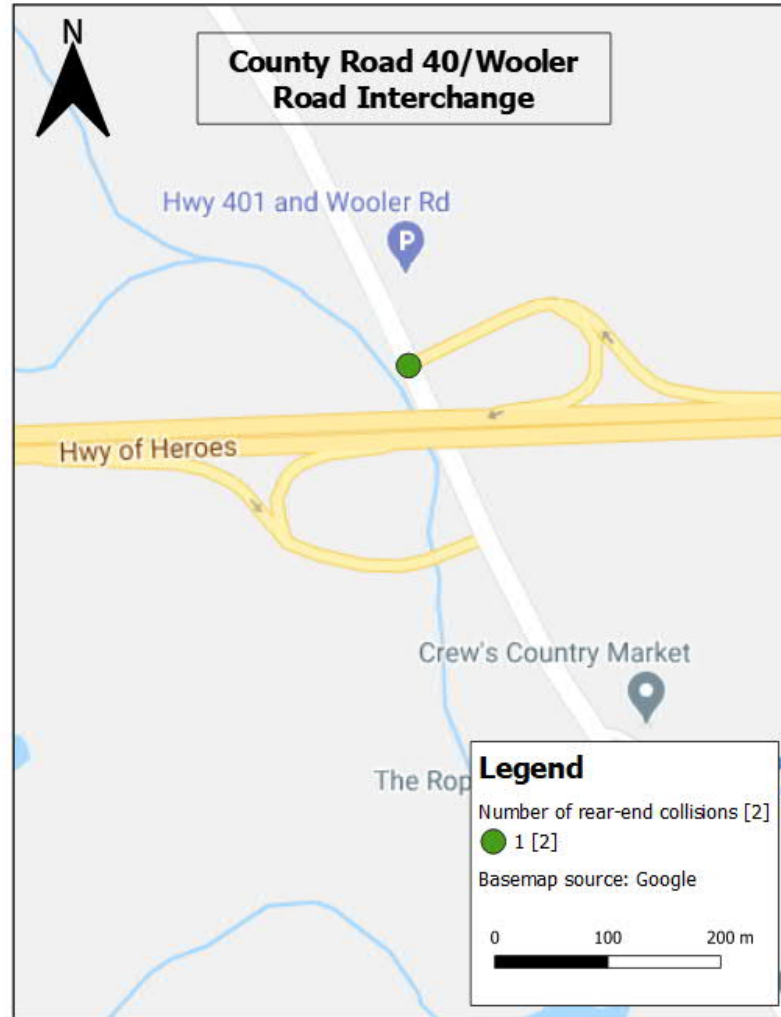
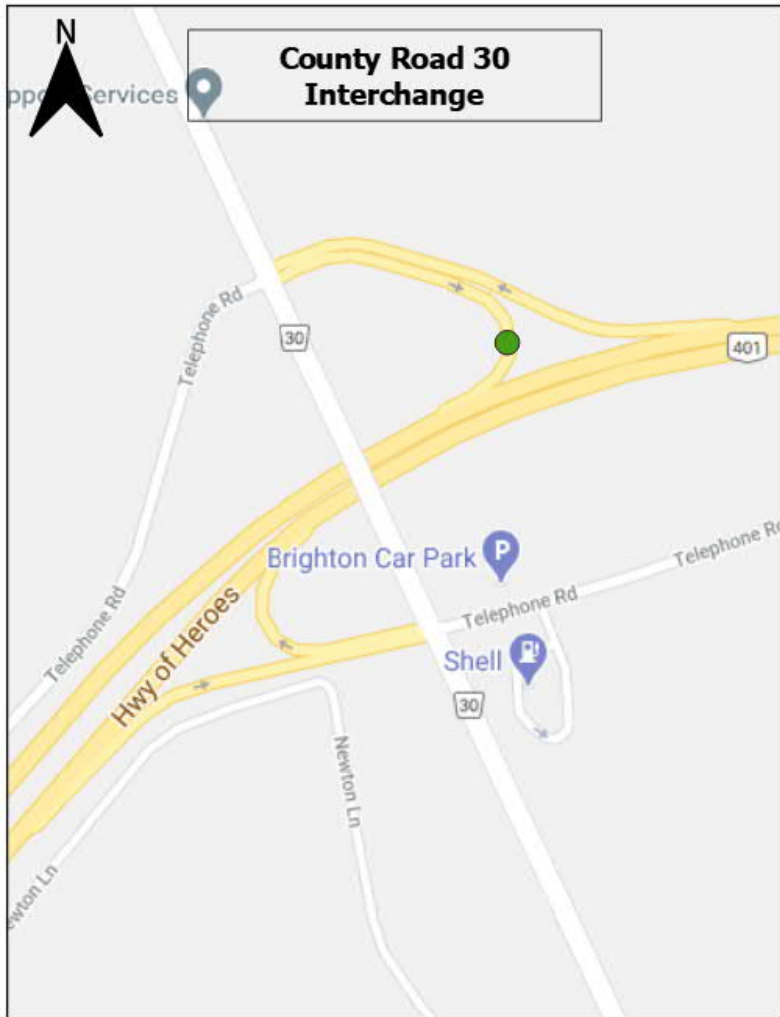


Figure 4-18: Distribution of rear-end collisions on Highway 401 ramps and ramp terminals within study area

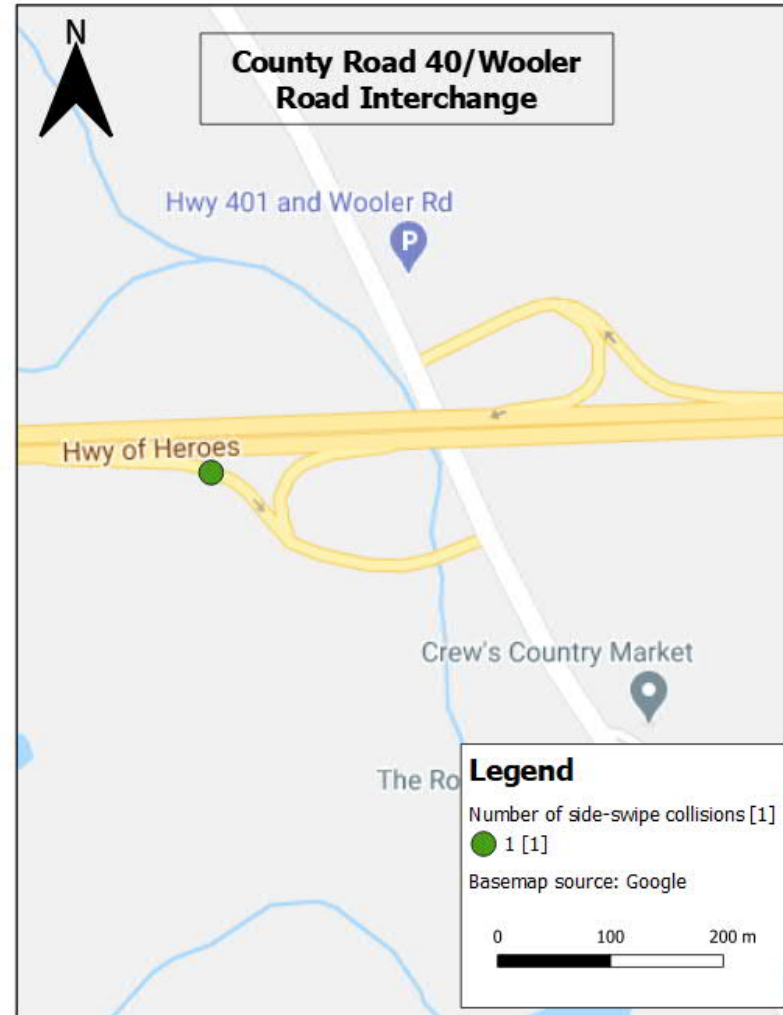
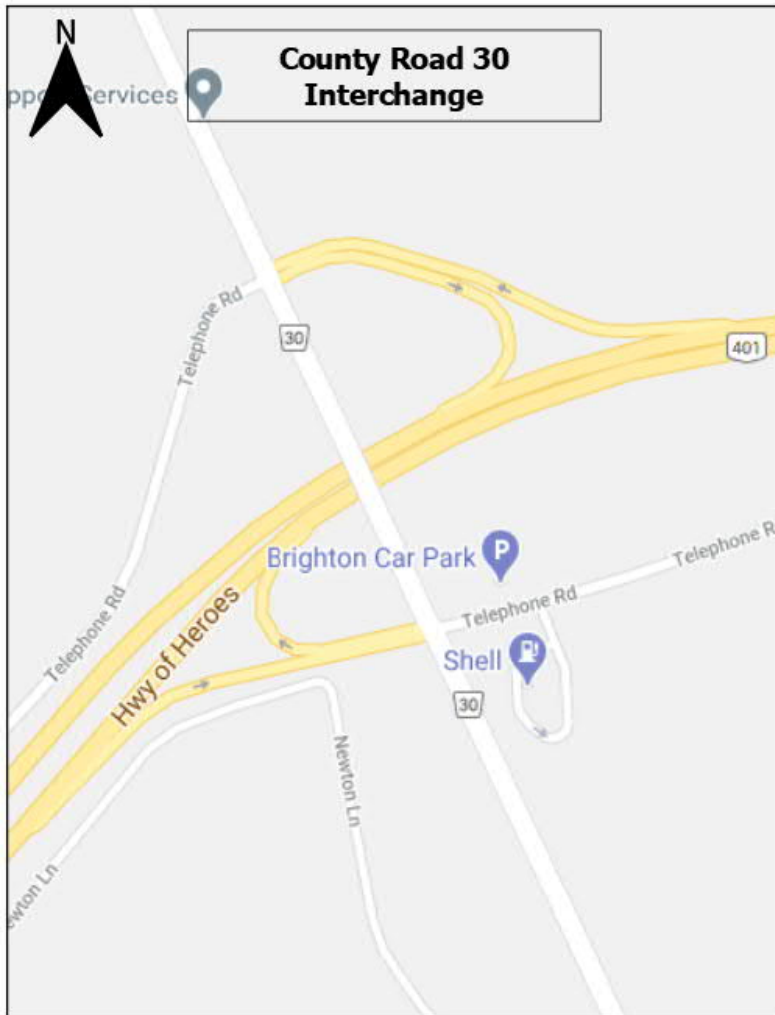


Figure 4-19: Distribution of side-swipe collisions on Highway 401 ramps and ramp terminals within study area

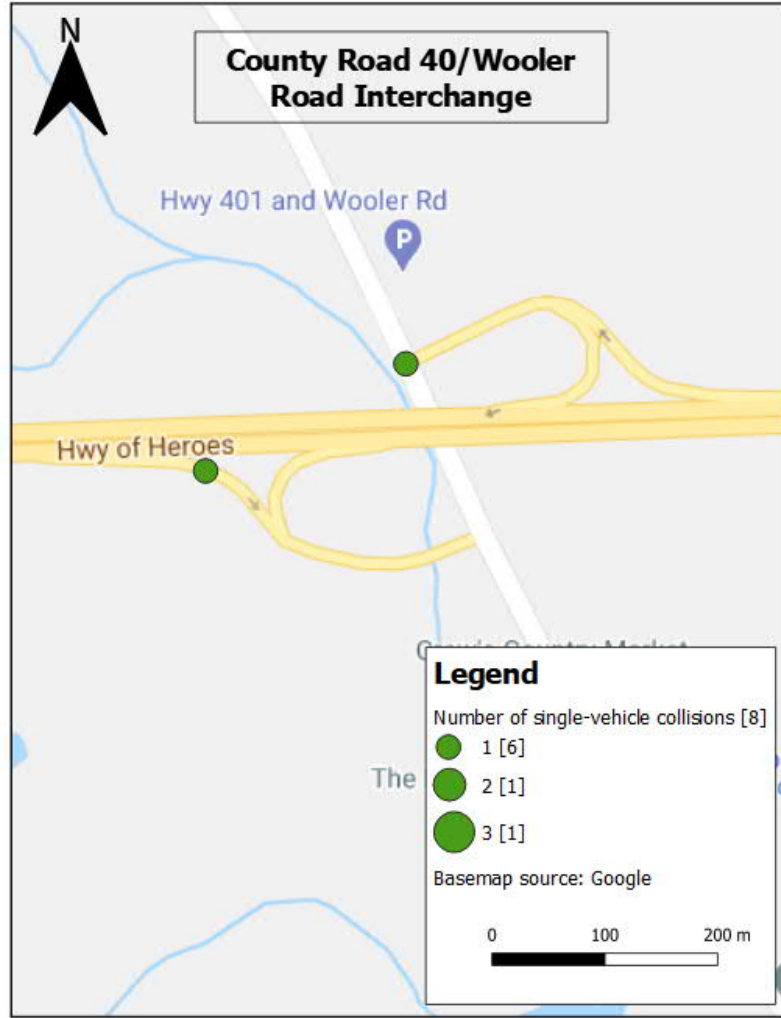
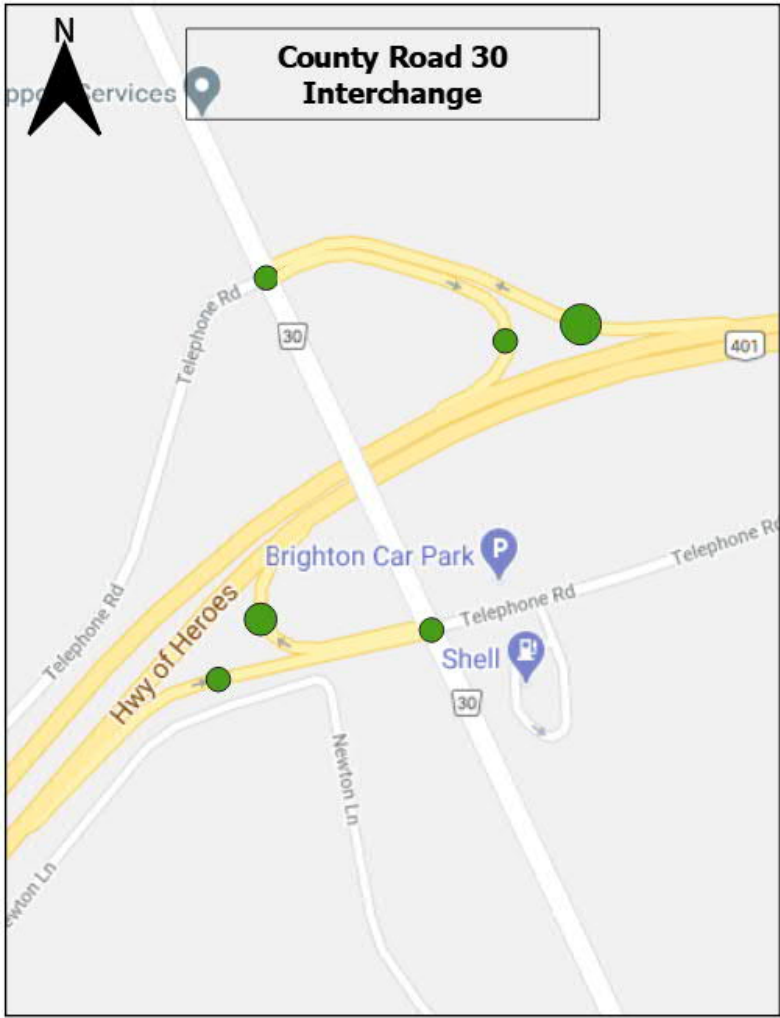


Figure 4-20: Distribution of single-vehicle collisions on Highway 401 ramps and ramp terminals within study area

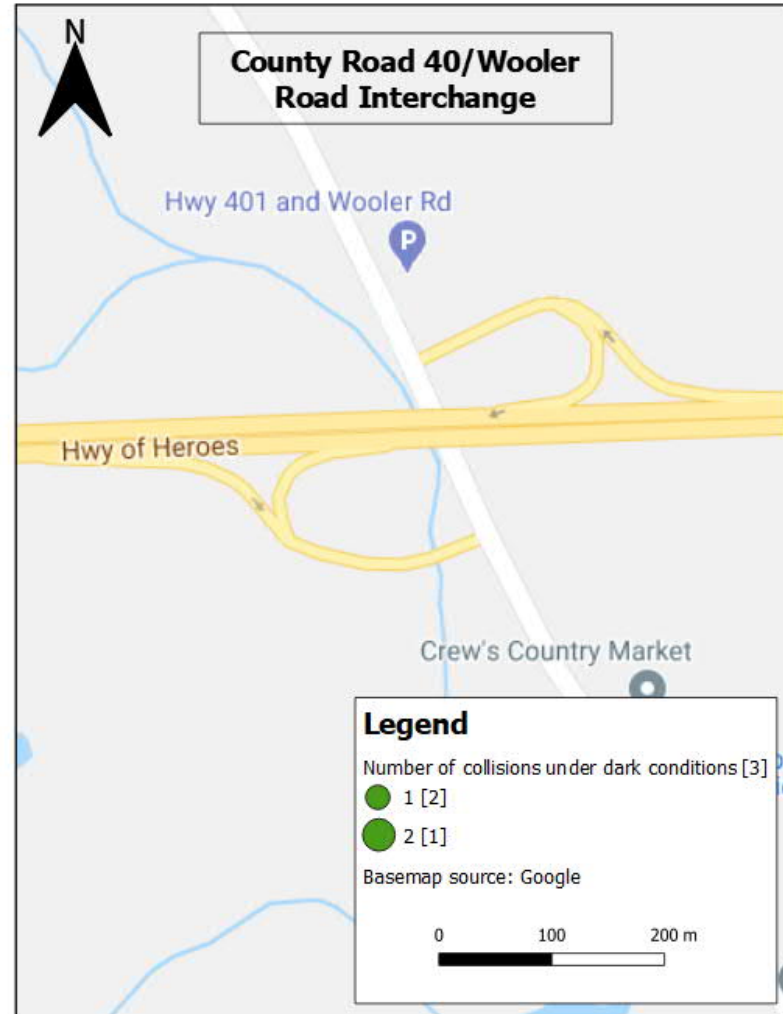
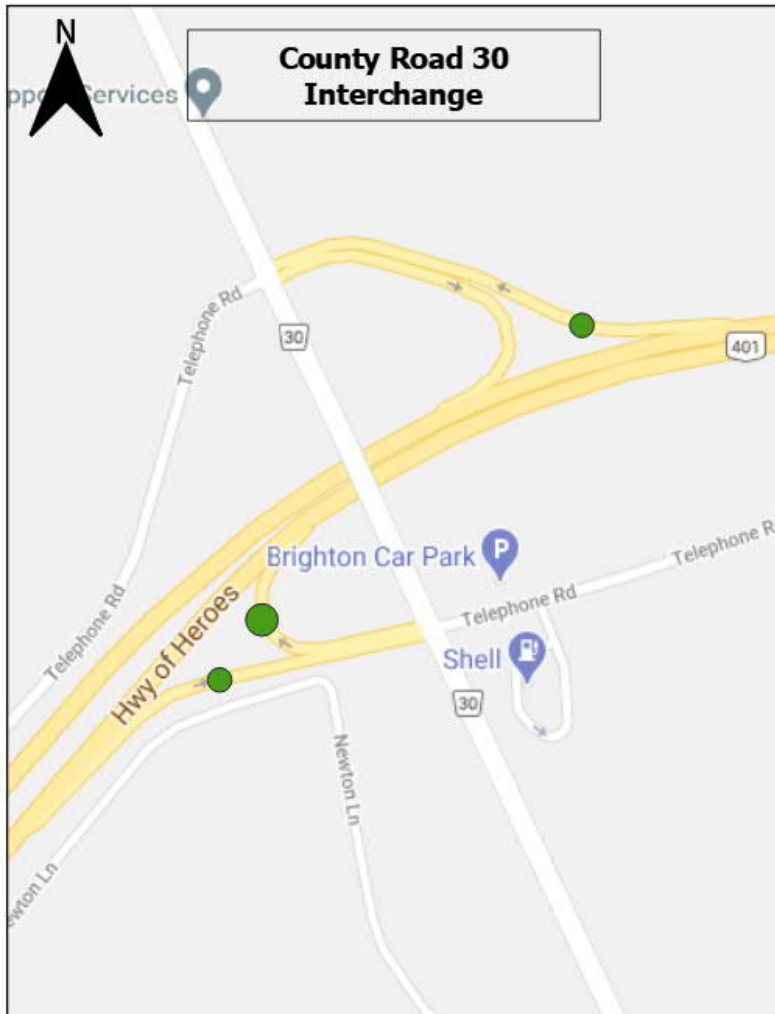


Figure 4-21: Distribution of collisions under conditions of darkness on Highway 401 ramps and ramp terminals within study area

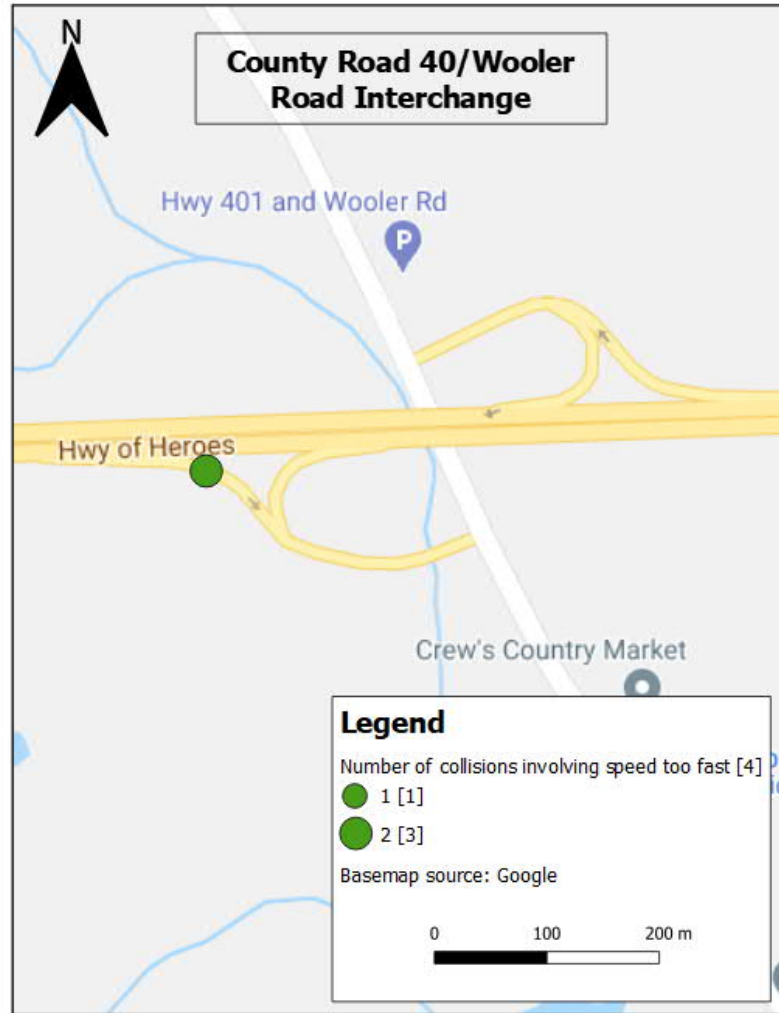
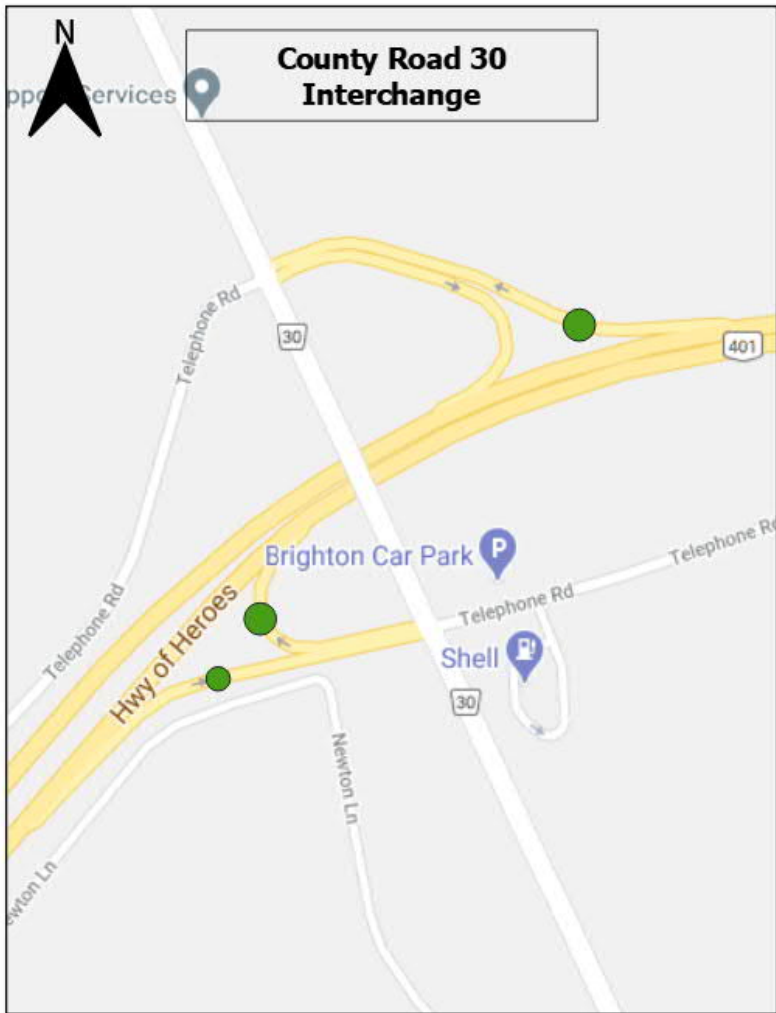


Figure 4-22: Distribution of collisions involving speed too fast on Highway 401 ramps and ramp terminals within study area

4.6 KEY FINDINGS

The Highway 401 mainline, through the study area, is operating at an acceptable level-of-service-safety (LOSS) with a LOSS of II. A LOSS II indicates that the Highway 401 corridor is operating below the predicted safety performance given the corridor's annual average daily traffic. Over the five-year period from 2012 to 2016, one incident resulted in a fatality. This incident occurred on the westbound lanes of Highway 401, 2.3 km west of County Road 40 and involved a rear-end collision between a stopped truck and a passenger vehicle. The most memorable incident occurred on the westbound lanes in 2015 and involved 39 vehicles. This incident resulted in property damage only and occurred during freezing rain when there was ice on the road surface.

5 FUTURE CONDITIONS – 2031

The transportation network was assessed for the planning year 2031. This section of the document presents the roadway performance for the planning year 2031 under the: 1) do-nothing scenario; and 2) widened scenario.

5.1 DO-NOTHING SCENARIO

The do-nothing scenario includes the Highway 401 corridor, from Colborne to Brighton, as a four-lane freeway with a posted speed limit of 100 km/h. As indicated in Section 2.1, the remaining segments of the roadway remain similar to the existing conditions, including the latest changes at the County Road 30 ramp terminals. The interchange configuration at County Road 25 was maintained from the existing conditions. A growth rate of 1.5% per annum was applied to the existing traffic volumes to generate 2031 AM, PM, and weekend volumes along the corridor. This scenario was used as a baseline to understand the impacts of future growth on the traffic operations of Highway 401.

5.1.1 MAINLINE/FREEWAY LEVEL OF SERVICE

The 2031 traffic demands were simulated over 5 simulation runs under the existing roadway configuration. The simulated peak hour traffic volumes on Highway 401 are summarized in Table 5-1 for the fall and summer conditions. The total (2-way combined) mainline peak hour traffic volumes are 14-30% greater in summer compared to fall highway traffic depending on time of the day. The mainline traffic is the greatest over the weekend periods, approximately twice the weekday peak hour traffic volumes.

Table 5-1 2031 Do-nothing scenario Highway 401 Mainline simulated peak hour traffic volume

| HIGHWAY 401 MAINLINE (veh/hr) | | WEST OF CR 25 | | WEST OF CR 30 | | WEST OF CR 40 | | EAST OF CR 40 | |
|----------------------------------|--------|---------------|-------|---------------|-------|---------------|-------|---------------|-------|
| | | EB | WB | EB | WB | EB | WB | EB | WB |
| AM Peak Hour | Fall | 1,065 | 1,120 | 1,020 | 985 | 1,045 | 960 | 1,230 | 1,040 |
| | Summer | 1,360 | 1,370 | 1,260 | 1,155 | 1,315 | 1,150 | 1,605 | 1,315 |
| PM Peak Hour | Fall | 1,625 | 1,560 | 1,480 | 1,495 | 1,420 | 1,540 | 1,445 | 1,800 |
| | Summer | 1,990 | 2,140 | 1,770 | 1,990 | 1,775 | 2,070 | 1,860 | 2,490 |
| Weekend Peak Hour | Fall | 2,365 | 3,220 | 2,265 | 3,185 | 2,300 | 3,240 | 2,360 | 3,355 |
| | Summer | 2,835 | 3,605 | 2,665 | 3,580 | 2,685 | 3,585 | 2,655 | 3,745 |

The calculated density, volume-to-capacity ratios (v/c), and LOS are presented in Table 5-2 for the Highway 401 mainline under different peak hour conditions. The peak-direction LOS analysis indicates that Highway 401 is operating with a LOS of C or better during both the AM and PM peak hours. The weekend peak hour operation is the most critical and the corridor operates with a LOS of D and E during the fall and summer months respectively. A level of service E represents operating conditions at or near the roadway's capacity. In this condition, even minor disruptions to the traffic stream, such as vehicles entering from a ramp or changing lanes, can cause delays as other vehicles give way to allow these maneuvers.

Table 5-2: 2031 Do-nothing scenario Highway 401 Mainline Density, v/c and LOS

| TRAVEL DEMAND PERIOD | SEASON | BETWEEN CR 25 & CR 30 | | | BETWEEN CR 30 & CR 40 | | |
|-----------------------------------|--------|-----------------------|------|-----|-----------------------|------|-----|
| | | DENSITY (PC/KM/LN) | V/C | LOS | DENSITY (PC/KM/LN) | V/C | LOS |
| AM Peak Hour, Peak-Direction | Fall | 5.6 | 0.26 | A | 5.6 | 0.26 | A |
| | Summer | 6.9 | 0.32 | A | 7.1 | 0.33 | B |
| PM Peak Hour, Peak-Direction | Fall | 7.9 | 0.37 | B | 8.3 | 0.39 | B |
| | Summer | 10.7 | 0.50 | B | 11.3 | 0.53 | C |
| Weekend Peak Hour, Peak-Direction | Fall | 20.3 | 0.87 | D | 20.2 | 0.87 | D |
| | Summer | 24.2 | 0.95 | E | 24.0 | 0.95 | E |

5.1.2 MAINLINE/FREEWAY TRAVEL TIMES AND SPEED

The simulated mainline travel times and speeds for the 2031 do-nothing weekday AM, PM, and weekend peak hour scenarios are presented in Table 5-3. This table also compares the travel times and speeds to the existing conditions scenarios and documents the difference between the two scenarios. Highway 401 generally operates under free-flow conditions with simulated speeds of greater than or slightly below 100 km/h during the weekday AM and PM peak hours. Under the weekend peak hour condition, the simulated speeds fall slightly below 100 km/h due to high traffic demand.

Table 5-3: 2031 Do-nothing scenario simulated travel times and speeds along Highway 401

| HIGHWAY 401 SEGMENT | TRAVEL TIME (MIN) | | | SPEED (KM/H) | | |
|---|-------------------|------------|------------|--------------|--------------|-------------|
| | AM PEAK | PM PEAK | WKND PEAK | AM PEAK | PM PEAK | WKND PEAK |
| Highway 401 Eastbound: Fall (Difference) | | | | | | |
| CR 25 to CR 30 | 7.2 (0.0) | 7.3 (0.0) | 7.5 (+0.1) | 103.1 (-0.5) | 102.0 (-0.7) | 99.7 (-0.8) |
| CR 30 to CR 40 | 7.3 (+0.1) | 7.3 (0.0) | 7.6 (+0.1) | 102.7 (-0.2) | 101.6 (-0.5) | 98.5 (-1.1) |
| Highway 401 Westbound: Fall (Difference) | | | | | | |
| CR 40 to CR 30 | 7.2 (0.0) | 7.3 (0.0) | 7.7 (+0.1) | 103.2 (-0.3) | 101.8 (-0.6) | 96.7 (-1.5) |
| CR 30 to CR 25 | 7.2 (0.0) | 7.4 (+0.1) | 7.8 (+0.1) | 102.8 (-0.3) | 101.3 (-0.7) | 95.6 (-1.5) |
| Highway 401 Eastbound: Summer (Difference) | | | | | | |
| CR 25 to CR 30 | 7.3 (0.1) | 7.4 (0.0) | 7.6 (+0.1) | 102.7 (-0.4) | 101.0 (-0.4) | 98.6 (-0.9) |
| CR 30 to CR 40 | 7.3 (0.0) | 7.5 (+0.1) | 7.6 (+0.3) | 101.9 (-0.1) | 99.9 (-1.1) | 97.5 (-0.9) |
| Highway 401 Westbound: Summer (Difference) | | | | | | |
| CR 40 to CR 30 | 7.3 (+0.1) | 7.4 (0.0) | 7.8 (+0.1) | 102.7 (-1.4) | 100.1 (-1.1) | 95.6 (-1.6) |
| CR 30 to CR 25 | 7.3 (+0.1) | 7.5 (+0.1) | 7.9 (+0.1) | 102.2 (-1.3) | 99.6 (-1.0) | 94.3 (-1.4) |

The speed contour plots along Highway 401 in both directions of travel for the weekday AM, PM and weekend peak periods are presented in Figure 5-1 to Figure 5-12. These speed contour plots were developed similar to the existing conditions. The speed contour plots show that for the weekday peak periods, Highway 401 mainline operates well with some minor speed reductions around the interchanges in both directions, especially at on-ramp merges. The travel speeds during the weekend peak period are lower than the weekday, with similar speed reductions near the interchanges.

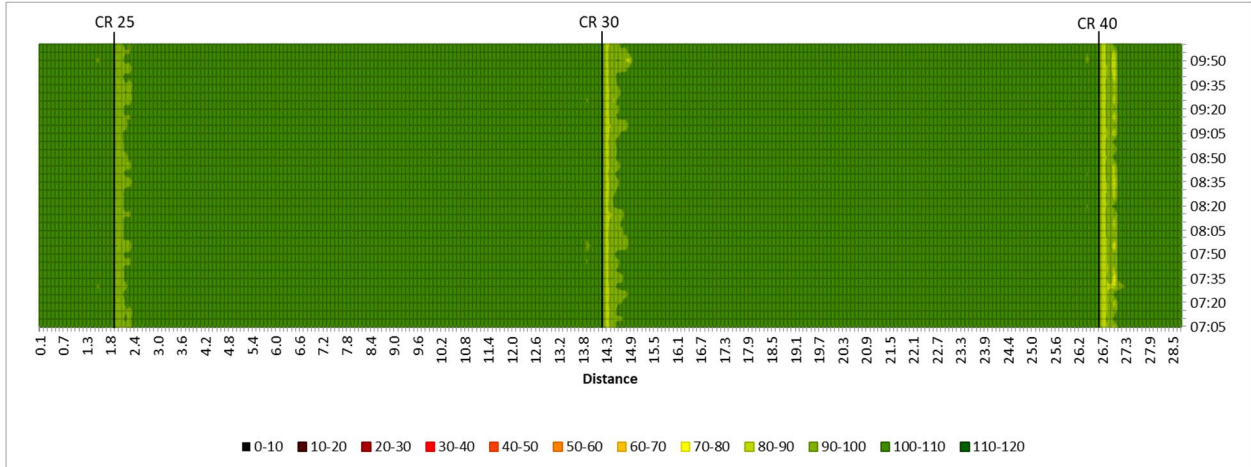


Figure 5-1: Highway 401 mainline eastbound speed – 2031 Do-nothing (fall) – AM peak period

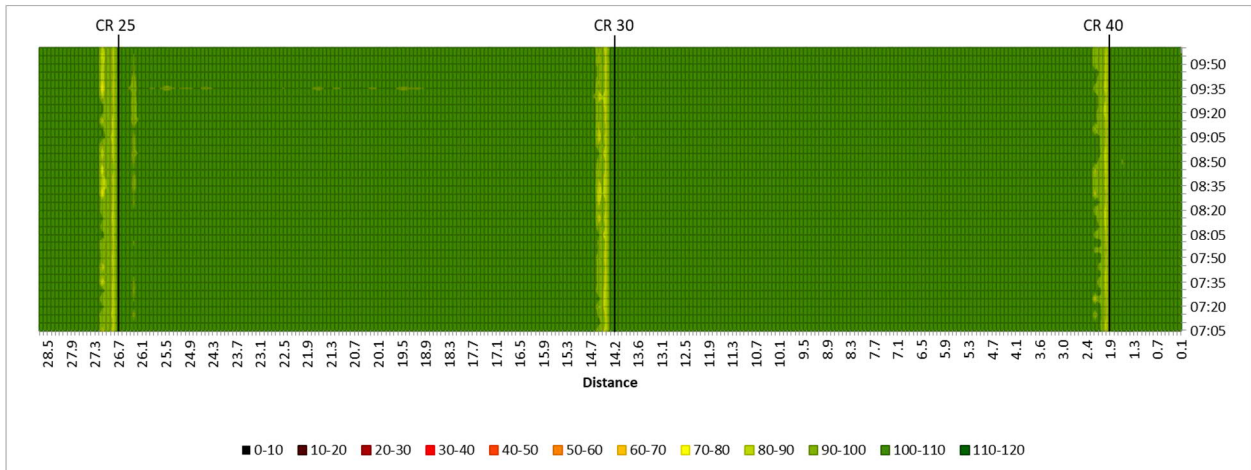


Figure 5-2: Highway 401 mainline westbound speed – 2031 Do-nothing (fall) – AM peak period

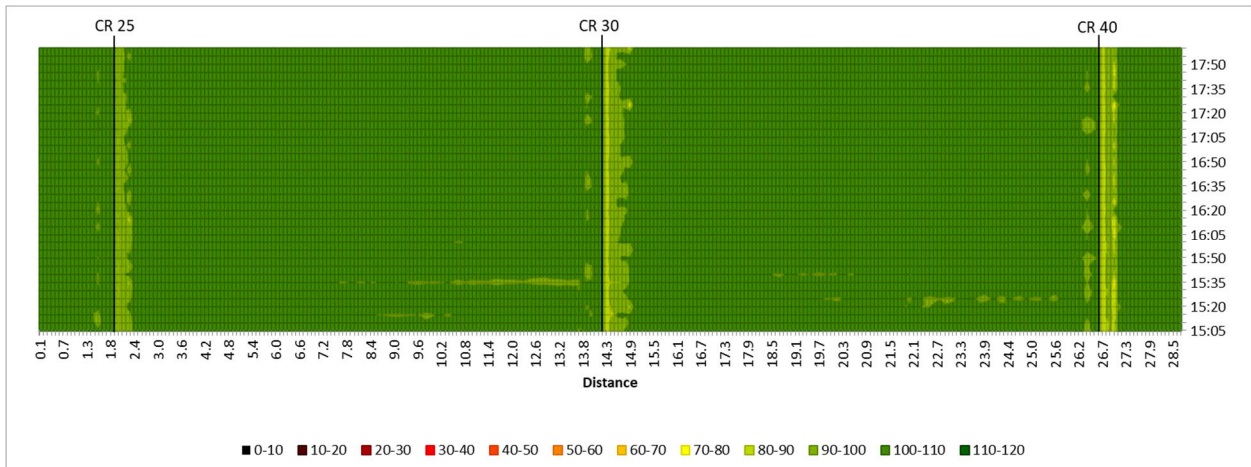


Figure 5-3: Highway 401 mainline eastbound speed – 2031 Do-nothing (fall) – PM peak period

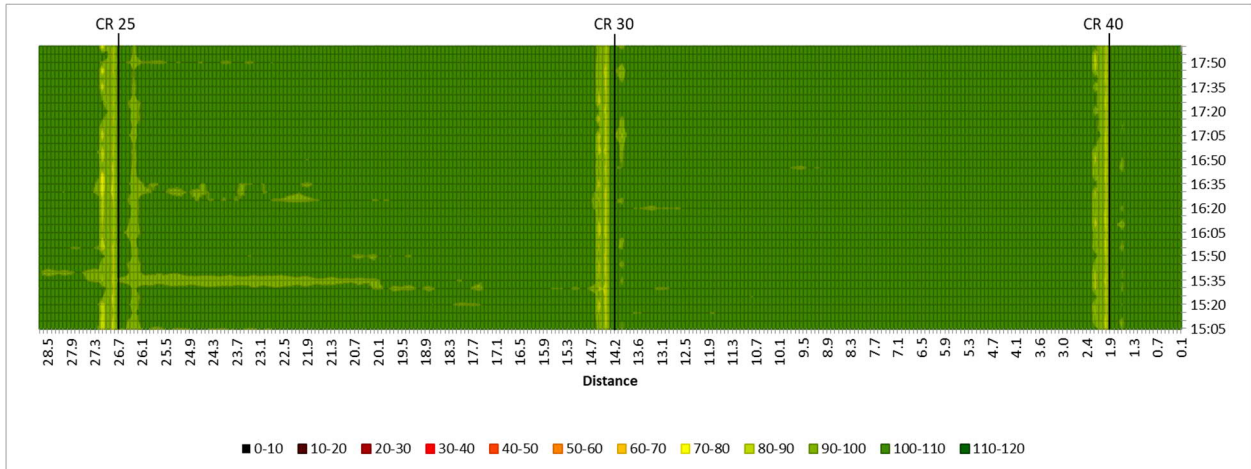


Figure 5-4: Highway 401 mainline westbound speed – 2031 Do-nothing (fall) – PM peak period

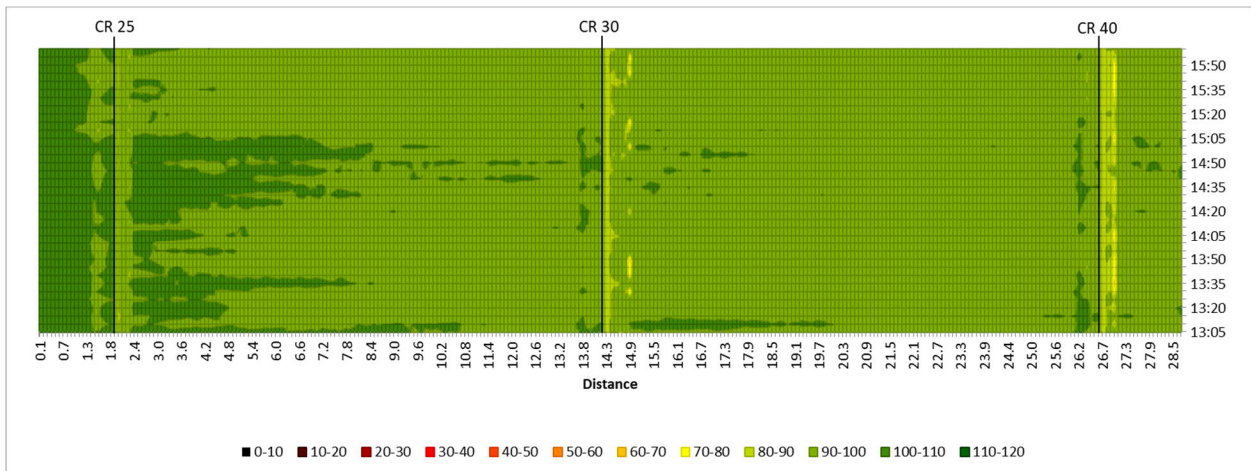


Figure 5-5: Highway 401 mainline eastbound speed – 2031 Do-nothing (fall) – weekend peak period

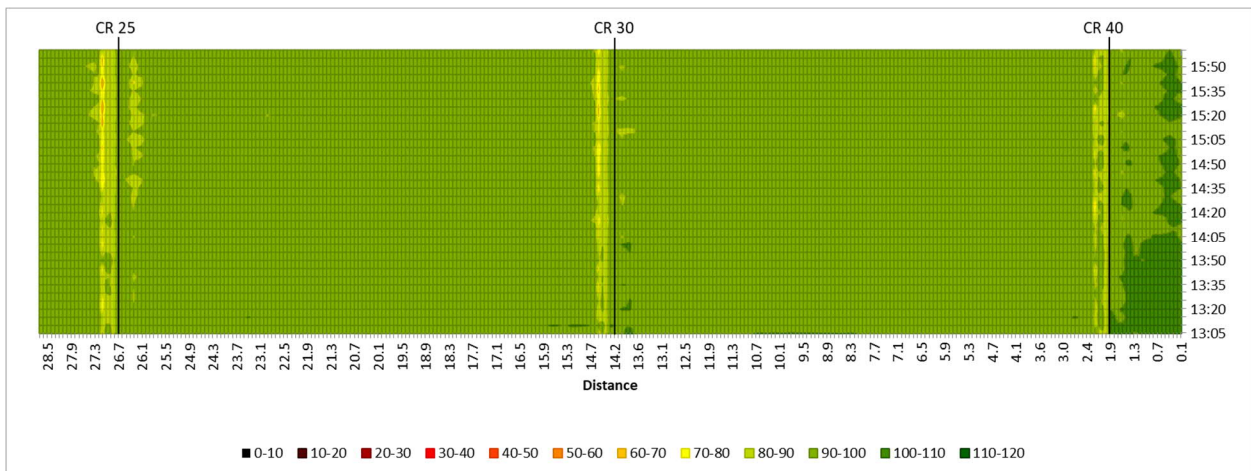


Figure 5-6: Highway 401 mainline westbound speed – 2031 Do-nothing (fall) – weekend peak period

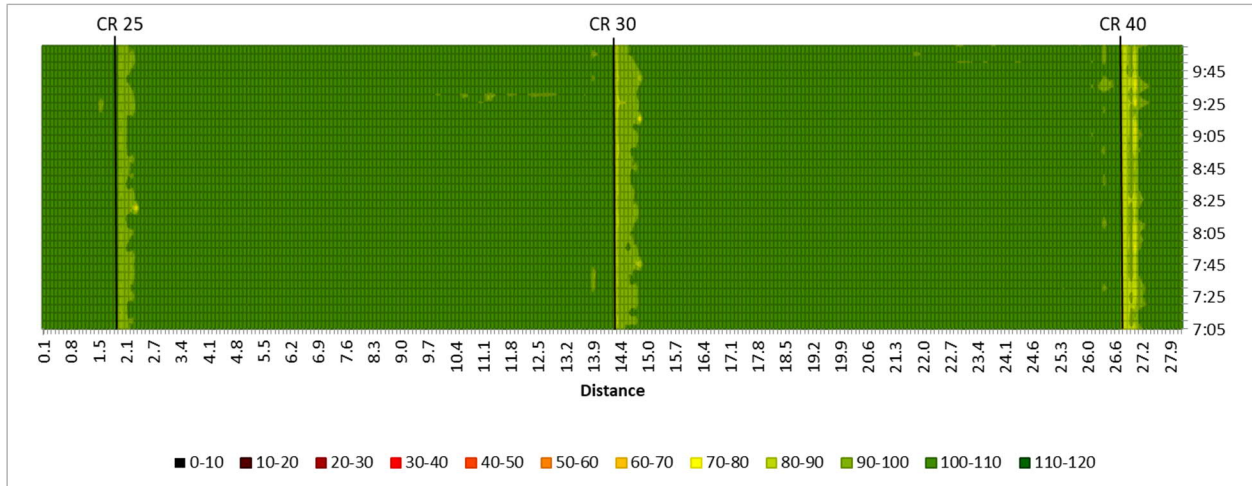


Figure 5-7: Highway 401 mainline eastbound speed – 2031 Do-nothing (summer) – AM peak period

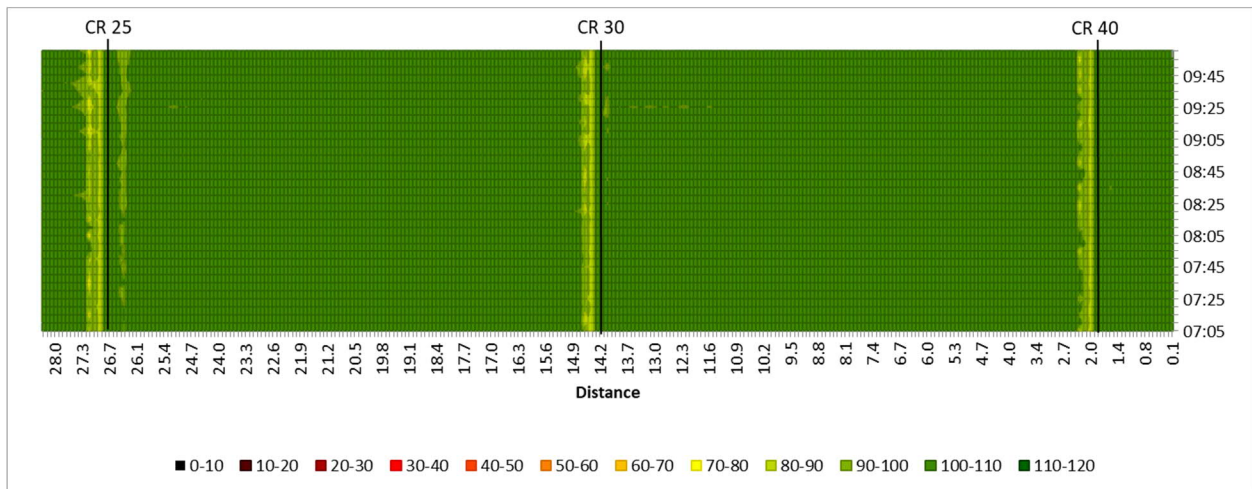


Figure 5-8: Highway 401 mainline westbound speed – 2031 Do-nothing (summer) – AM peak period

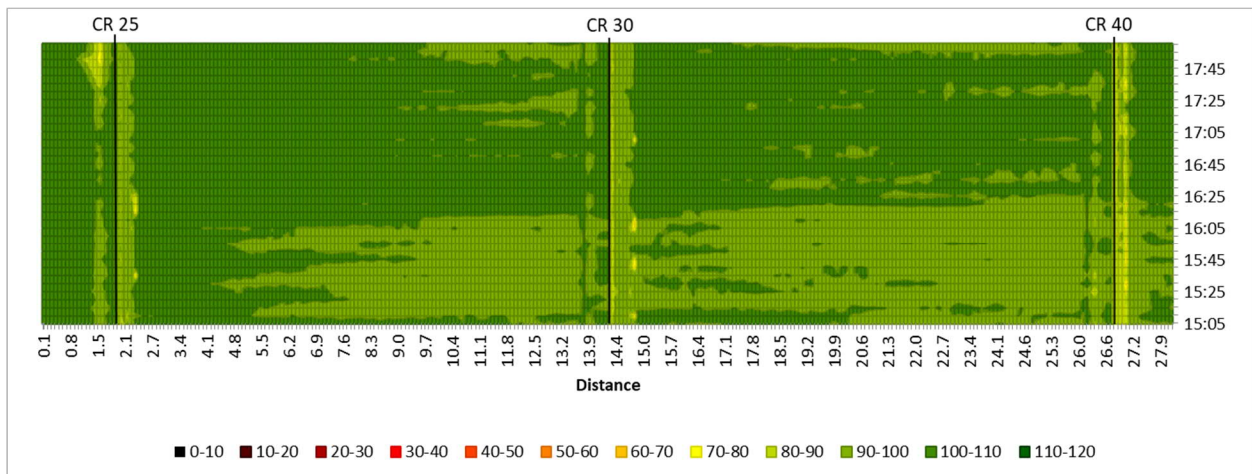


Figure 5-9: Highway 401 mainline eastbound speed – 2031 Do-nothing (summer) – PM peak period

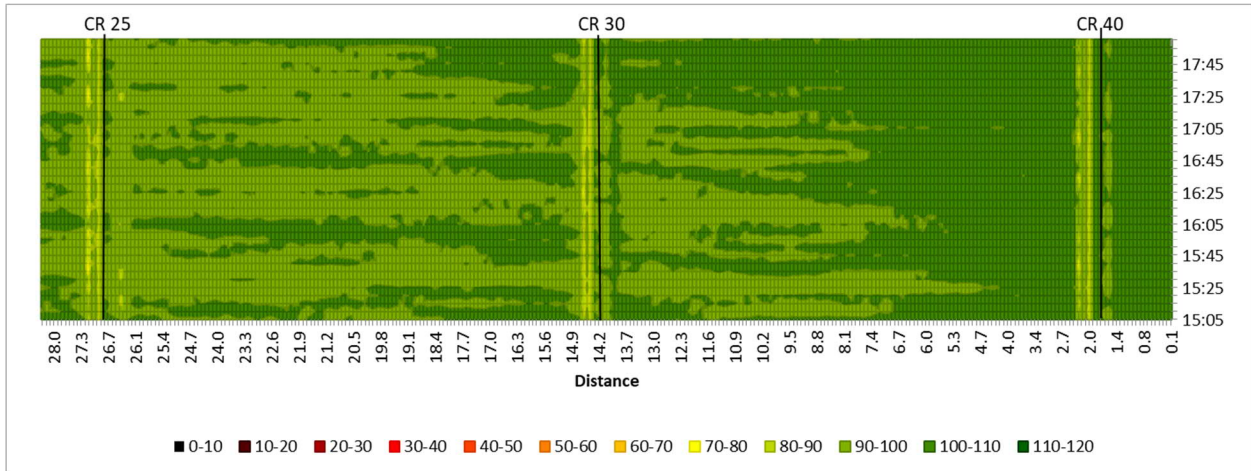


Figure 5-10: Highway 401 mainline westbound speed – 2031 Do-nothing (summer) – PM peak period

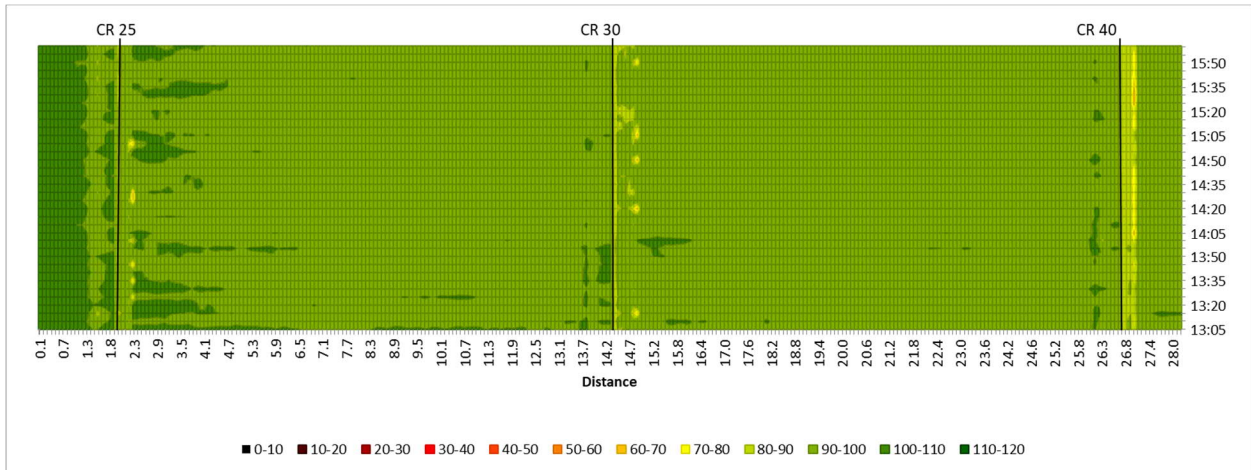


Figure 5-11: Highway 401 mainline eastbound speed – 2031 Do-nothing (summer) – weekend peak period

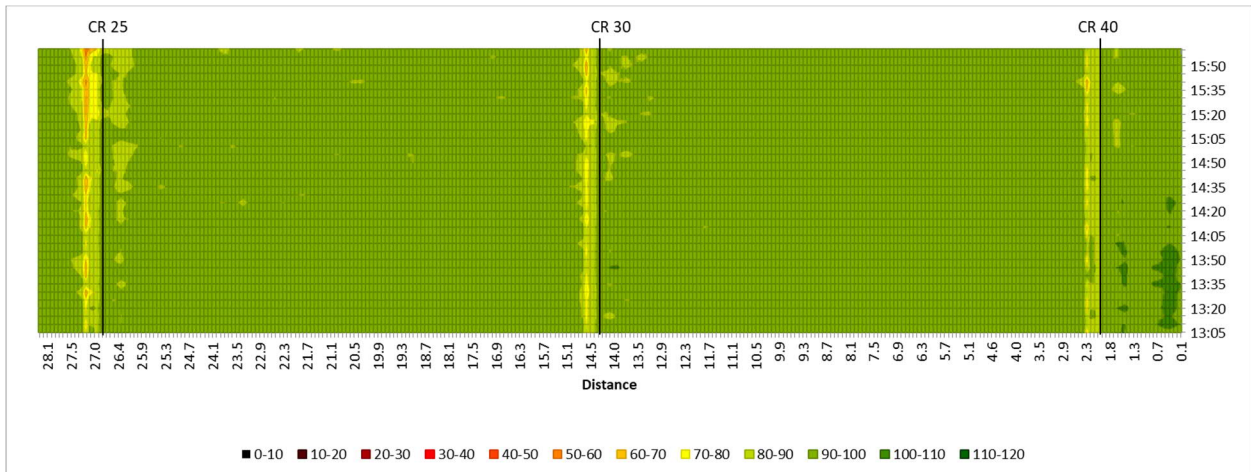


Figure 5-12: Highway 401 mainline westbound speed – 2031 Do-nothing (summer) – weekend peak period

5.1.3 RAMP TERMINAL OPERATIONS

Traffic performance was assessed under the 2031 do-nothing scenario at highway ramp terminals to determine the impact of growth in traffic volumes. The intersection LOS thresholds from the 2016 CAM (in Table 2-3) were used for the analysis. The intersection traffic operational performance (based on the micro-simulation model outputs over 5 random simulation runs) are summarized in Table 5-4 and Table 5-5 under the fall and summer conditions, respectively.

- Intersections operate at an overall LOS A during the weekday and weekend peak hours under the fall conditions similar to the existing conditions. All turning movements operate at an acceptable LOS C or better.
- All intersections remain operational at LOS B or better during the summer conditions, except for the south ramp terminal at County Road 25. This stop-controlled intersection operates at LOS E, with 39 seconds of average delay, during the weekday PM peak hour. This delay is because the eastbound vehicles from Highway 401 (turning onto County Road 25) experience delays of approximately 2 minutes on average as demand on the ramp and County Road 25 has grown by 10% and 17%, respectively. Thus, the eastbound vehicles must wait longer to find a gap before entering County Road 25. Queues grow rapidly on the off-ramp since the eastbound approach is a shared traffic lane with the left-turning vehicles often blocking the passage of right-turning traffic.
- Even though the south ramp terminal at County Road 25 operates at LOS E under the weekday afternoon peaks, the queues do not spill back onto the mainline, but the 95th percentile queue exceeds the 2/3 of distance between the bullnose and the stop-bar by approximately 70 metres.

Table 5-4 2031 Do-nothing scenario intersection operational analysis results (fall)

| INTERSECTIONS/ MOVEMENTS | WEEKDAY AM PEAK | | | WEEKDAY PM PEAK | | | WEEKEND PEAK | | |
|---|-----------------|----------|---------------------------|-----------------|----------|---------------------------|--------------|----------|---------------------------|
| | DELAY (s) | LOS | QUEUE ¹ (M) | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 2 | A | | 3 | A | | 2 | A | |
| Westbound Left/Right | 10/6 | A/A | 10 | 12/8 | B/A | 20 | 9/8 | A/A | 13 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left/Through | 3/1 | A/A | 0 | 4/0 | A/A | 0 | 2/0 | A/A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 2 | A | | 5 | A | | 3 | A | |
| Eastbound Left/Right | 10/8 | A/A | 17 | 17/14 | C/B | 41 | 12/9 | B/A | 24 |
| Northbound Left | 3 | A | 0 | 3 | A | 0 | 2 | A | 0 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Through/Right | 0/1 | A/A | 0 | 0/1 | A/A | 0 | 0/1 | A/A | 0 |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 3 | A | | 4 | A | | 2 | A | |
| Eastbound Left/Through/Right | 4/0/7 | A/A/A | 6 | 6/9/6 | A/A/A | 5 | 6/5/7 | A/A/A | 5 |
| Westbound Left/Through/Right | 8/12/8 | A/B/A | 17 | 10/14/10 | B/B/B | 28 | 8/13/7 | A/B/A | 14 |
| Northbound Left/Through | 2/0 | A/A | 0 | 2/1 | A/A | 0 | 2/1 | A/A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left/Through/Right | 3/0/0 | A/A/A | 0 | 3/0/1 | A/A/A | 0 | 3/0/1 | A/A/A | 0 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 7 | A | | 9 | A | | 9 | A | |
| Eastbound Left/Through/Right | 10/10/7 | A/B/A | 24 | 12/14/9 | B/B/A | 39 | 11/12/7 | B/B/A | 20 |
| Westbound Left/Through/Right | 10/13/6 | B/B/A | 22 | 12/12/5 | B/B/A | 24 | 10/12/6 | B/B/A | 19 |
| Northbound Left/Through/Right | 8/6/4 | A/A/A | 22 | 11/8/5 | B/A/A | 27 | 9/8/5 | A/A/A | 17 |
| Southbound Left/Through | 9/8 | A/A | 25 | 12/10 | B/B | 35 | 10/11 | B/B | 34 |
| Southbound Right | 4 | A | 12 | 4 | A | 9 | 4 | A | 7 |
| Hwy 401 at CR 40 North ramp terminal (Signalized) | 6 | A | | 9 | A | | 6 | A | |
| Westbound Left/Right | 10/5 | B/A | 28 | 13/9 | B/A | 51 | 10/6 | B/A | 30 |
| Northbound Through | 6 | A | 16 | 8 | A | 26 | 7 | A | 17 |
| Northbound Right | 3 | A | 6 | 4 | A | 17 | 3 | A | 13 |
| Southbound Left/Through | 8/6 | A/A | 19 | 11/8 | B/A | 23 | 9/6 | A/A | 16 |
| Hwy 401 at CR 40 South ramp terminal (Stop-controlled) | 3 | A | | 5 | A | | 3 | A | |
| Eastbound Left/Right | 7/7 | A/A | 0 | 18/11 | C/B | 0 | 14/8 | B/A | 0 |
| Northbound Left/Through | 4/1 | A/A | 0 | 4/1 | A/A | 0 | 3/0 | A/A | 0 |
| Southbound Through | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |

Note 1: Queue length reflects the 95th percentile queue length

Table 5-5 2031 Do-nothing scenario intersection operational analysis results (summer)

| INTERSECTIONS/ MOVEMENTS | WEEKDAY AM PEAK | | | WEEKDAY PM PEAK | | | WEEKEND PEAK | | |
|---|-----------------|----------|---------------------------|-----------------|----------|---------------------------|--------------|----------|---------------------------|
| | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 2 | A | | 3 | A | | 3 | A | |
| Westbound Left/Right | 10/8 | B/A | 14 | 13/11 | B/B | 22 | 13/10 | B/A | 22 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left/Through | 5/1 | A/A | 3 | 5/1 | A/A | 0 | 3/0 | A/A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 3 | A | | 39 | E | | 5 | A | |
| Eastbound Left/Right | 15/11 | B/B | 29 | 129/123 | F/F | 245 | 19/16 | C/C | 46 |
| Northbound Left | 3 | A | 0 | 5 | A | 4 | 4 | A | 0 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Through/Right | 1/1 | A/A | 0 | 1/1 | A/A | 0 | 1/1 | A/A | 0 |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 4 | A | | 8 | A | | 4 | A | 4 |
| Eastbound Left/Through/Right | 11/0/7 | B/A/A | 8 | 13/17/6 | B/C/A | 6 | 10/17/6 | A/C/A | 6 |
| Westbound Left/Through/Right | 14/20/10 | B/C/B | 28 | 29/31/24 | D/D/C | 71 | 16/19/12 | C/C/B | 25 |
| Northbound Left | 2 | A | 0 | 3 | A | 3 | 3 | A | 1 |
| Northbound Through | 0 | A | 0 | 1 | A | 0 | 0 | A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left | 4 | A | 6 | 4 | A | 6 | 4 | A | 3 |
| Southbound Through/Right | 0/0 | A/A | 4 | 0/1 | A/A | 4 | 0/1 | A/A | 1 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 11 | B | | 12 | B | | 11 | B | |
| Eastbound Left/Through/Right | 15/13/9 | B/B/A | 38 | 16/18/12 | B/B/B | 59 | 13/13/8 | B/B/A | 36 |
| Westbound Left/Through/Right | 16/16/9 | B/B/A | 36 | 22/16/10 | C/B/B | 46 | 18/15/9 | B/B/A | 46 |
| Northbound Left | 17 | B | 29 | 22 | C | 36 | 17 | B | 18 |
| Northbound Through/Right | 8/5 | A/A | 21 | 9/6 | A/A | 30 | 8/6 | A/A | 25 |
| Southbound Left | 12 | B | 21 | 15 | B | 15 | 14 | B | 20 |
| Southbound Through/Right | 9/6 | A/A | 34 | 10/8 | B/A | 48 | 10/6 | A/A | 43 |
| Hwy 401 at CR 40 North ramp terminal (Signalized) | 8 | A | | 16 | B | | 8 | A | |
| Westbound Left/Right | 12/7 | B/A | 42 | 27/24 | C/C | 140 | 13/8 | B/A | 41 |
| Northbound Through | 8 | A | 28 | 11 | B | 44 | 8 | A | 25 |
| Northbound Right | 4 | A | 19 | 5 | A | 24 | 4 | A | 19 |
| Southbound Left/Through | 10/8 | A/A | 27 | 17/11 | B/B | 32 | 13/8 | B/A | 22 |
| Hwy 401 at CR 40 South ramp terminal (Stop-controlled) | 3 | A | | 6 | A | | 3 | A | |
| Eastbound Left/Right | 13/7 | B/A | 21 | 25/19 | C/C | 72 | 14/11 | B/B | 37 |
| Northbound Left/Through | 8/1 | A/A | 25 | 11/1 | B/A | 34 | 5/1 | A/A | 11 |
| Southbound Through | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 1 | A | 0 | 2 | A | 0 | 1 | A | 0 |

5.2 WIDENED SCENARIO

The widened scenario includes the Highway 401 corridor, from Colborne to Brighton, as a six-lane freeway. The interchange configuration was updated at the County Road 25 interchange as discussed in Section 2.1. Lane configuration for the rest of the network and the modelled vehicular demand is similar to the do-nothing scenario.

5.2.1 MAINLINE/FREEWAY LEVEL OF SERVICE

The 2031 vehicular demand (from the do-nothing scenario) were simulated over 5 simulation runs under the widened scenario roadway network. The simulated traffic volumes are within 1% of the simulated traffic from the do-nothing scenario as summarized in Table 5-1. The mainline traffic volumes are the highest under the summer weekend conditions similar to the do-nothing scenario, especially in the westbound direction.

The calculated density, volume-to-capacity ratios (v/c), and LOS are presented in Table 5-6 for Highway 401 segments under different peak hour conditions. The mainline continues to operate at LOS A or B during the weekday peak hours (similar to the existing conditions), and vehicles travel at the highway posted speed. With widening of Highway 401, the LOS improves under the weekend conditions from LOS D to LOS C, and the traffic travels at free flow speed.

Table 5-6: 2031 Widened scenario Highway 401 Mainline Density, v/c and LOS

| TRAVEL DEMAND PERIOD | SEASON | BETWEEN CR 25 & CR 30 | | | BETWEEN CR 30 & CR 40 | | |
|-----------------------------------|--------|-----------------------|------|-----|-----------------------|------|-----|
| | | DENSITY (PC/KM/LN) | V/C | LOS | DENSITY (PC/KM/LN) | V/C | LOS |
| AM Peak Hour, Peak-Direction | Fall | 3.7 | 0.17 | A | 3.8 | 0.18 | A |
| | Summer | 4.6 | 0.22 | A | 4.7 | 0.22 | B |
| PM Peak Hour, Peak-Direction | Fall | 5.3 | 0.25 | A | 5.5 | 0.26 | A |
| | Summer | 7.1 | 0.33 | B | 7.5 | 0.35 | B |
| Weekend Peak hour, Peak-Direction | Fall | 12.4 | 0.58 | C | 12.4 | 0.58 | C |
| | Summer | 13.5 | 0.63 | C | 13.5 | 0.63 | C |

5.2.2 MAINLINE /FREEWAY TRAVEL TIMES AND SPEED

The simulated mainline travel times and speeds for the 2031 widened weekday AM, PM, and weekend peak hour scenarios are presented in Table 5-7. This table also compares the travel times and speeds to the existing conditions. With addition of a highway lane, the travel times on Highway 401 decrease by 0.1-0.4 minutes across all time periods, and vehicles travel at the posted speed limit of 100 km/h. The greatest improvement in the operating speed corresponds to the weekend conditions where the mainline vehicular demands are the highest.

Table 5-7: 2031 Widened scenario simulated travel times and speeds along Highway 401

| HIGHWAY 401 SEGMENT | TRAVEL TIME (MIN) | | | SPEED (KM/H) | | |
|---|-------------------|------------|------------|--------------|--------------|--------------|
| | AM PEAK | PM PEAK | WKND PEAK | AM PEAK | PM PEAK | WKND PEAK |
| Highway 401 Eastbound: Fall (Difference) | | | | | | |
| CR 25 to CR 30 | 7.1 (-0.1) | 7.1 (-0.2) | 7.2 (-0.2) | 104.7 (+1.1) | 104.3 (+1.6) | 103.0 (+2.5) |
| CR 30 to CR 40 | 7.1 (-0.1) | 7.2 (-0.1) | 7.3 (-0.2) | 104.7 (+1.8) | 104.2 (+2.1) | 102.8 (+3.2) |
| Highway 401 Westbound: Fall (Difference) | | | | | | |
| CR 40 to CR 30 | 7.1 (-0.1) | 7.1 (-0.2) | 7.4 (-0.2) | 104.9 (+1.4) | 104.4 (+2.0) | 101.4 (+3.2) |
| CR 30 to CR 25 | 7.1 (-0.1) | 7.1 (-0.2) | 7.4 (-0.3) | 104.8 (+1.7) | 104.2 (+2.2) | 100.9 (+3.8) |
| Highway 401 Eastbound: Summer (Difference) | | | | | | |
| CR 25 to CR 30 | 7.1 (-0.1) | 7.2 (-0.2) | 7.3 (-0.2) | 104.8 (+1.7) | 103.8 (+2.4) | 102.4 (+2.9) |
| CR 30 to CR 40 | 7.2 (-0.1) | 7.2 (-0.2) | 7.3 (-0.3) | 104.4 (+2.1) | 103.5 (+2.8) | 102.0 (+3.6) |
| Highway 401 Westbound: Summer (Difference) | | | | | | |
| CR 40 to CR 30 | 7.1 (-0.1) | 7.2 (-0.2) | 7.4 (-0.3) | 105.0 (+0.9) | 103.5 (+2.3) | 100.7 (+3.5) |
| CR 30 to CR 25 | 7.1 (-0.1) | 7.2 (-0.2) | 7.4 (-0.4) | 104.9 (+1.4) | 103.5 (+2.9) | 100.2 (+4.5) |

The speed contour plots along Highway 401 in both directions of travel for the weekday AM, PM and weekend peak periods are presented in Figure 5-13 to Figure 5-24. The speed plots illustrate that vehicles travel at highway posted speed during weekday peak hours, with small reduction in speeds at interchanges. During weekend conditions, the speed of traffic is similar to the weekday conditions for most segments, apart from the speed of westbound traffic, which is reduced to 90-100 km/h near the end of the weekend peak hour period.

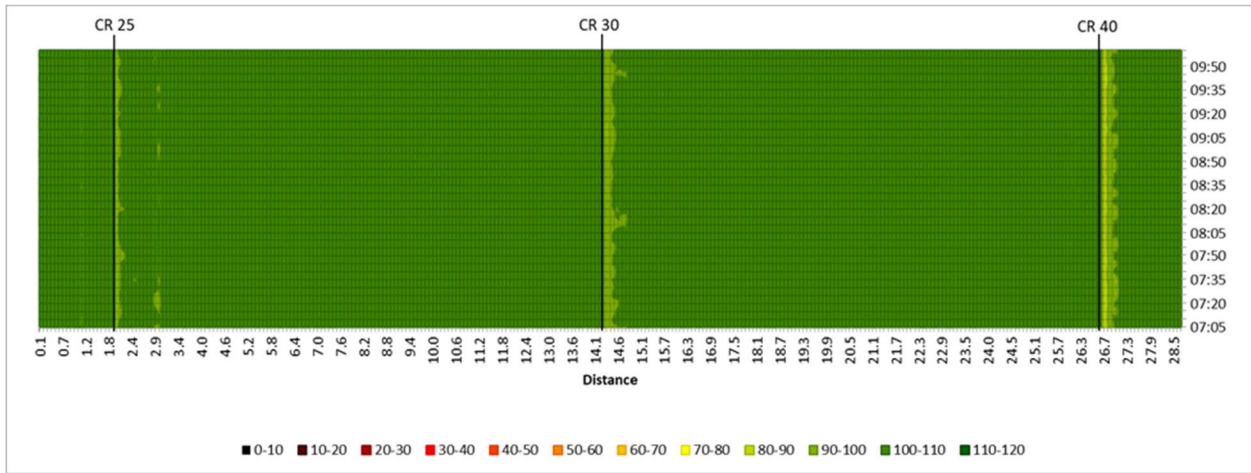


Figure 5-13: Highway 401 mainline eastbound speed – 2031 Widened (fall) – AM peak period

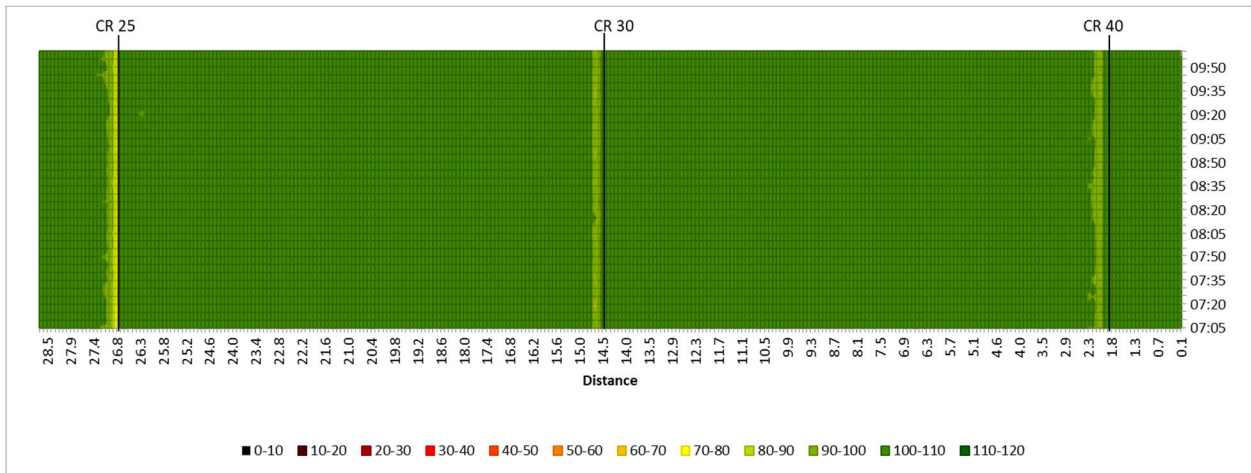


Figure 5-14: Highway 401 mainline westbound speed – 2031 Widened (fall) – AM peak period

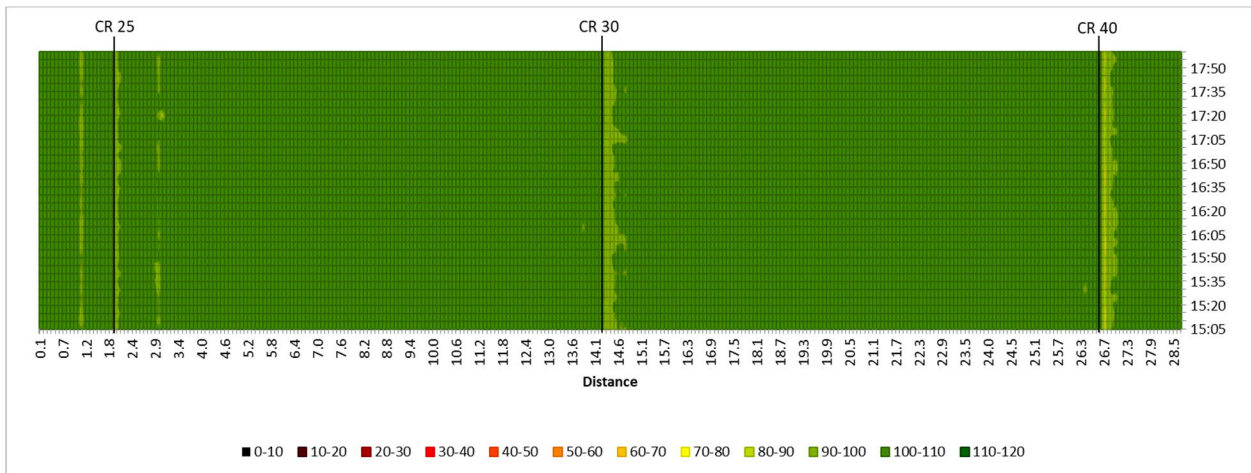


Figure 5-15: Highway 401 mainline eastbound speed – 2031 Widened (fall) – PM peak period

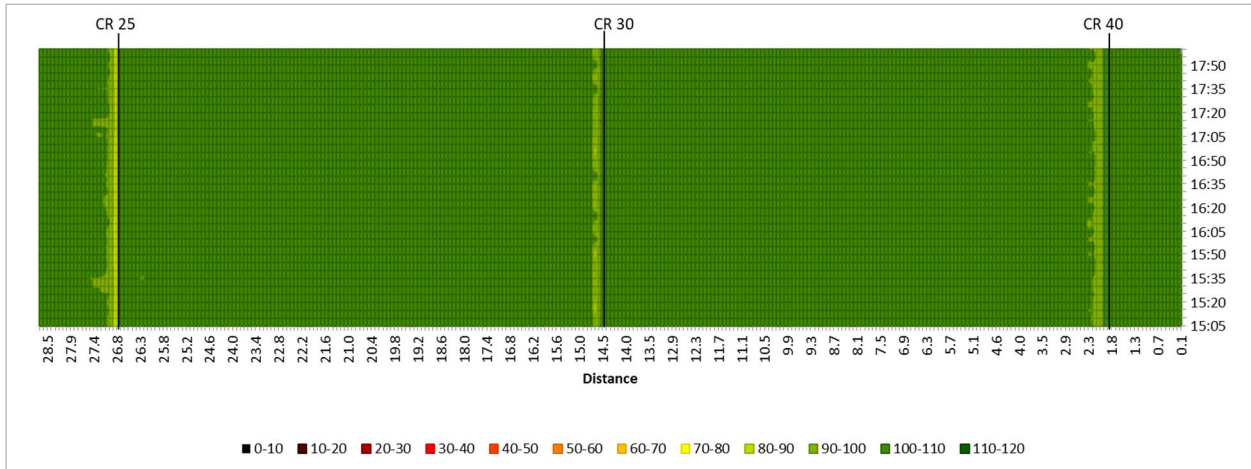


Figure 5-16: Highway 401 mainline westbound speed – 2031 Widened (fall) – PM peak period

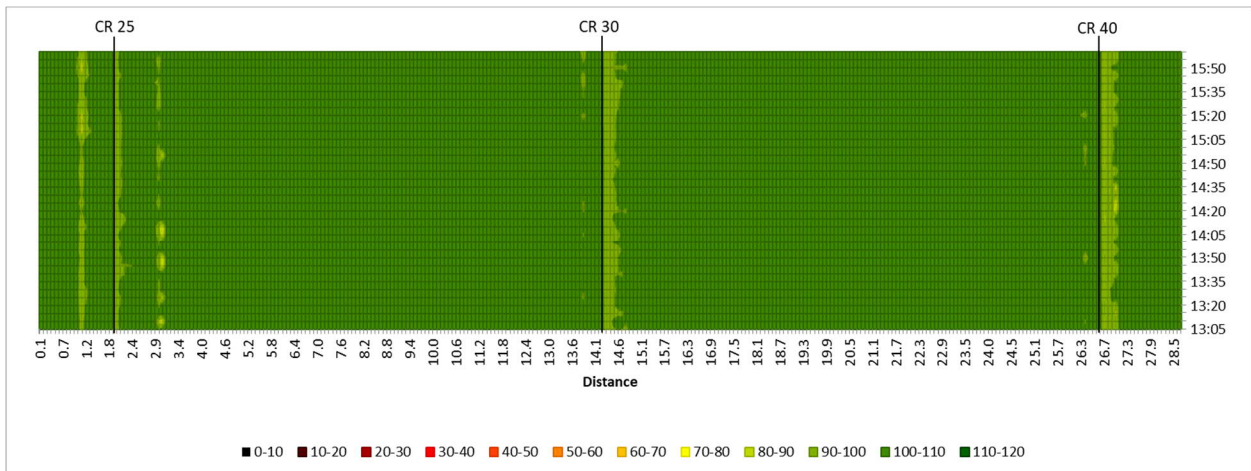


Figure 5-17: Highway 401 mainline eastbound speed – 2031 Widened (fall) – weekend peak period

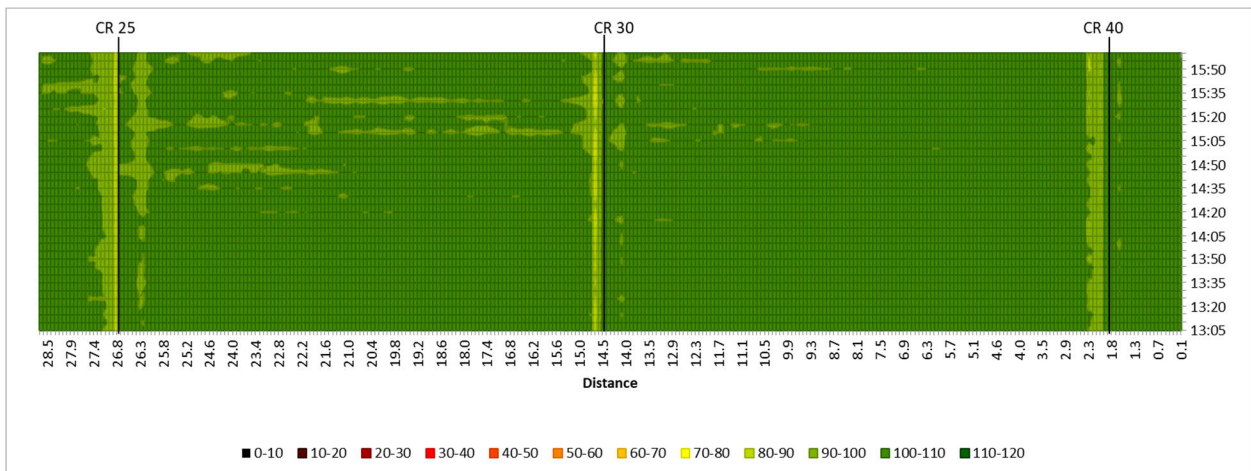


Figure 5-18: Highway 401 mainline westbound speed – 2031 Widened (fall) – weekend peak period

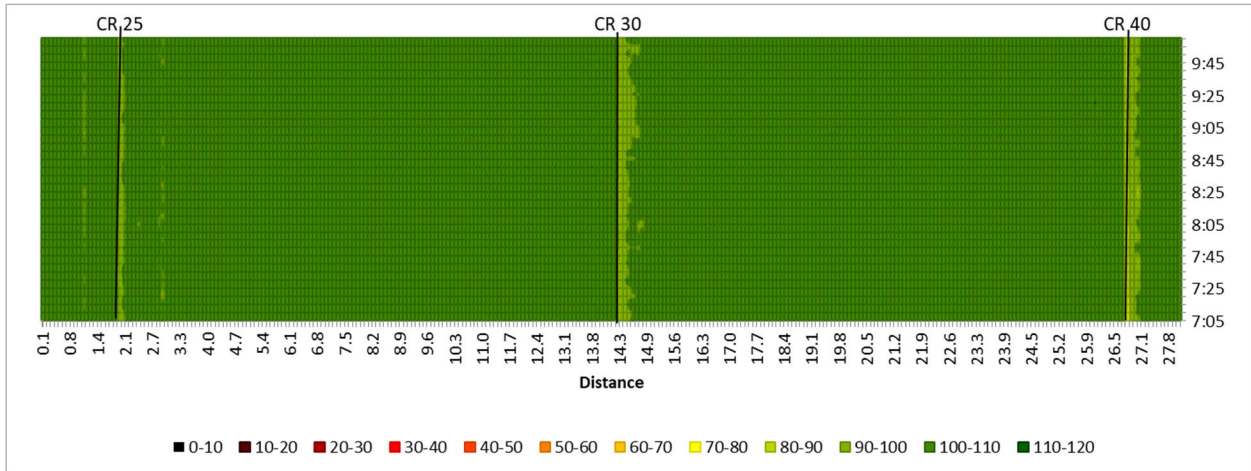


Figure 5-19: Highway 401 mainline eastbound speed – 2031 Widened (summer) – AM peak period

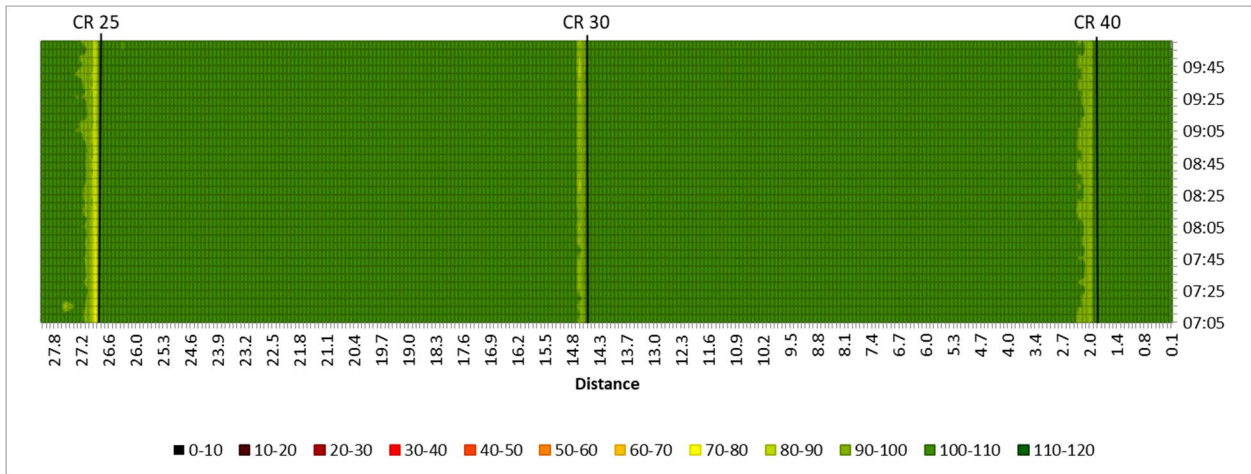


Figure 5-20: Highway 401 mainline westbound speed – 2031 Widened (summer) – AM peak period

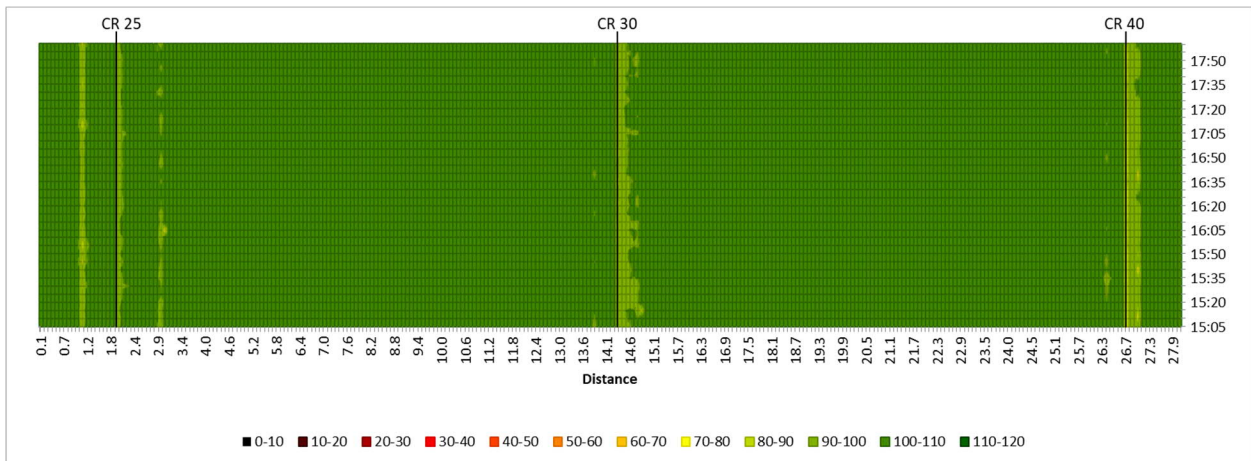


Figure 5-21: Highway 401 mainline eastbound speed – 2031 Widened (summer) – PM peak period

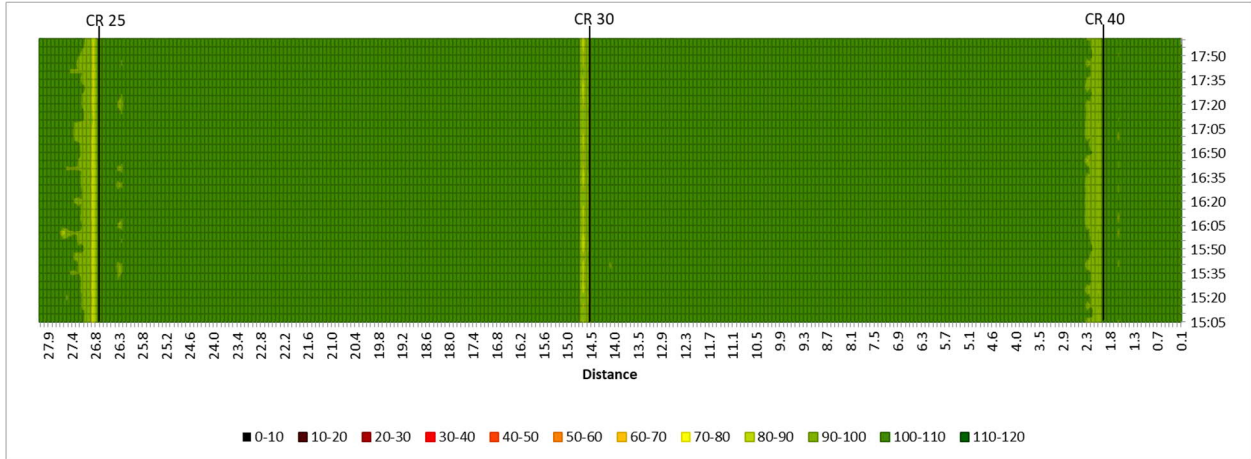


Figure 5-22: Highway 401 mainline westbound speed – 2031 Widened (summer) – PM peak period

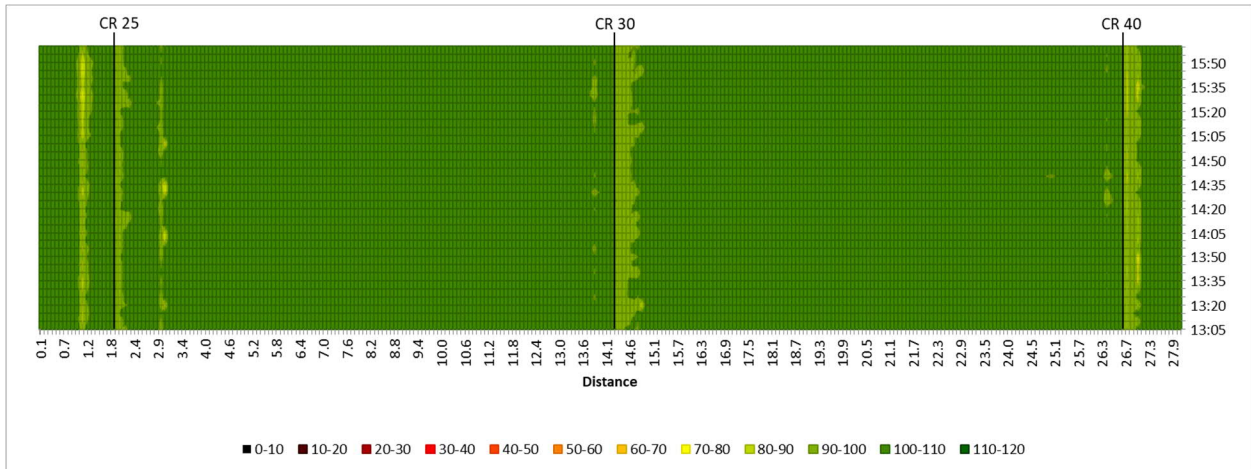


Figure 5-23: Highway 401 mainline eastbound speed – 2031 Widened (summer) – weekend peak period

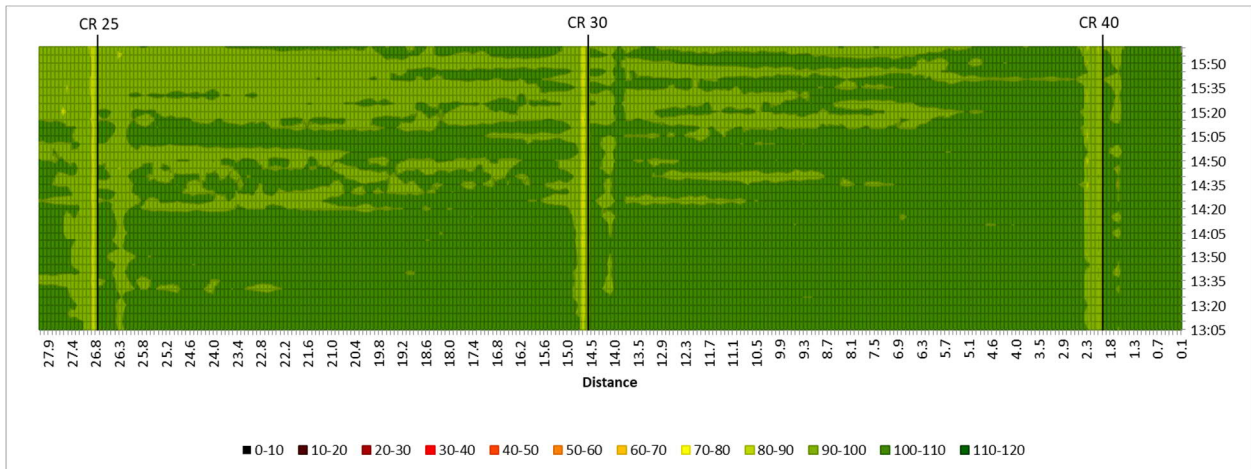


Figure 5-24: Highway 401 mainline westbound speed – 2031 Widened (summer) – weekend peak period

5.2.3 RAMP TERMINAL OPERATIONS

The intersection operations were evaluated under the widened scenario based on the 2031 weekday and weekend peak demands. The LOS was determined based on the classification defined in the 2016 CAM as shown in Table 2-3. The LOS, delays, and 95th percentile queues estimated based on the model results after 5 simulation runs are shown in Table 5-8 and Table 5-9 for the fall and summer conditions, respectively.

- Highway 401 ramp terminals continue to operate at LOS A under the fall conditions with all turning movements experiencing LOS C or better.
- The overall intersection LOS is LOS A or B under the summer conditions. Even though vehicles may experience additional delays at ramp terminals (compared to the existing conditions) with growth in traffic, all movements continue to operate at LOS C or better.
- The south ramp terminal at County Road 25, which was operating at LOS E under the do-nothing summer weekday afternoon peak scenario, experience a LOS of A. This LOS A reflects the improvements to the interchange under this scenario based on the proposed plan shown in Figure 2-2. With this modification of the Highway 401 interchange at County Road 25, the eastbound vehicles no longer yield to the northbound traffic (on County Road 25) turning onto Highway 401 in the eastbound direction, and the movement of the right-turning traffic is not impeded by the left-turning vehicles. Thus, the eastbound vehicles from Highway 401 encounter delays of 14-15 seconds as opposed to 2 minutes from the do-nothing scenario. The 95th percentile eastbound queues neither spill back onto Highway 401 or exceed the 2/3 of distance between the bullnose and the stop-bar.

Table 5-8 2031 widened scenario intersection operational analysis results (fall)

| INTERSECTIONS/ MOVEMENTS | WEEKDAY AM PEAK | | | WEEKDAY PM PEAK | | | WEEKEND PEAK | | |
|---|-----------------|----------|---------------------------|-----------------|----------|---------------------------|--------------|----------|---------------------------|
| | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 1 | A | | 2 | A | | 2 | A | |
| Westbound Left/Right | 9/7 | A/A | 12 | 9/8 | A/A | 16 | 9/8 | A/A | 13 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Left/Through | 0/0 | A/A | 0 | 1/0 | A/A | 0 | 0/0 | A/A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 2 | A | | 4 | A | | 3 | A | |
| Eastbound Left/Right | 9/8 | A/A | 13 | 11/11 | B/B | 25 | 8/10 | A/B | 20 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 3 | A | | 4 | A | | 3 | A | |
| Eastbound Left/Through/Right | 5/0/6 | A/A/A | 6 | 10/6/6 | A/A/A | 5 | 8/9/6 | A/A/A | 5 |
| Westbound Left/Through/Right | 13/12/7 | B/B/A | 15 | 15/16/9 | C/C/A | 23 | 14/12/8 | B/B/A | 14 |
| Northbound Left | 2 | A | 0 | 2 | A | 0 | 2 | A | 0 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left | 2 | A | 0 | 2 | A | 2 | 2 | A | 0 |
| Southbound Through/Right | 0/0 | A/A | 0 | 0/1 | A/A | 0 | 0/1 | A/A | 0 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 7 | A | | 9 | A | | 8 | A | |
| Eastbound Left/Through/Right | 9/10/6 | A/B/A | 22 | 11/12/8 | B/B/A | 34 | 12/11/6 | B/B/A | 25 |
| Westbound Left/Through/Right | 11/11/5 | B/B/A | 19 | 12/12/6 | B/B/A | 25 | 10/11/6 | B/B/A | 24 |
| Northbound Left | 8 | A | 8 | 11 | B | 20 | 8 | A | 16 |
| Northbound Through/Right | 7/6 | A/A | 20 | 8/9 | A/A | 21 | 7/8 | A/A | 20 |
| Southbound Left | 10 | B | 14 | 11 | B | 13 | 10 | A | 12 |
| Southbound Through/Right | 8/4 | A/A | 25 | 9/5 | A/A | 31 | 9/5 | A/A | 28 |
| Hwy 401 at CR 40 North ramp terminal (Signalized) | 6 | A | | 9 | A | | 6 | A | |
| Westbound Left/Right | 10/5 | A/A | 27 | 13/9 | B/A | 55 | 10/6 | B/A | 29 |
| Northbound Through | 6 | A | 17 | 8 | A | 30 | 7 | A | 18 |
| Northbound Right | 3 | A | 17 | 4 | A | 15 | 3 | A | 13 |
| Southbound Left/Through | 8/6 | A/A | 20 | 11/8 | B/A | 23 | 10/6 | A/A | 15 |
| Hwy 401 at CR 40 South ramp terminal (Stop-controlled) | 3 | A | | 5 | A | | 3 | A | |
| Eastbound Left/Right | 8/6 | A/A | 15 | 17/10 | C/A | 30 | 15/7 | B/A | 19 |
| Northbound Left/Through | 4/1 | A/A | 1 | 4/1 | A/A | 1 | 3/0 | A/A | 0 |
| Southbound Through | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |

Note 1: Queue length reflects the 95th percentile queue length

Table 5-9 2031 widened scenario intersection operational analysis results (summer)

| INTERSECTIONS/ MOVEMENTS | WEEKDAY AM PEAK | | | WEEKDAY PM PEAK | | | WEEKEND PEAK | | |
|---|-----------------|----------|---------------------------|-----------------|----------|---------------------------|--------------|----------|---------------------------|
| | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 1 | A | | 2 | A | | 2 | A | |
| Westbound Left/Right | 9/7 | A/A | 13 | 12/9 | B/A | 23 | 11/9 | B/A | 21 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Left/Through | 1/0 | A/A | 0 | 1/0 | A/A | 0 | 0/0 | A/A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 3 | A | | 5 | A | | 4 | A | |
| Eastbound Left/Right | 10/10 | A/B | 20 | 14/15 | B/B | 39 | 11/13 | B/B | 28 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Through | 0 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 4 | A | | 6 | A | | 4 | A | |
| Eastbound Left/Through/Right | 10/0/6 | A/A/A | 7 | 11/16/6 | B/C/A | 6 | 10/17/6 | A/C/A | 6 |
| Westbound Left/Through/Right | 15/13/9 | C/B/A | 23 | 25/25/16 | C/C/C | 47 | 18/19/10 | C/C/A | 25 |
| Northbound Left | 2 | A | 0 | 2 | A | 0 | 3 | A | 0 |
| Northbound Through | 0 | A | 0 | 1 | A | 0 | 0 | A | 0 |
| Northbound Right | 2 | A | 0 | 1 | A | 0 | 2 | A | 0 |
| Southbound Left | 2 | A | 4 | 3 | A | 5 | 2 | A | 0 |
| Southbound Through/Right | 0/0 | A/A | 0 | 0/1 | A/A | 0 | 0/1 | A/A | 0 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 9 | A | | 11 | B | | 10 | B | |
| Eastbound Left/Through/Right | 12/12/8 | B/B/A | 35 | 15/15/10 | B/B/A | 50 | 13/13/8 | B/B/A | 30 |
| Westbound Left/Through/Right | 11/13/7 | B/B/A | 32 | 16/14/9 | B/B/A | 36 | 15/12/9 | B/B/A | 39 |
| Northbound Left | 12 | B | 23 | 14 | B | 25 | 13 | B | 19 |
| Northbound Through/Right | 7/8 | A/A | 25 | 9/10 | A/B | 30 | 8/9 | A/A | 26 |
| Southbound Left | 12 | B | 21 | 14 | B | 17 | 13 | B | 19 |
| Southbound Through/Right | 9/5 | A/A | 31 | 10/7 | B/A | 48 | 10/6 | A/A | 42 |
| Hwy 401 at CR 40 North ramp terminal (Signalized) | 8 | A | | 15 | B | | 8 | A | |
| Westbound Left/Right | 12/7 | B/A | 44 | 25/21 | C/C | 142 | 13/8 | B/A | 43 |
| Northbound Through | 8 | A | 29 | 12 | B | 45 | 9 | A | 27 |
| Northbound Right | 4 | A | 17 | 5 | A | 25 | 4 | A | 19 |
| Southbound Left/Through | 11/8 | B/A | 25 | 18/12 | B/B | 33 | 12/8 | B/A | 23 |
| Hwy 401 at CR 40 South ramp terminal (Stop-controlled) | 3 | A | | 6 | A | | 3 | A | |
| Eastbound Left/Right | 12/7 | B/A | 18 | 22/15 | C/C | 55 | 15/10 | B/A | 31 |
| Northbound Left/Through | 7/1 | A/A | 22 | 12/2 | B/A | 32 | 5/1 | A/A | 9 |
| Southbound Through | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 1 | A | 0 | 2 | A | 0 | 1 | A | 0 |

Note 1: Queue length reflects the 95th percentile queue length

6 FUTURE CONDITIONS – 2041

The transportation network was assessed for the 2041 planning year. Similar to the 2031 scenarios, this chapter of the report presents the roadway network performance for the 2041 planning year under the: 1) do-nothing scenario; and 2) widened scenario.

6.1 DO-NOTHING SCENARIO

The 2041 do-nothing scenario was simulated under a similar roadway configuration as the 2031 do-nothing scenario (in Section 5.1). The 2041 AM, PM, and weekend vehicular demands were estimated based on the growth rate of 1.5% per annum.

6.1.1 MAINLINE/FREEWAY LEVEL OF SERVICE

The simulated 2041 Highway 401 traffic flows follow the same pattern as the 2031 scenarios. The simulated total (2-way combined) mainline vehicle volumes are generally greater by 14-32% in summer compared to the fall conditions, and among the simulated peak periods, the greatest highway traffic volume corresponds to the weekend conditions, especially in the westbound direction east of County Road 40. Table 6-1 summarizes the 2041 simulated weekday and weekend peak hour traffic volumes by direction of travel and highway segment under the fall and summer conditions.

Table 6-1 2041 Do-nothing scenario Highway 401 Mainline simulated peak hour traffic volume

| HIGHWAY 401 MAINLINE (veh/hr) | | WEST OF CR 25 | | WEST OF CR 30 | | WEST OF CR 40 | | EAST OF CR 40 | |
|----------------------------------|--------|---------------|-------|---------------|-------|---------------|-------|---------------|-------|
| | | EB | WB | EB | WB | EB | WB | EB | WB |
| AM Peak Hour | Fall | 1,205 | 1,260 | 1,155 | 1,130 | 1,170 | 1,080 | 1,385 | 1,175 |
| | Summer | 1,535 | 1,545 | 1,415 | 1,310 | 1,475 | 1,300 | 1,815 | 1,485 |
| PM Peak Hour | Fall | 1,835 | 1,755 | 1,640 | 1,650 | 1,580 | 1,720 | 1,615 | 2,025 |
| | Summer | 2,245 | 2,435 | 2,000 | 2,260 | 2,000 | 2,335 | 2,095 | 2,810 |
| Weekend Peak Hour | Fall | 2,670 | 3,640 | 2,540 | 3,610 | 2,595 | 3,645 | 2,660 | 3,785 |
| | Summer | 3,200 | 4,080 | 3,000 | 4,050 | 3,015 | 4,075 | 2,990 | 4,235 |

The highway mainline density, v/c, and LOS was assessed based on the 2041 simulated peak direction traffic volumes. Highway 401 is anticipated to operate at a LOS of C or better during the weekday peak hours similar to the 2031 do-nothing scenario. The LOS degrades during the weekend peak hours given the high volume of traffic. The highway segments are anticipated to operate at capacity (LOS E) during fall and the highway capacity is exceeded under the summer conditions (operating at LOS F). The mainline density, volume-to-capacity ratio, and level of service for all highway segments are shown in Table 6-2.

Table 6-2: 2041 Do-nothing scenario Highway 401 Mainline Density, v/c and LOS

| TRAVEL DEMAND PERIOD | SEASON | BETWEEN CR 25 & CR 30 | | | BETWEEN CR 30 & CR 40 | | |
|-----------------------------------|--------|-----------------------|------|-----|-----------------------|------|-----|
| | | DENSITY (PC/KM/LN) | V/C | LOS | DENSITY (PC/KM/LN) | V/C | LOS |
| AM Peak Hour, Peak-Direction | Fall | 6.3 | 0.29 | A | 6.4 | 0.30 | A |
| | Summer | 7.8 | 0.37 | B | 8.0 | 0.37 | B |
| PM Peak Hour, Peak-Direction | Fall | 8.9 | 0.42 | B | 9.4 | 0.44 | B |
| | Summer | 12.1 | 0.57 | C | 12.7 | 0.60 | C |
| Weekend Peak Hour, Peak-Direction | Fall | 26.6 | 0.98 | E | 26.5 | 0.98 | E |
| | Summer | 28 < | 1.07 | F | 28 < | 1.07 | F |

6.1.2 MAINLINE/FREEWAY TRAVEL TIMES AND SPEED

The Highway 401 mainline travel times (obtained from the simulation models) increase across all time periods leading to lower operating speeds. The operating speed remain near the posted speed limit (100km/h) under the weekday conditions. The operating speed reduces to 92-95 km/h during weekends in the westbound direction due to high volume of traffic volume (discussed in Section 6.1). The eastbound operating speed is slightly greater (compared to the westbound operating speed) since the eastbound traffic volumes are approximately equivalent to 70% of the westbound traffic volumes. The simulated mainline travel times and speeds are shown in Table 6-3.

Table 6-3: 2041 Do-nothing scenario simulated travel times and speeds along Highway 401

| HIGHWAY 401 SEGMENT | TRAVEL TIME (MIN) | | | SPEED (KM/H) | | |
|---|-------------------|------------|------------|--------------|--------------|-------------|
| | AM PEAK | PM PEAK | WKND PEAK | AM PEAK | PM PEAK | WKND PEAK |
| Highway 401 Eastbound: Fall (Difference) | | | | | | |
| CR 25 to CR 30 | 7.3 (+0.1) | 7.3 (0.0) | 7.6 (+0.2) | 102.6 (-1.0) | 101.6 (-1.1) | 98.7 (-1.8) |
| CR 30 to CR 40 | 7.3 (+0.1) | 7.4 (+0.1) | 7.6 (+0.1) | 102.0 (-0.9) | 101.1 (-1.0) | 97.7 (-1.9) |
| Highway 401 Westbound: Fall (Difference) | | | | | | |
| CR 40 to CR 30 | 7.2 (0.0) | 7.3 (0.0) | 7.8 (+0.2) | 103.0 (-0.5) | 101.6 (-0.8) | 95.4 (-2.8) |
| CR 30 to CR 25 | 7.3 (+0.1) | 7.4 (+0.1) | 8.0 (+0.3) | 101.9 (-1.2) | 101.0 (-1.0) | 93.5 (-3.6) |
| Highway 401 Eastbound: Summer (Difference) | | | | | | |
| CR 25 to CR 30 | 7.3 (+0.1) | 7.5 (+0.1) | 7.6 (+0.1) | 102.1 (-1.0) | 100.1 (-1.3) | 97.6 (-1.9) |
| CR 30 to CR 40 | 7.4 (0.0) | 7.5 (+0.1) | 7.7 (+0.1) | 101.2 (-1.1) | 99.0 (-1.7) | 96.3 (-2.1) |
| Highway 401 Westbound: Summer (Difference) | | | | | | |
| CR 25 to CR 30 | 7.3 (+0.1) | 7.5 (+0.1) | 8.0 (+0.3) | 102.2 (-1.9) | 99.5 (-1.7) | 93.4 (-3.8) |
| CR 30 to CR 40 | 7.3 (+0.1) | 7.5 (+0.1) | 8.1 (+0.3) | 101.8 (-1.7) | 98.7 (-1.9) | 91.9 (-3.8) |

The speed contour plots along Highway 401 in both directions of travel for the weekday AM, PM and weekend peak periods are presented in Figure 6-1 to Figure 6-12. Vehicles generally travel at the posted speed limit for the weekday conditions in which marginal reduction at highway ramps is noticeable. The weekend speed contour plots indicate that the speed of the vehicles fall below the 100 km/h speed limit for most of the highway over the weekend conditions. The operating speed falls below 90 km/h at highway ramps under the weekend conditions.

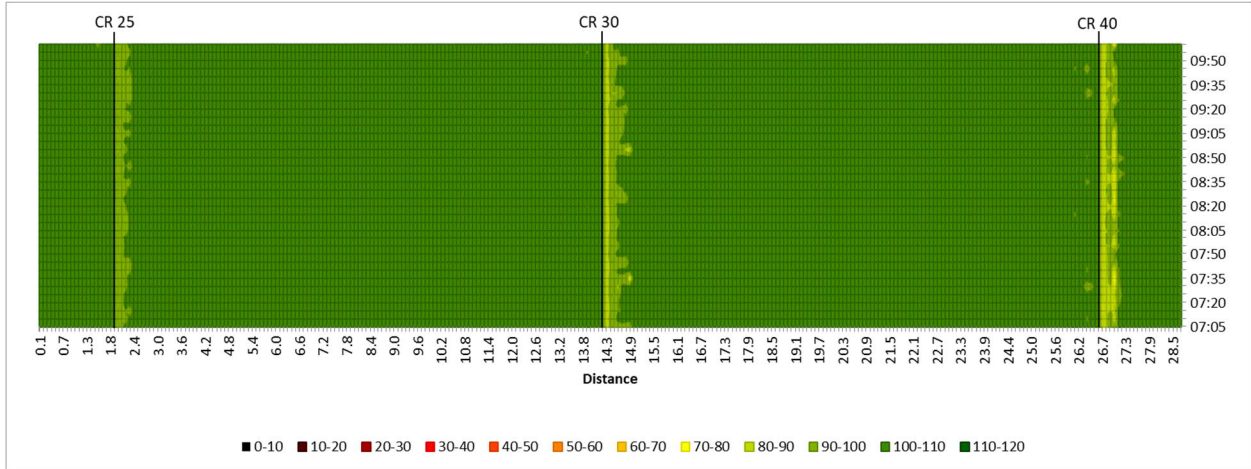


Figure 6-1: Highway 401 mainline eastbound speed – 2041 Do-nothing (fall) – AM peak period

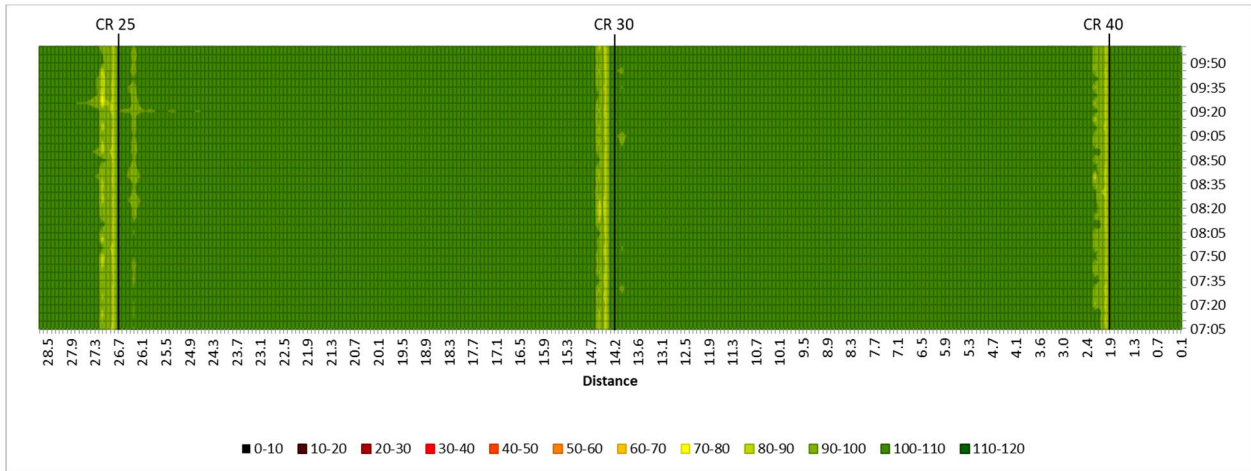


Figure 6-2: Highway 401 mainline westbound speed – 2041 Do-nothing (fall) - AM peak period

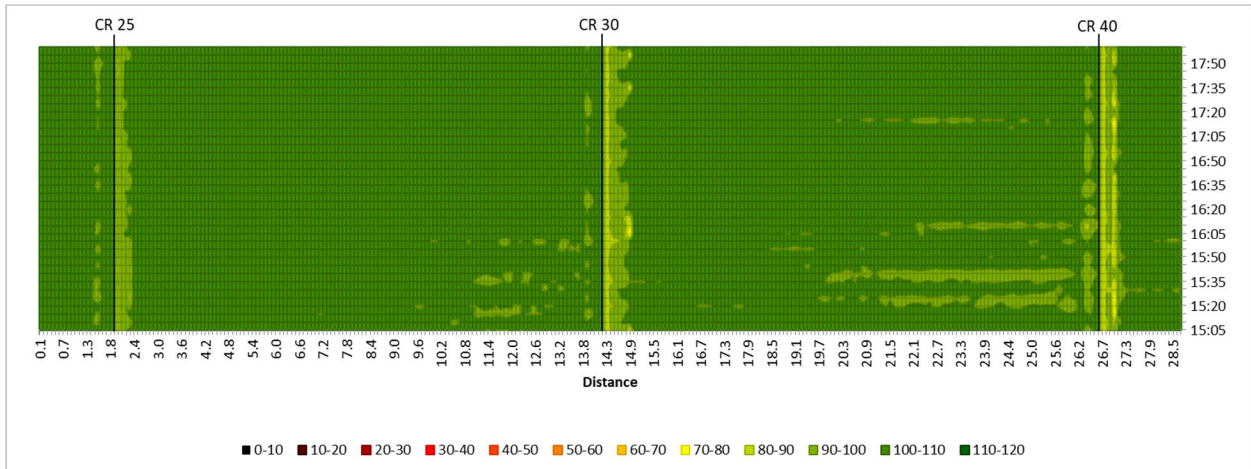


Figure 6-3: Highway 401 mainline eastbound speed – 2041 Do-nothing (fall) - PM peak period

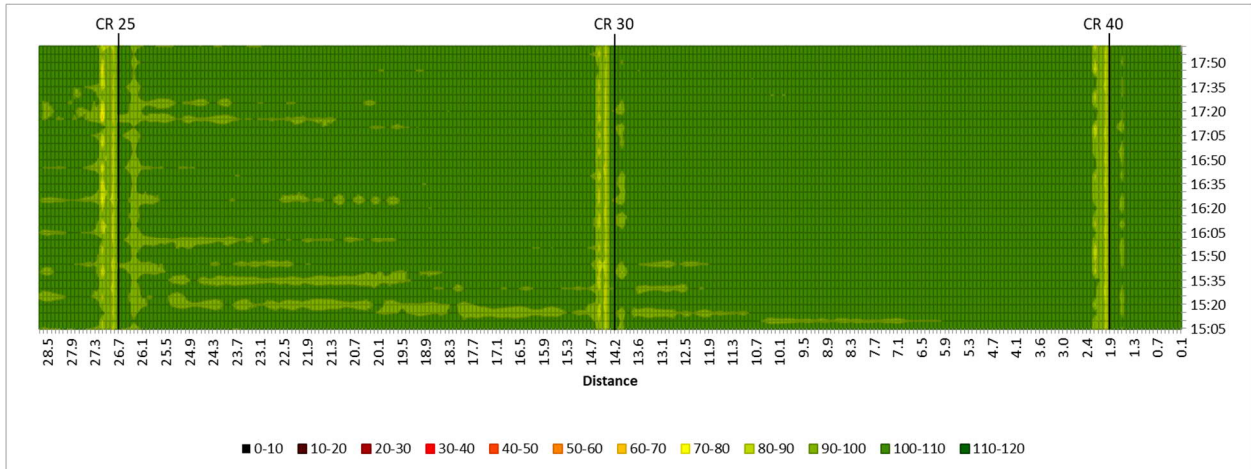


Figure 6-4: Highway 401 mainline westbound speed – 2041 Do-nothing (fall) - PM peak period

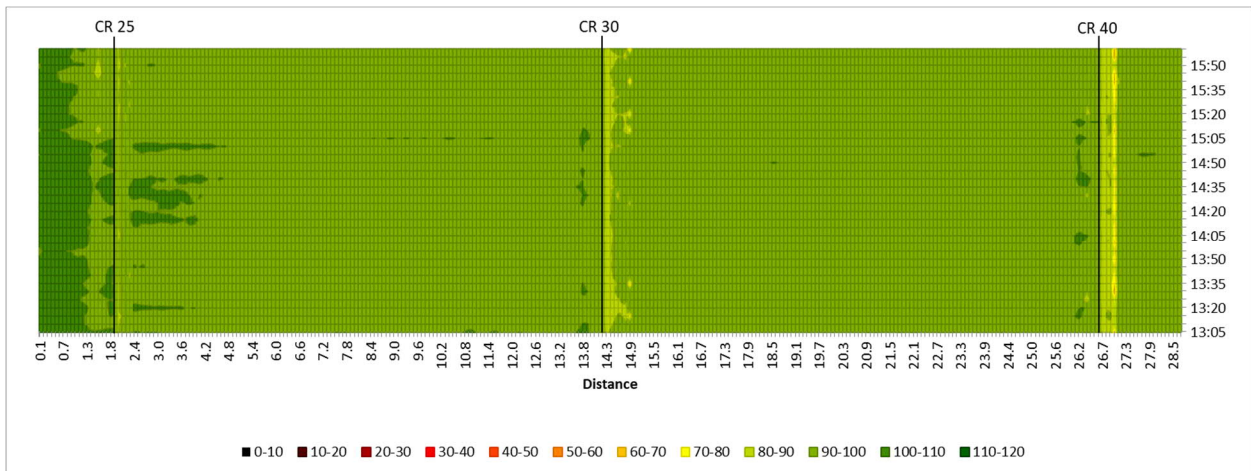


Figure 6-5: Highway 401 mainline eastbound speed – 2041 Do-nothing (fall) – weekend peak period

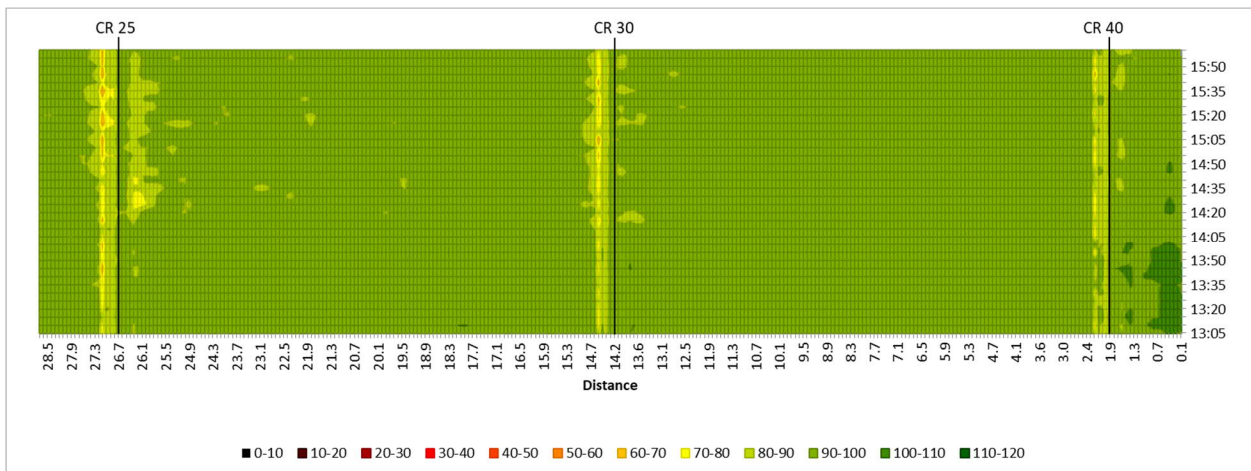


Figure 6-6: Highway 401 mainline westbound speed – 2041 Do-nothing (fall) – weekend peak period

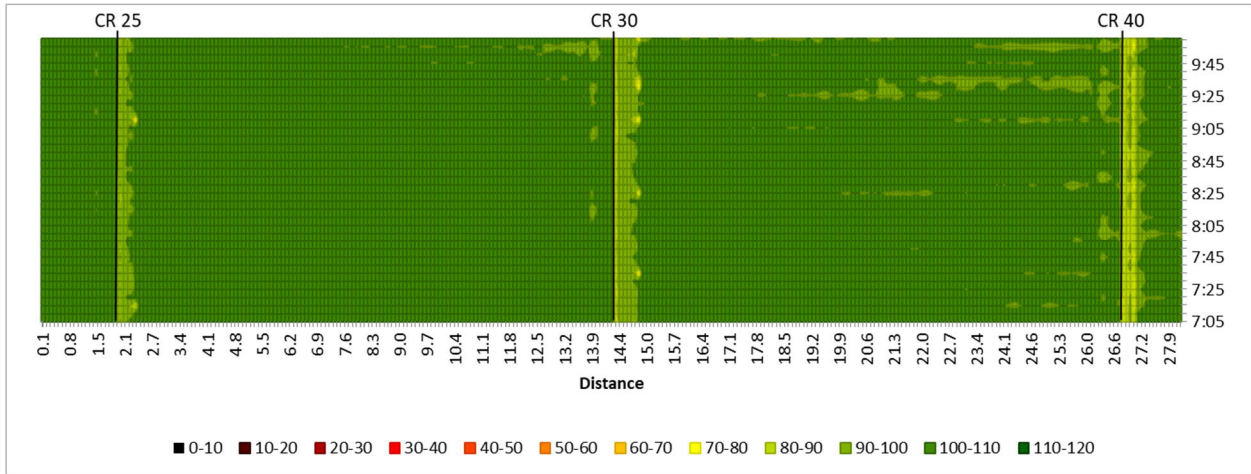


Figure 6-7: Highway 401 mainline eastbound speed – 2041 Do-nothing (summer) – AM peak period

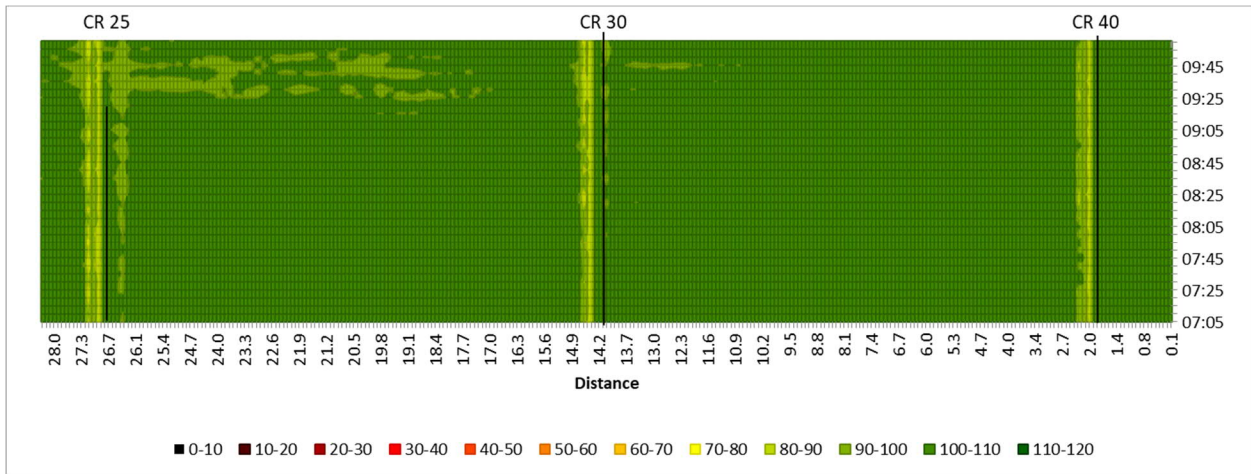


Figure 6-8: Highway 401 mainline westbound speed – 2041 Do-nothing (summer) - AM peak period

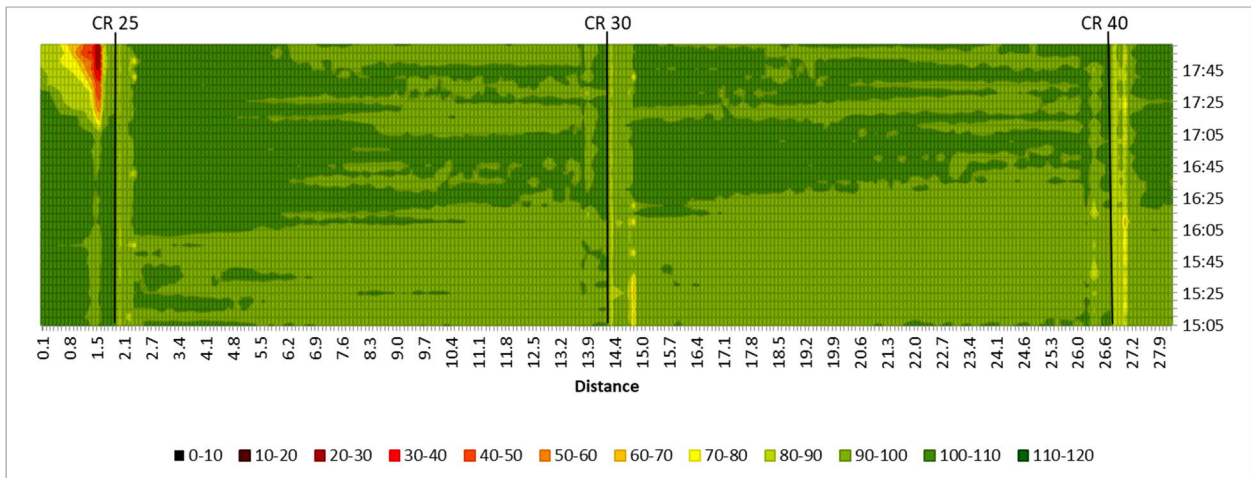


Figure 6-9: Highway 401 mainline eastbound speed – 2041 Do-nothing (summer) - PM peak period

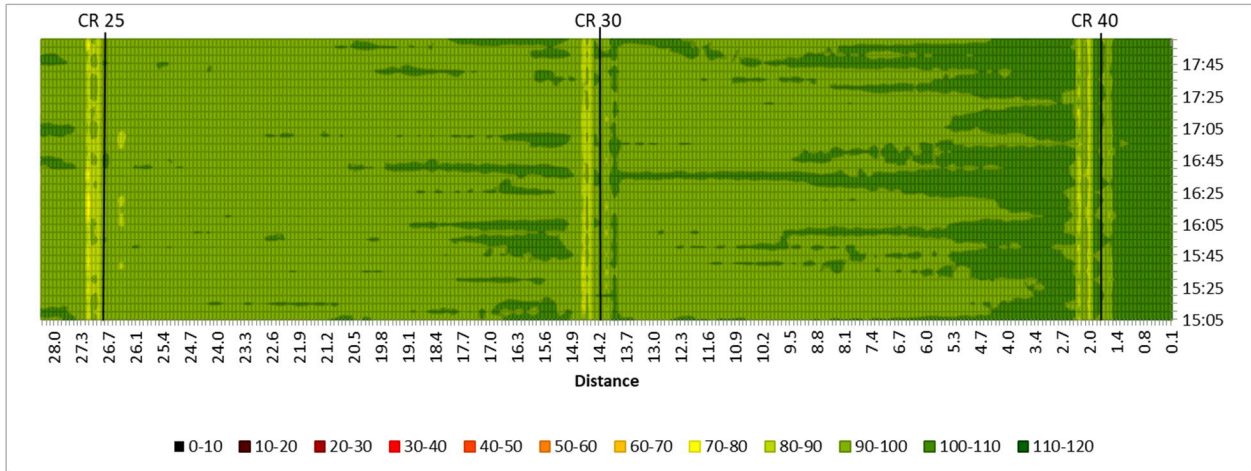


Figure 6-10: Highway 401 mainline westbound speed – 2041 Do-nothing (summer) - PM peak period

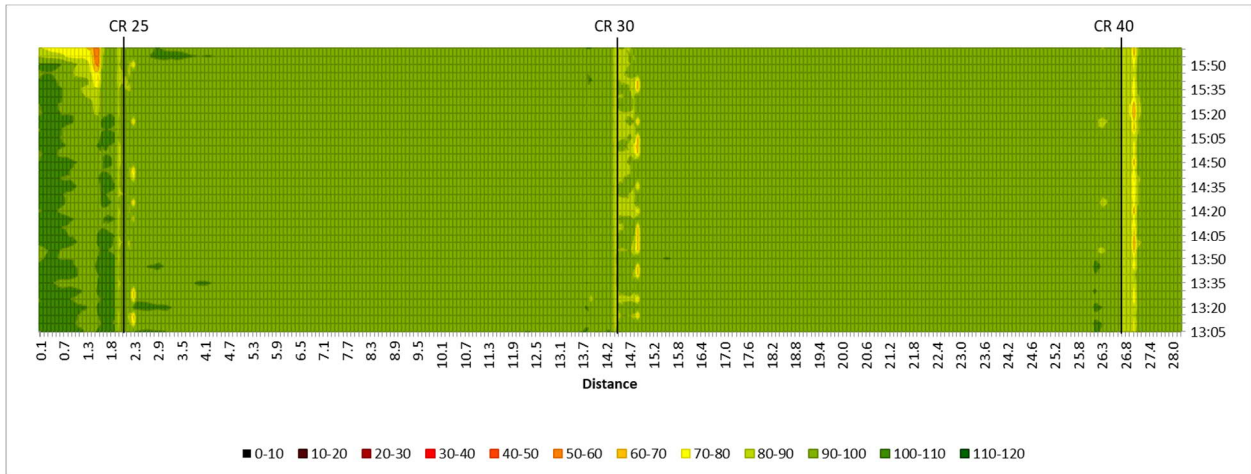


Figure 6-11: Highway 401 mainline eastbound speed – 2041 Do-nothing (summer) – weekend peak period

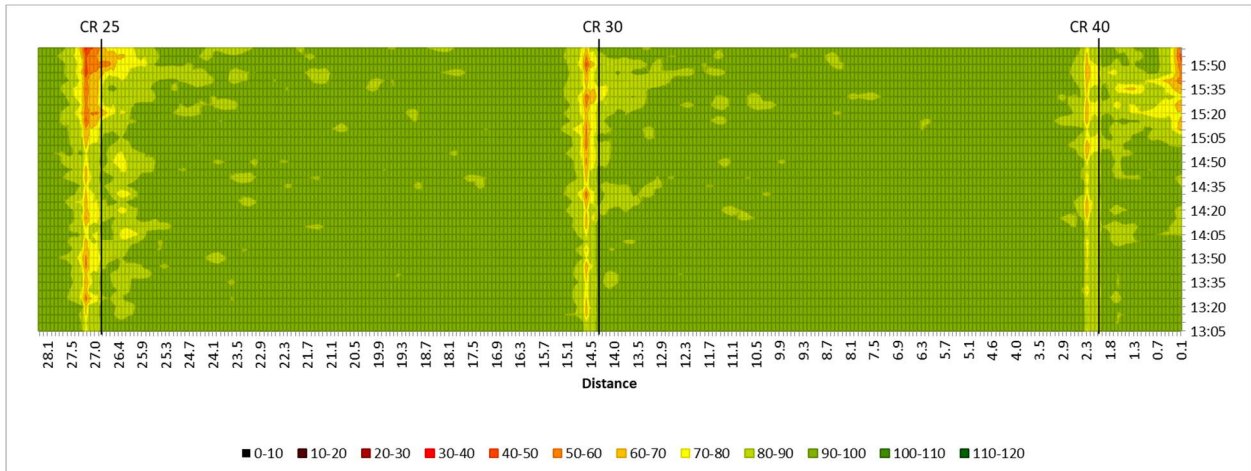


Figure 6-12: Highway 401 mainline westbound speed – 2041 Do-nothing (summer) – weekend peak period

6.1.3 RAMP TERMINAL OPERATIONS

The delays and the queues are anticipated to grow at highway ramp terminals for the 2041 do-nothing scenario with growth in traffic volumes. Table 6-4 and Table 6-5 show the evaluated intersection delay, LOS, and 95th percentile queue under the 2041 fall and summer conditions, respectively.

- Despite the growth in traffic volumes, the overall intersection LOS for all ramp terminals remain as LOS A under the fall conditions. All turning movements operate at an acceptable LOS D or better.
- Similar to the 2031 do-nothing scenario, the south ramp terminal at County Road 25 operates at an overall intersection LOS of E during the summer afternoon peak hours, and the remaining intersections operate at a LOS of C or better. The eastbound vehicles from Highway 401 may wait up to 2.3 minutes before finding a safe gap to enter County Road 25, and the queues may spill back beyond the on-ramp bullnose.
- Westbound movements at County Road 30 north ramp terminal are the only movements that operate at LOS of E or F besides the eastbound movements at the County Road 25 interchange. These movements experience a delay of 37-52 seconds during the summer PM peak hours. With the 32% increase in County Road 30 traffic, westbound vehicles from Highway 401 must wait longer to find a safe gap before entering County Road 30. The westbound through and left-turning vehicles also impede the path of right-turning traffic, and with the 37 % increase in the highway ramp volumes, the delay for these movements for westbound approach is expected to grow.
- The 95th percentile queue on the westbound off-ramp at County Road 40 exceed the 2/3 of distance between the stop-bar and the bullnose by 35 metres under the summer PM peak hours but does not spill back onto the mainline. Since this intersection is operated by traffic signals, the signal timings may be altered to better accommodate for the highway traffic and reduce the delays and queues on the off-ramp. The signal timings were maintained across all scenarios to allow for equal comparison of the measures of effectiveness.

Table 6-4: 2041 Do-nothing scenario operational analysis results (fall)

| INTERSECTIONS/ MOVEMENTS | WEEKDAY AM PEAK | | | WEEKDAY PM PEAK | | | WEEKEND PEAK | | |
|---|-----------------|----------|---------------------------|-----------------|----------|---------------------------|--------------|----------|---------------------------|
| | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 2 | A | | 2 | A | | 2 | A | |
| Westbound Left/Right | 10/7 | B/A | 15 | 11/9 | B/A | 19 | 10/7 | A/A | 14 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left/Through | 3/1 | A/A | 0 | 4/1 | A/A | 0 | 2/0 | A/A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 2 | A | | 8 | A | | 4 | A | |
| Eastbound Left/Right | 11/8 | B/A | 19 | 27/24 | D/C | 72 | 15/11 | B/B | 27 |
| Northbound Left | 2 | A | 0 | 3 | A | 0 | 0 | A | 0 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 3 | A | 0 |
| Southbound Through/Right | 0/1 | A/A | 0 | 1/1 | A/A | 0 | 0/1 | A/A | 0 |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 3 | A | | 4 | A | | 2 | A | |
| Eastbound Left/Through/Right | 7/0/7 | A/A/A | 8 | 6/7/7 | A/A/A | 6 | 6/5/7 | A/A/A | 6 |
| Westbound Left/Through/Right | 8/11/7 | A/B/A | 18 | 10/13/10 | B/B/B | 28 | 8/13/8 | A/B/A | 15 |
| Northbound Left/Through | 3/1 | A/A | 0 | 3/1 | A/A | 0 | 3/1 | A/A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left/Through/Right | 3/0/0 | A/A/A | 2 | 4/0/1 | A/A/A | 0 | 3/0/1 | A/A/A | 0 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 8 | A | | 10 | A | | 9 | A | |
| Eastbound Left/Through/Right | 9/11/7 | A/B/A | 24 | 12/13/9 | B/B/A | 44 | 13/12/8 | B/B/A | 29 |
| Westbound Left/Through/Right | 11/11/6 | B/B/A | 25 | 14/13/7 | B/B/A | 31 | 14/13/7 | B/B/A | 29 |
| Northbound Left/Through/Right | 8/7/5 | A/A/A | 22 | 11/8/5 | B/A/A | 28 | 10/8/5 | B/A/A | 24 |
| Southbound Left/Through | 9/9 | A/A | 27 | 13/11 | B/B | 38 | 11/10 | B/B | 31 |
| Southbound Right | 4 | A | 10 | 4 | A | 11 | 4 | A | 7 |
| Hwy 401 at CR 40 North ramp terminal (Signalized) | 6 | A | | 10 | A | | 7 | A | |
| Westbound Left/Right | 10/6 | B/A | 33 | 15/10 | B/B | 66 | 11/6 | B/A | 32 |
| Northbound Through | 6 | A | 18 | 9 | A | 27 | 7 | A | 20 |
| Northbound Right | 3 | A | 14 | 4 | A | 16 | 4 | A | 14 |
| Southbound Left/Through | 10/6 | B/A | 21 | 12/9 | B/A | 25 | 10/6 | B/A | 17 |
| Hwy 401 at CR 40 South ramp terminal (Stop-controlled) | 4 | A | | 7 | A | | 4 | A | |
| Eastbound Left/Right | 9/7 | A/A | 0 | 26/14 | D/B | 0 | 15/9 | C/A | 23 |
| Northbound Left/Through | 5/1 | A/A | 0 | 6/1 | A/A | 0 | 3/1 | A/A | 0 |
| Southbound Through | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |

Note 1: Queue length reflects the 95th percentile queue length

Table 6-5 2041 Do-nothing scenario operational analysis results (summer)

| INTERSECTIONS/ MOVEMENTS | WEEKDAY AM PEAK | | | WEEKDAY PM PEAK | | | WEEKEND PEAK | | |
|---|-----------------|----------|---------------------------|-----------------|----------|---------------------------|--------------|----------|---------------------------|
| | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 3 | A | | 3 | A | | 3 | A | |
| Westbound Left/Right | 12/8 | B/A | 16 | 15/10 | B/B | 25 | 13/10 | B/B | 25 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 1 | A | 0 | 2 | A | 0 | 1 | A | 0 |
| Southbound Left/Through | 5/1 | A/A | 3 | 6/1 | A/A | 2 | 3/0 | A/A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 4 | A | | 40 | E | | 10 | B | |
| Eastbound Left/Right | 15/13 | B/B | 35 | 136/129 | F/F | 259 | 36/29 | E/D | 84 |
| Northbound Left | 3 | A | 0 | 6 | A | 6 | 5 | A | 0 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Through/Right | 1/1 | A/A | 0 | 1/1 | A/A | 0 | 1/1 | A/A | 0 |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 5 | A | | 12 | B | | 5 | A | |
| Eastbound Left/Through/Right | 12/0/7 | B/A/A | 10 | 18/18/7 | C/C/A | 6 | 14/15/7 | B/B/A | 6 |
| Westbound Left/Through/Right | 18/18/16 | C/C/C | 41 | 43/52/37 | E/F/E | 97 | 22/27/19 | C/D/C | 37 |
| Northbound Left | 3 | A | 0 | 4 | A | 3 | 4 | A | 1 |
| Northbound Through | 0 | A | 0 | 1 | A | 0 | 0 | A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left | 4 | A | 9 | 5 | A | 7 | 4 | A | 4 |
| Southbound Through/Right | 0/0 | A/A | 8 | 0/1 | A/A | 7 | 0/1 | A/A | 3 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 12 | B | | 14 | B | | 12 | B | |
| Eastbound Left/Through/Right | 17/15/11 | B/B/B | 46 | 22/20/15 | C/B/B | 81 | 15/16/9 | B/B/A | 43 |
| Westbound Left/Through/Right | 19/15/9 | B/B/A | 42 | 23/20/12 | C/B/B | 53 | 20/19/11 | C/B/B | 51 |
| Northbound Left | 19 | B | 28 | 28 | C | 40 | 23 | C | 28 |
| Northbound Through/Right | 8/6 | A/A | 23 | 9/6 | A/A | 30 | 8/6 | A/A | 27 |
| Southbound Left | 13 | B | 22 | 17 | B | 23 | 16 | B | 26 |
| Southbound Through/Right | 10/6 | A/A | 44 | 11/8 | B/A | 58 | 10/8 | B/A | 51 |
| Hwy 401 at CR 40 North ramp terminal (Signalized) | 9 | A | | 24 | C | | 9 | A | |
| Westbound Left/Right | 13/8 | B/A | 47 | 47/43 | D/D | 331 | 14/9 | B/A | 49 |
| Northbound Through | 9 | A | 28 | 13 | B | 53 | 9 | A | 28 |
| Northbound Right | 4 | A | 20 | 5 | A | 26 | 4 | A | 19 |
| Southbound Left/Through | 13/8 | B/A | 30 | 19/12 | B/B | 39 | 13/8 | B/A | 25 |
| Hwy 401 at CR 40 South ramp terminal (Stop-controlled) | 5 | A | | 8 | A | | 4 | A | |
| Eastbound Left/Right | 13/8 | B/A | 23 | 32/26 | D/D | 105 | 19/13 | C/B | 44 |
| Northbound Left/Through | 13/2 | B/A | 44 | 17/2 | C/A | 46 | 6/1 | A/A | 14 |
| Southbound Through | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 2 | A | 0 | 2 | A | 0 | 1 | A | 0 |

6.2 WIDENED SCENARIO

The roadway performance was assessed under the 2041 vehicular demand and the widened roadway geometry, including the expansion of Highway 401 to 6 traffic lanes and the update at the County Road 25 south ramp terminal. The 2041 AM, PM, and weekend vehicular demands were estimated based on the growth rate of 1.5% per annum.

6.2.1 MAINLINE/FREEWAY LEVEL OF SERVICE

The 2041 widened scenario simulated traffic volumes are within 3% of the peak hour traffic volumes (from the do-nothing scenario) in Table 6-1. The highest peak hour mainline traffic volume corresponds to the weekend conditions, which is also the critical time period.

The Highway 401 mainline operates at LOS C or better under the 2041 widened scenario. The LOS during the weekday peak hours is anticipated be LOS B or better similar to the existing conditions. The LOS improves during the weekend peak hours from LOS D to LOS C with widening of the highway from 4 lanes to 6 lanes, and vehicles travel at free flow speed. Table 6-6 summarized the evaluated density, volume-to-capacity ratios (v/c), and LOS for the Highway 401 segments.

Table 6-6: 2041 Widened scenario Highway 401 Mainline Density, v/c and LOS

| TRAVEL DEMAND PERIOD | SEASON | BETWEEN CR 25 & CR 30 | | | BETWEEN CR 30 & CR 40 | | |
|-----------------------------------|--------|-----------------------|------|-----|-----------------------|------|-----|
| | | DENSITY (PC/KM/LN) | V/C | LOS | DENSITY (PC/KM/LN) | V/C | LOS |
| AM Peak Hour, Peak-Direction | Fall | 4.2 | 0.20 | A | 4.2 | 0.20 | A |
| | Summer | 5.2 | 0.24 | A | 5.3 | 0.25 | A |
| PM Peak Hour, Peak-Direction | Fall | 5.9 | 0.28 | A | 6.2 | 0.29 | A |
| | Summer | 8.1 | 0.38 | B | 8.5 | 0.40 | B |
| Weekend Peak Hour, Peak-Direction | Fall | 14.0 | 0.66 | C | 14.0 | 0.65 | C |
| | Summer | 15.3 | 0.71 | C | 15.3 | 0.71 | C |

6.2.2 MAINLINE/FREEWAY TRAVEL TIMES AND SPEED

The simulated mainline travel times and operating speed improves under all peak hour conditions with the widening of Highway 401 corridor. Vehicles travel at or near the posted speed limit, and the greatest increase in the operating speed corresponds to the weekend conditions where the mainline vehicular demands are the highest. Table 6-7 summarizes the simulated travel times and operating speeds under the 2041 widened scenario with the improvements in the roadway operation in brackets.

Table 6-7: 2041 Widened scenario simulated travel times and speeds along Highway 401

| HIGHWAY 401 SEGMENT | TRAVEL TIME (MIN) | | | SPEED (KM/H) | | |
|---|-------------------|------------|------------|--------------|--------------|--------------|
| | AM PEAK | PM PEAK | WKND PEAK | AM PEAK | PM PEAK | WKND PEAK |
| Highway 401 Eastbound: Fall (Difference) | | | | | | |
| CR 25 to CR 30 | 7.1 (-0.1) | 7.1 (-0.2) | 7.3 (-0.1) | 104.5 (+0.9) | 104.3 (+1.6) | 102.5 (+2.0) |
| CR 30 to CR 40 | 7.1 (-0.1) | 7.2 (-0.1) | 7.3 (-0.2) | 104.4 (+1.5) | 104.0 (+1.9) | 102.1 (+2.5) |
| Highway 401 Westbound: Fall (Difference) | | | | | | |
| CR 40 to CR 30 | 7.1 (-0.1) | 7.2 (-0.1) | 7.4 (-0.2) | 104.7 (+1.2) | 104.2 (+1.8) | 100.5 (+2.3) |
| CR 30 to CR 25 | 7.1 (-0.1) | 7.2 (-0.1) | 7.4 (-0.3) | 104.5 (+1.4) | 104.0 (+2.0) | 100.2 (+3.1) |
| Highway 401 Eastbound: Summer (Difference) | | | | | | |
| CR 25 to CR 30 | 7.1 (-0.1) | 7.2 (-0.2) | 7.3 (-0.2) | 104.3 (+1.2) | 103.4 (+2.0) | 101.8 (+2.3) |
| CR 30 to CR 40 | 7.2 (-0.1) | 7.2 (-0.2) | 7.3 (-0.3) | 104.0 (+1.7) | 103.1 (+2.4) | 101.6 (+3.2) |
| Highway 401 Eastbound: Summer (Difference) | | | | | | |
| CR 40 to CR 30 | 7.1 (-0.1) | 7.2 (-0.2) | 7.5 (-0.2) | 104.5 (+0.4) | 103.0 (+1.8) | 99.6 (+2.4) |
| CR 30 to CR 25 | 7.1 (-0.1) | 7.2 (-0.2) | 7.5 (-0.3) | 104.3 (+0.8) | 103.1 (+2.5) | 99.2 +(3.5) |

The speed contour plots along Highway 401 in both directions of travel for the weekday AM, PM and weekend peak periods are presented in Figure 6-13 to Figure 6-24. Vehicles travel at the highway posted speed along the corridor with small reductions at highway ramps where vehicles enter/exit the highway. The highway operating speed reduces to 90-100 km/h near the end of the weekend peak hour period in the westbound direction since it is the critical time period and direction of travel.

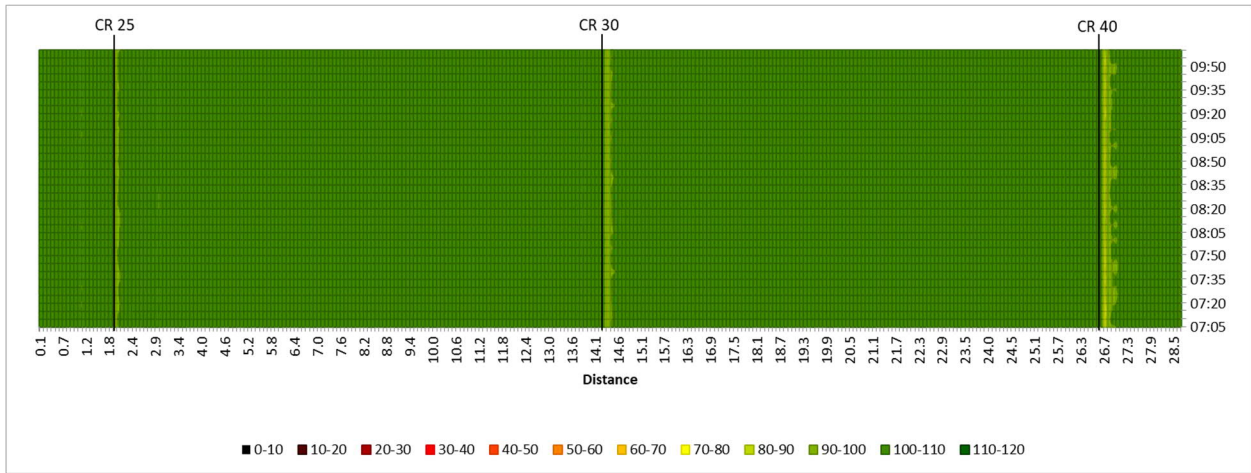


Figure 6-13: Highway 401 mainline eastbound speed – 2041 Widened (fall) – AM peak period

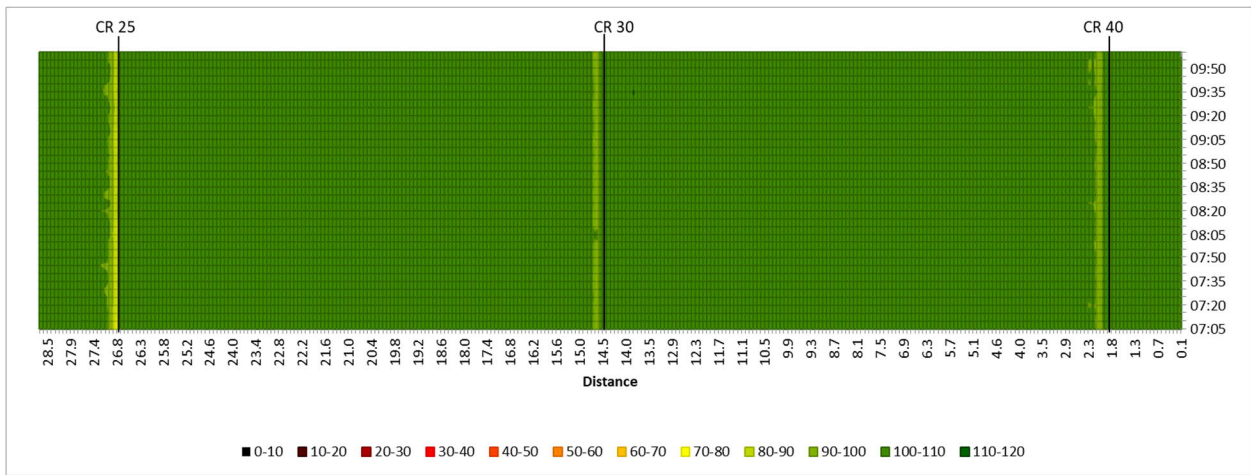


Figure 6-14: Highway 401 mainline westbound speed – 2041 Widened (fall) – AM peak period

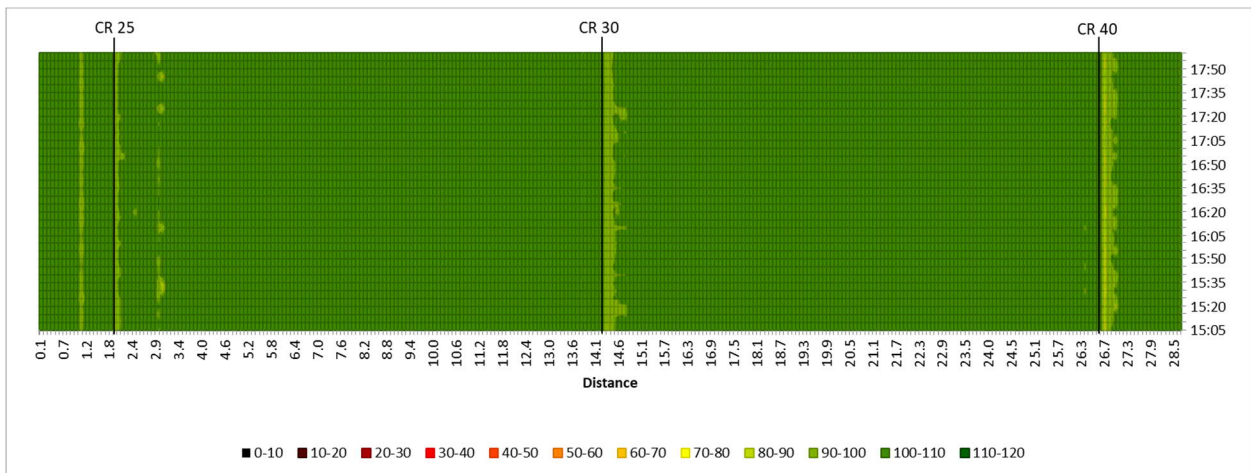


Figure 6-15: Highway 401 mainline eastbound speed – 2041 Widened (fall) – PM peak period

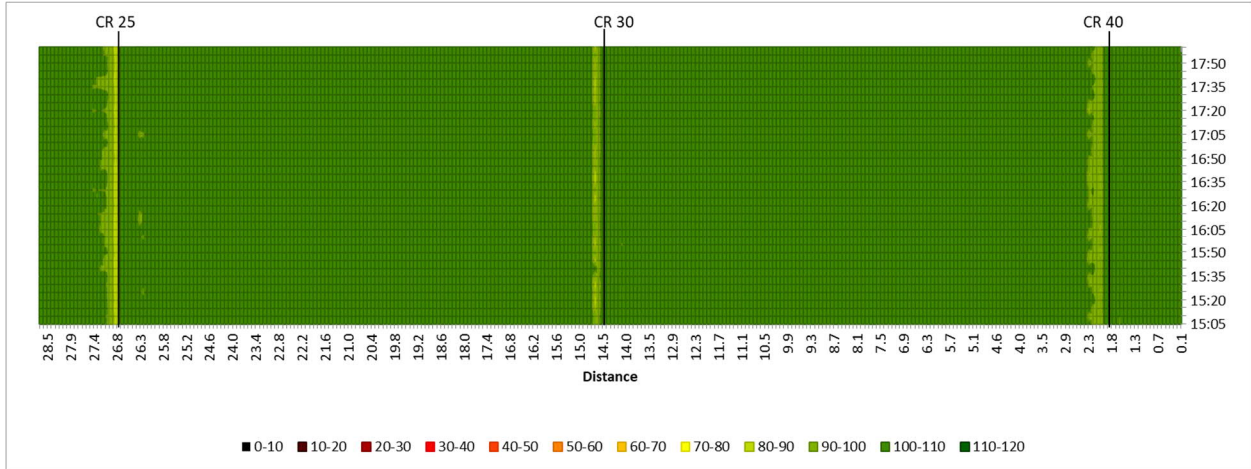


Figure 6-16: Highway 401 mainline westbound speed – 2041 Widened (fall) – PM peak period

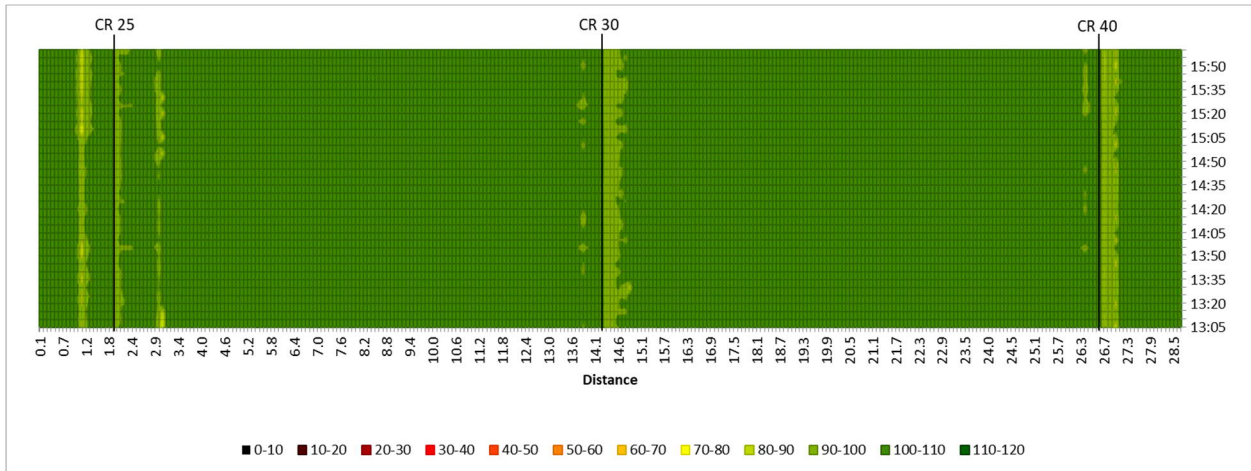


Figure 6-17: Highway 401 mainline eastbound speed – 2041 Widened (fall) – weekend peak period

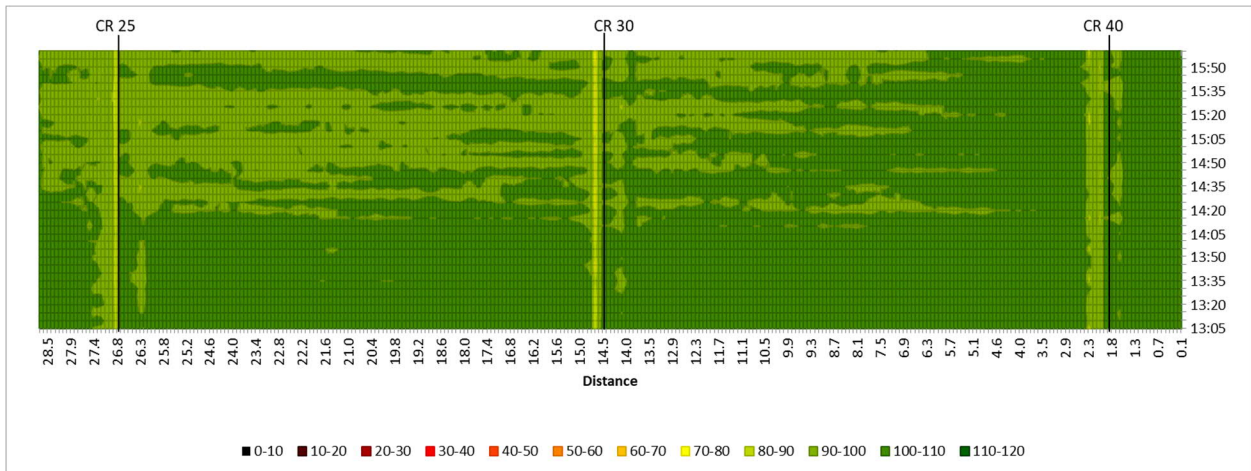


Figure 6-18: Highway 401 mainline westbound speed – 2041 Widened (fall) – weekend peak period

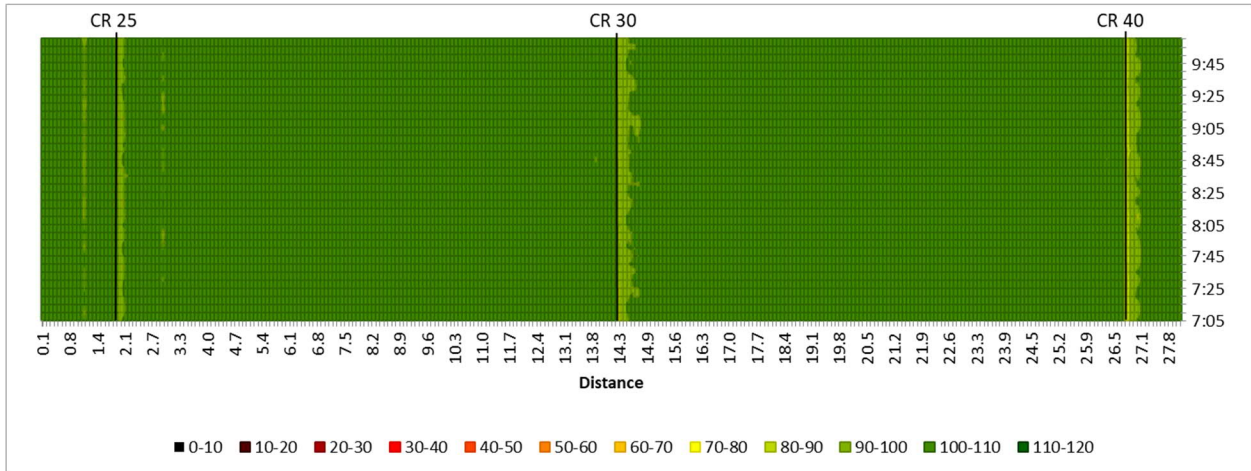


Figure 6-19: Highway 401 mainline eastbound speed – 2041 Widened (summer) – AM peak period

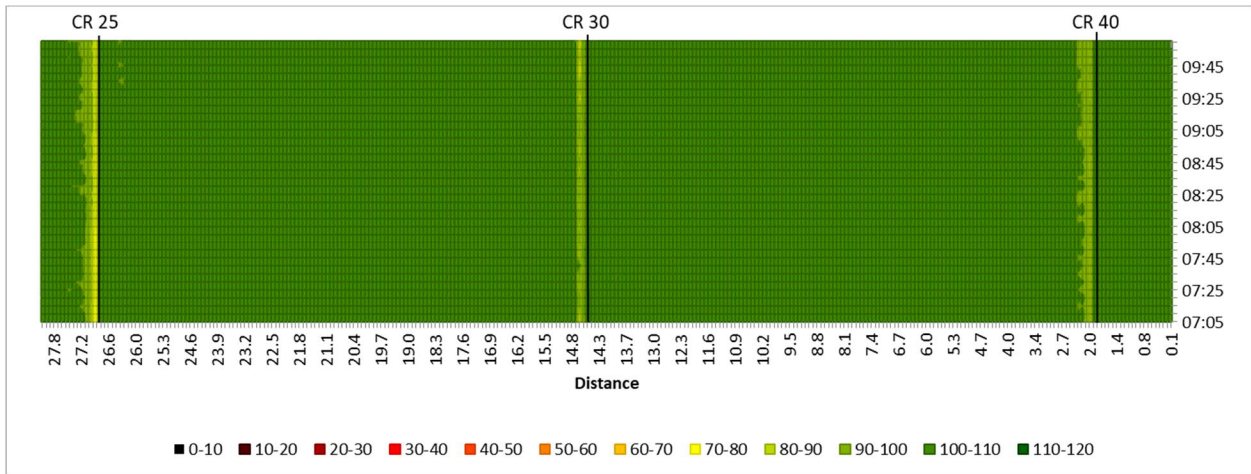


Figure 6-20: Highway 401 mainline westbound speed – 2041 Widened (summer) – AM peak period

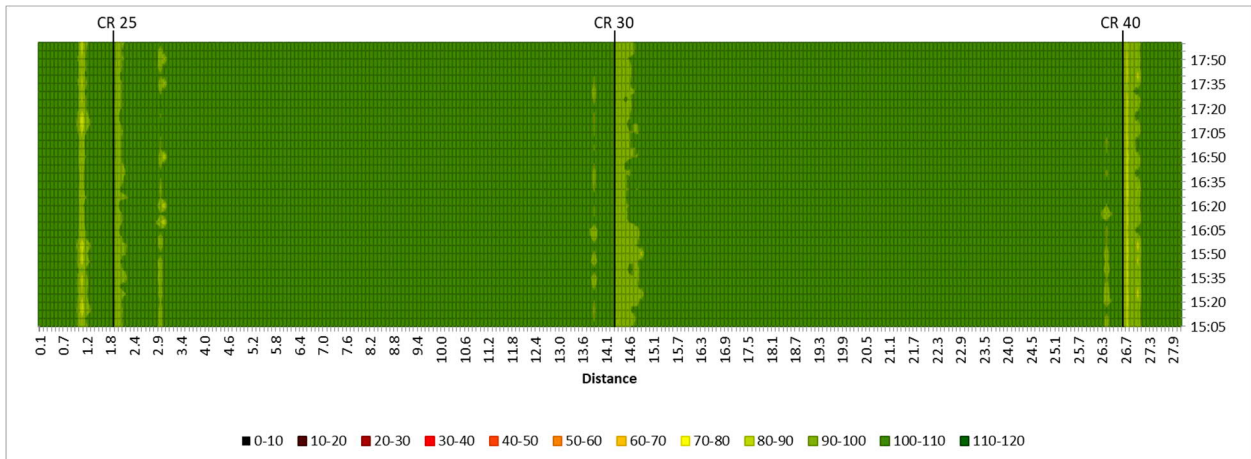


Figure 6-21: Highway 401 mainline eastbound speed – 2041 Widened (summer) – PM peak period

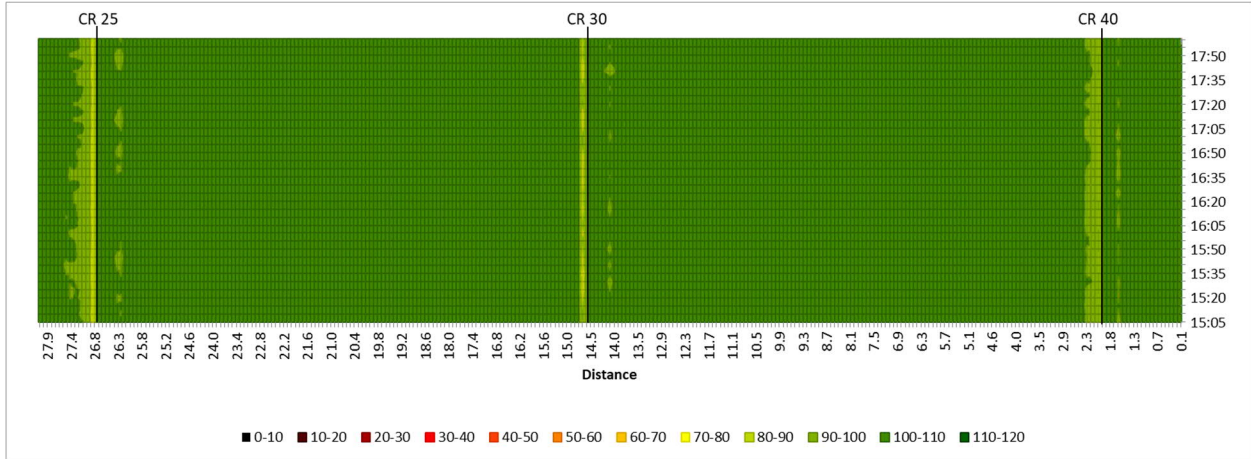


Figure 6-22 Highway 401 mainline westbound speed – 2041 Widened (summer) – PM peak period

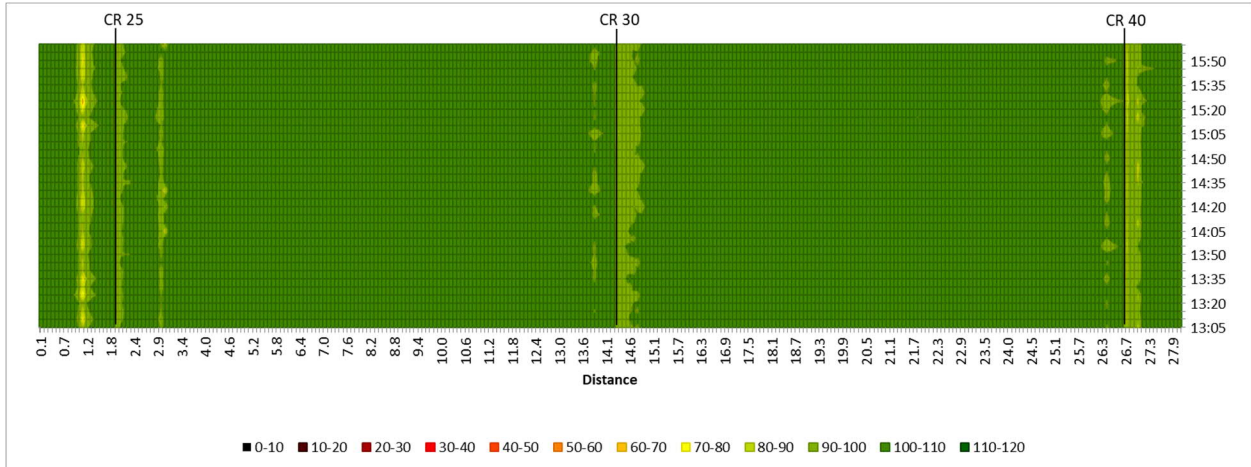


Figure 6-23: Highway 401 mainline eastbound speed – 2041 Widened (summer) – weekend peak period

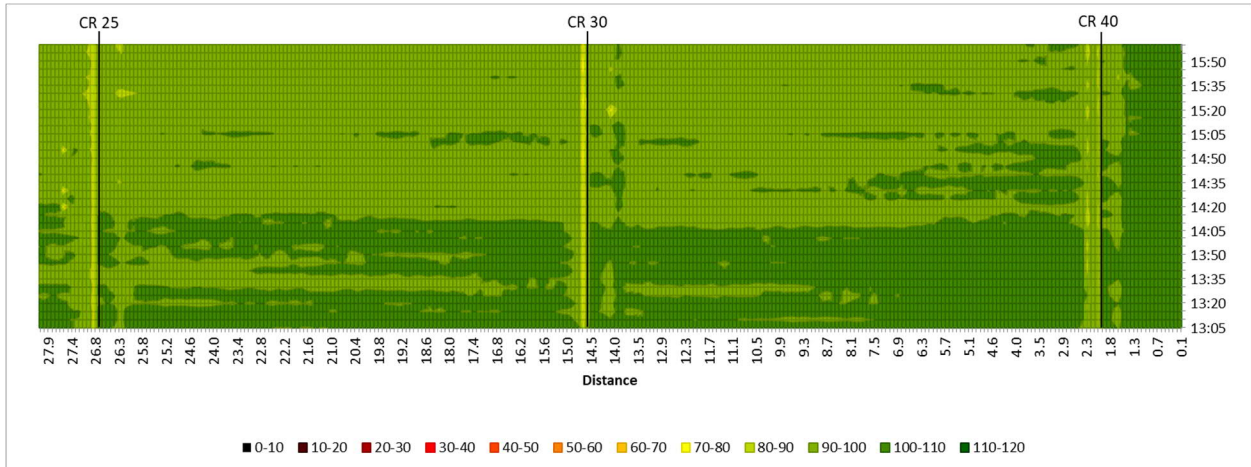


Figure 6-24: Highway 401 mainline westbound speed – 2041 Widened (summer) – weekend peak period

6.2.3 RAMP TERMINAL OPERATIONS

The measure of effectiveness was evaluated across the highway ramp terminals under the 2041 AM, PM and weekend peak demands over the fall and summer conditions. Vehicles are anticipated to experience delays and queues at most of the ramp terminals under the 2041 widened scenario given the growth in vehicular demand. The LOS, delays, and 95th percentile queues estimated based on the model results after 5 simulation runs are shown in Table 6-8 and Table 6-9.

- All turning movements operate at LOS D or better under the fall conditions, and the overall intersection LOS remains as LOS A similar to the existing conditions.
- Unlike the 2041 do-nothing scenario, all turning movements experience a LOS of D or better under the summer conditions, including the eastbound approach at the County Road 25 south ramp terminal and the westbound approach at the County Road 30 north ramp terminal. The eastbound delay reduces from 2.3 minutes to 17 seconds during the summer PM peak hours with addition of a S-E ramp and an eastbound left-turn lane at County Road 25 interchange. Westbound delay at County Road 30 north ramp terminal decreases by 14 seconds (compared to the 2041 do-nothing scenario) as smaller platoons of vehicles arrive at the ramp terminal at once under the PM peak widened scenario.
- The 95th percentile queue on the westbound ramp at County Road 40 decreases by 100 metres under the summer PM peak hour compared to the do-nothing scenario and does not exceed 2/3 the distance from the stop-bar to the bullnose. Since this ramp is located at the model boundary, vehicles arrival at this interchange are more evenly spread out, leading to shorter queues.

Table 6-8: 2041 Widened scenario intersection operational analysis results (fall)

| INTERSECTIONS/ MOVEMENTS | WEEKDAY AM PEAK | | | WEEKDAY PM PEAK | | | WEEKEND PEAK | | |
|---|-----------------|----------|---------------------------|-----------------|----------|---------------------------|--------------|----------|---------------------------|
| | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 1 | A | | 2 | A | | 2 | A | |
| Westbound Left/Right | 8/7 | A/A | 15 | 10/8 | A/A | 16 | 9/7 | A/A | 14 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Left/Through | 0/0 | A/A | 0 | 1/0 | A/A | 0 | 0/0 | A/A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 2 | A | | 4 | A | | 3 | A | |
| Eastbound Left/Right | 10/9 | A/A | 13 | 11/12 | B/B | 27 | 10/11 | A/B | 22 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 3 | A | | 5 | A | | 3 | A | |
| Eastbound Left/Through/Right | 7/0/6 | A/A/A | 8 | 9/9/6 | A/A/A | 6 | 8/10/7 | A/B/A | 6 |
| Westbound Left/Through/Right | 14/13/7 | B/B/A | 18 | 19/18/12 | C/C/B | 28 | 14/15/8 | B/C/A | 15 |
| Northbound Left | 2 | A | 0 | 2 | A | 0 | 2 | A | 0 |
| Northbound Left/Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Left | 2 | A | 3 | 2 | A | 2 | 2 | A | 0 |
| Southbound Through/Right | 0/0 | A/A | 0 | 0/1 | A/A | 0 | 0/1 | A/A | 0 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 8 | A | | 10 | A | | 9 | A | |
| Eastbound Left/Through/Right | 10/10/6 | B/B/A | 21 | 12/14/8 | B/B/A | 43 | 11/12/7 | B/B/A | 28 |
| Westbound Left/Through/Right | 12/10/6 | B/B/A | 27 | 13/11/6 | B/B/A | 26 | 11/11/6 | B/B/A | 28 |
| Northbound Left | 8 | A | 11 | 12 | B | 23 | 10 | B | 15 |
| Northbound Through/Right | 7/7 | A/A | 21 | 8/9 | A/A | 24 | 7/8 | A/A | 21 |
| Southbound Left | 10 | A | 17 | 12 | B | 14 | 11 | B | 15 |
| Southbound Through/Right | 7/5 | A/A | 27 | 9/6 | A | 38 | 8/5 | A/A | 28 |
| Hwy 401 at CR 40 North ramp terminal (Signalized) | 6 | A | | 10 | A | | 7 | A | |
| Westbound Left/Right | 10/6 | B/A | 33 | 14/10 | B/B | 63 | 10/6 | B/A | 34 |
| Northbound Through | 6 | A | 19 | 9 | A | 30 | 7 | A | 20 |
| Northbound Right | 3 | A | 13 | 4 | A | 14 | 4 | A | 15 |
| Southbound Left/Through | 11/6 | B/A | 21 | 11/9 | B/A | 24 | 10/6 | A/A | 17 |
| Hwy 401 at CR 40 South ramp terminal (Stop-controlled) | 3 | A | | 6 | A | | 3 | A | |
| Eastbound Left/Right | 11/7 | B/A | 18 | 25/12 | D/B | 0 | 16/8 | C/A | 0 |
| Northbound Left/Through | 5/1 | A/A | 5 | 5/1 | A/A | 0 | 3/1 | A/A | 0 |
| Southbound Through | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |

Note 1: Queue length reflects the 95th percentile queue length

Table 6-9 2041 Widened scenario intersection operational analysis results (summer)

| INTERSECTIONS/ MOVEMENTS | WEEKDAY AM PEAK | | | WEEKDAY PM PEAK | | | WEEKEND PEAK | | |
|---|-----------------|----------|---------------------------|-----------------|----------|---------------------------|--------------|----------|---------------------------|
| | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 1 | A | | 2 | A | | 3 | A | |
| Westbound Left/Right | 10/7 | A/A | 15 | 13/9 | B/A | 22 | 12/9 | B/A | 24 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Left/Through | 1/0 | A/A | 0 | 1/0 | A/A | 0 | 1/0 | A/A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 3 | A | | 5 | A | | 5 | A | |
| Eastbound Left/Right | 12/11 | B/B | 22 | 16/17 | C/C | 46 | 11/15 | B/C | 38 |
| Northbound Through | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Northbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Southbound Through | 0 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 0 | A | 0 | 0 | A | 0 | 0 | A | 0 |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 5 | A | | 8 | A | | 5 | A | |
| Eastbound Left/Through/Right | 10/0/7 | B/A/A | 9 | 15/21/7 | B/C/A | 6 | 11/14/6 | B/B/A | 6 |
| Westbound Left/Through/Right | 18/18/12 | C/C/B | 32 | 29/28/22 | D/D/C | 62 | 21/21/14 | C/C/B | 29 |
| Northbound Left | 2 | A | 0 | 2 | A | 0 | 3 | A | 0 |
| Northbound Through | 0 | A | 0 | 1 | A | 0 | 0 | A/A | 0 |
| Northbound Right | 2 | A | 0 | 2 | A | 0 | 2 | A | 0 |
| Southbound Left | 2 | A | 4 | 3 | A | 5 | 2 | A | 3 |
| Southbound Through/Right | 0/0 | A/A | 0 | 0/1 | A/A | 0 | 0/1 | A/A | 0 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 11 | B | | 13 | B | | 11 | B | |
| Eastbound Left/Through/Right | 14/15/10 | B/B/A | 43 | 18/19/13 | B/B/B | 70 | 14/14/9 | B/B/A | 37 |
| Westbound Left/Through/Right | 15/13/7 | B/B/A | 37 | 18/17/10 | B/B/A | 50 | 15/16/10 | B/B/A | 46 |
| Northbound Left | 13 | B | 23 | 17 | B | 30 | 14 | B | 22 |
| Northbound Through/Right | 9/9 | A/A | 27 | 9/10 | A/A | 32 | 9/9 | A/A | 29 |
| Southbound Left | 12 | B | 20 | 15 | B | 19 | 15 | B | 23 |
| Southbound Through/Right | 10/6 | A/A | 42 | 11/7 | B/A | 53 | 10/7 | A/A | 46 |
| Hwy 401 at CR 40 North ramp terminal (Signalized) | 9 | A | | 22 | C | | 9 | A | |
| Westbound Left/Right | 13/7 | B/A | 45 | 42/39 | D/D | 266 | 14/8 | B/A | 50 |
| Northbound Through | 9 | A | 29 | 12 | B | 53 | 9 | A | 30 |
| Northbound Right | 4 | A | 19 | 5 | A | 26 | 5 | A | 25 |
| Southbound Left/Through | 12/9 | B/A | 30 | 20/12 | C/B | 39 | 13/9 | B/A | 28 |
| Hwy 401 at CR 40 South ramp terminal (Stop-controlled) | 4 | A | | 8 | A | | 4 | A | |
| Eastbound Left/Right | 13/7 | B/A | 21 | 32/25 | D/C | 104 | 16/13 | C/B | 44 |
| Northbound Left/Through | 12/2 | B/A | 40 | 16/2 | C/A | 44 | 6/1 | A/A | 12 |
| Southbound Through | 1 | A | 0 | 1 | A | 0 | 1 | A | 0 |
| Southbound Right | 2 | A | 0 | 2 | A | 0 | 1 | A | 0 |

Note 1: Queue length reflects the 95th percentile queue length

7 CONSTRUCTION STAGING

Highway 401, Herley Road, Lake Road, and County Road 26 must be temporarily closed to accommodate for the replacement/rehabilitation of structures, along Highway 401 from 0.8 km east of Percy Street to 0.4 km west of Christiani Road. Traffic performance was evaluated under the following temporary construction conditions.

1. Highway closure – The closure of Highway 401 is anticipated to be undertaken overnight on weekends to minimize the impact on the mainline traffic.
2. Cross-roads closures – Herley Road, Lake Road, and County Road 26 must be closed at Highway 401 to replace the bridge structures. Even though the construction schedule is not specified at this time, the construction work is expected to last for a continuous period of time, and these cross-roads will be closed to vehicles, cyclists and pedestrians during this time.

7.1 HIGHWAY CLOSURE

Traffic will be diverted onto the emergency detour route (EDR) during the replacement of the structures along Highway 401. The EDR extends along County Road 25, County Road 2, County Road 30, County Road 41, and County Road 40 as illustrated in Figure 7-1. During the mainline closures it is recommended to have police officers present at the constraining intersections to minimize the delays by monitoring the in-field intersection. To emulate the presence of police officers in the model, stop-controlled intersections were modelled as signalized intersections to minimize the delays and the queues.

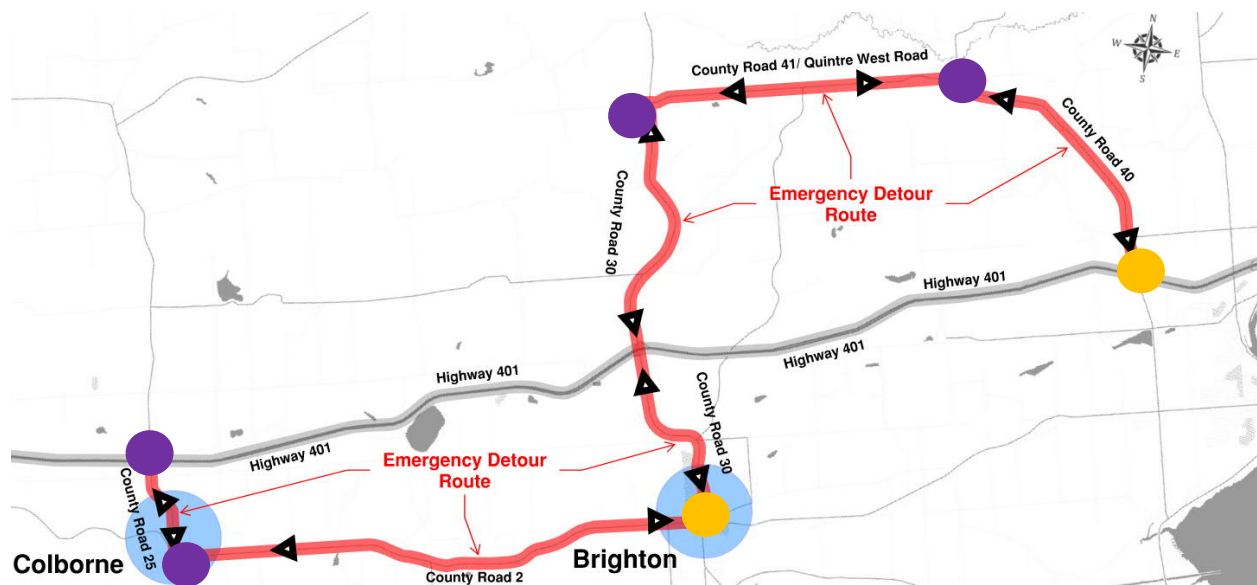


Figure 7-1 Emergency detour route

- These intersections are stop controlled but were modelled with a traffic signal to represent a police officer.
- These intersections are signal controlled but were modelled with a modified signal timing plan to favour the key movements. The signal at the north ramp terminal at Highway 401 and County Road 40 was modified to operate with a split-phase timing.

A microsimulation model of the EDR was developed in Vissim 11 for the 2031 and 2041 planning horizons. The expected closures of Highway 401 were assumed to commence at 9:00 PM on a Friday and end at 9:00 AM on a Saturday during the summer months. The overnight mainline traffic volumes were estimated based on the 2016 ATR counts, and the regional road traffic volumes were estimated based on the balanced existing (2020) traffic volumes.

Traffic volumes were increased by an annual growth rate of 1.5% to the 2031 and 2041 planning horizons. Assumptions were made as to the volume of traffic on the roads along the EDR based on road type and time of night.

Travel Time and Speeds

Travel times, for the full length of the EDR, were measured in Vissim and the average of 5 simulation runs were reported for the 2031 and 2041 planning horizons. The average travel time between County Road 25 and County Road 40 increases from 15 minutes (along Highway 401) to 53-56 minutes under the 2031 planning horizon and to 57-63 minutes under the 2041 conditions (along the EDR).

Average speeds along the detour route are approximately 45 km/hr to 47 km/hr under the 2031 planning horizon and 40 km/hr to 44 km/hr under the 2041 planning horizon.

Queue Information

Given the limited capacity of the off-ramps, the queues spill back onto the mainline and can extend to 4.8-5.4 km in the eastbound direction and beyond the model area in the westbound direction forming a virtual queue. Queue information at the key intersections is summarized in in Table 7-1 and Table 7-2 under the 2031 and 2041 planning horizons, respectively.

Table 7-1 Queue length for the key movements under the planning year 2031

| INTERSECTION | EASTBOUND | | WESTBOUND | |
|---------------------------------|-----------|-----------|-----------|-----------|
| | MVT | QUEUE (m) | MVT | QUEUE (m) |
| HWY 401 & CR 25 South Ramp | EBR | 4,800 | NBT | 0 |
| CR 25 & Purdy Road/Orchard Road | SBT | 60 | NBT | 50 |
| CR 25 & CR 2 | SBL | 170 | WBR | 520 |
| CR 2 & Prince Edward Street | EBL | 1,200 | SBR | 380 |
| CR 30 & CR 41 | NBR | 3,330 | WBL | 660 |
| Quinte West Road & CR 40 | EBR | 7,170 | NBL | 6,960 |
| HWY 401 & CR 40 North Ramp | SBT | 2,040 | WBR | >4,250 |

Queue length reflects the 95th percentile queue length over the entire 12-hour closure

Table 7-2 Queue length for the key movements under planning year 2041

| INTERSECTION | EASTBOUND | | WESTBOUND | |
|---------------------------------|-----------|-----------|-----------|-----------|
| | MVT | QUEUE (m) | MVT | QUEUE (m) |
| HWY 401 & CR 25 South Ramp | EBR | 5,400 | NBT | 10 |
| CR 25 & Purdy Road/Orchard Road | SBT | 70 | NBT | 50 |
| CR 25 & CR 2 | SBL | 400 | WBR | 1,260 |
| CR 2 & Prince Edward Street | EBL | 1,570 | SBR | 570 |
| CR 30 & CR 41 | NBR | 6,100 | WBL | 620 |
| Quinte West Road & CR 40 | EBR | 7,420 | NBL | 7,100 |
| HWY 401 & CR 40 North Ramp | SBT | 2,950 | WBR | >4,250 |

Queue length reflects the 95th percentile queue length over the entire 12-hour closure

7.2 CROSSING ROAD CLOSURE

The bridge structures along the study area were built in the late 1950s and are nearing the end of their lives. These structures are also insufficient to accommodate for the widening of Highway 401 from 4 traffic lanes to 6 lanes and must be replaced.

- Herley Road Underpass (ID 21-294) – constructed in 1959 with the recommended replacement year 2035 (modelled for the 2041 planning horizon)
- Lake Road Underpass (ID 21-295) – constructed in 1959 with the recommended replacement year 2025 (modelled for the 2031 planning horizon)
- County Road 26 Underpass (ID 21-297) – constructed in 1965 with the recommended replacement year 2041 (modelled for the 2041 planning horizon)

A series of assumptions were made to assess the traffic performance during the closure of the crossing roads since the construction work schedule is not established at the time when the analyses were undertaken. These assumptions were made conservatively to assess the road network under a worst-case scenario.

- Closures of these crossing roads (to replace the bridge structures) were assumed to be continuous for several months, over multiple seasons, and the underpasses will be closed to the public at all times for the full duration of construction.
- Traffic from these crossing roads were diverted onto the nearest parallel regional road. The traffic from Herley Road was assumed to use County Road 25, and the traffic from Lake Road and County Road 26 was assigned to County Road 30.
- Traffic performance was evaluated under a summer weekday PM peak hour. The analyses of the existing and the future conditions demonstrated that the LOS is more critical during this time of day.
- The crossing road traffic counts that were collected during Fall of 2020 were first converted to summer counts using the seasonality factors and were grown using the annual growth rate of 1.5%.
- To be conservative, the 2031 planning year was assumed for the closure of Lake Road, which is anticipated to occur in 2025. The 2041 planning year was assumed for the Herley Road and County Road 26 closures, which will commence in 2035 and 2041, respectively.

The 2031 and 2041 widened scenario weekday PM peak Vissim models were modified to account for the diverted traffic from Herley Road, Lake Road, and County Road 26 based on the assumptions (discussed above). These models also capture the interchange update at County Road 25. The traffic models were simulated over 5 simulation runs, and the control delays, LOS, and 95th percentile queues were re-evaluated at the ramp terminals. The intersection performance was assessed at the County Road 30 ramp terminals where the traffic was diverted from Lake Road and County Road 26, emulating the closure of these cross-roads, and the results are shown in Table 7-3. The intersection performance on County Road 25 including the diverted traffic from Herley Road during the bridge replacement is shown in Table 7-4.

- The control delays for each movement remain within 1-2 seconds of the delays reported under the 2031 widened scenario at the County Road 30 interchange, except for the westbound movements, despite the closure of the Lake Road underpass and diversion of traffic onto County Road 30. The westbound approach may experience an additional 3 seconds of delay since vehicles must wait longer to find a safe gap before turning onto County Road 30.
- The impact on the intersection operations under the closure of County Road 26 is similar to the Lake Road closure but to a greater degree due to diversion of higher volumes of traffic. The westbound movements, which operate at LOS D under the future permanent conditions, experience additional delays of 23-32 seconds at the County Road 30 north ramp terminal. The queue on the westbound ramp extends by 40 metres but does not spill back onto the mainline.
- The County Road 25 ramp terminals continue to operate at LOS A during the closure of Herley Road.

Table 7-3 Diversion to County Road 30 from Lake Road and County Road 26 operational analysis results

| INTERSECTIONS/ MOVEMENTS | LAKE ROAD (2031) | | | | COUNTY ROAD 26 (2041) | | | |
|---|-----------------------------|--------------|----------|---------------------------|-----------------------------|--------------|----------|---------------------------|
| | DIVERTED VOLUME (veh/hr) | DELAY (s) | LOS | QUEUE ¹ (m) | DIVERTED VOLUME (veh/hr) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 30 North ramp terminal (Stop-controlled) | 85 | 7 | A | | 245 | 12 | B | |
| Eastbound Left/Through/Right | -/- | 13/14/6 | B/B/A | 6 | -/- | 16/17/7 | C/C/A | 6 |
| Westbound Left/Through/Right | -/- | 28/28/19 | D/D/C | 56 | -/- | 55/60/45 | F/F/E | 102 |
| Northbound Left | - | 3 | A | 0 | - | 4 | A | 0 |
| Northbound Through | 35 | 1 | A/A | 0 | 135 | 1 | A | 0 |
| Northbound Right | - | 1 | A | 0 | - | 2 | A | 0 |
| Southbound Left | - | 3 | A | 5 | - | 4 | A | 6 |
| Southbound Through/Right | 50/- | 0/1 | A/A | 0 | 110/- | 0/1 | A/A | 0 |
| Hwy 401 at CR 30 South ramp terminal (Signalized) | 85 | 12 | B | | 245 | 13 | B | |
| Eastbound Left/Through/Right | -/- | 15/17/11 | B/B/B | 51 | -/- | 19/19/14 | B/B/B | 68 |
| Westbound Left/Through/Right | -/- | 18/14/9 | B/B/A | 36 | -/- | 18/15/9 | B/B/A | 45 |
| Northbound Left | - | 16 | B | 28 | - | 23 | C | 36 |
| Northbound Through/Right | 35/- | 9/10 | A/B | 31 | 135/- | 10/10 | A/A | 37 |
| Southbound Left | - | 14 | B | 17 | - | 18 | B | 22 |
| Southbound Through/Right | 50/- | 11/7 | B/A | 58 | 110/- | 12/9 | B/A | 69 |

Note 1: Queue length reflects the 95th percentile queue length

Table 7-4 Diversion to County Road 25 from Herley Road operational analysis results

| INTERSECTIONS/ MOVEMENTS | HERLEY ROAD (2041) | | | |
|---|-----------------------------|-----------|----------|------------------------|
| | DIVERTED VOLUME (veh/hr) | DELAY (s) | LOS | QUEUE ¹ (m) |
| Hwy 401 at CR 25 North ramp terminal (Stop-controlled) | 115 | 2 | A | |
| Westbound Left/Right | -/- | 14/9 | B/A | 22 |
| Northbound Through | 75 | 0 | A | 0 |
| Northbound Right | - | 0 | A | 0 |
| Southbound Left/Through | -/40 | 2/0 | A/A | 0 |
| Hwy 401 at CR 25 South ramp terminal (Stop-controlled) | 115 | 5 | A | |
| Eastbound Left/Right | -/- | 18/17 | C/C | 46 |
| Northbound Through | 75 | 0 | A | 0 |
| Northbound Right | - | 0 | A | 0 |
| Southbound Through | 40 | 1 | A | 0 |
| Southbound Right | - | 0 | A | 0 |

Note 1: Queue length reflects the 95th percentile queue length

8 CONCLUSION

The Ministry of Transportation of Ontario (MTO) has retained WSP to undertake the Preliminary Design and Environmental Assessment for the widening of Highway 401 and replacement/rehabilitation of structures, from 0.8 km east of Percy Street to 0.4 km west of Christiani Road.

The existing conditions was assessed in Vissim along the study area. The peak-direction LOS analysis indicates that Highway 401 is currently operating with LOS A during the AM peak hour and LOS A to B during the PM peak hour. The weekend peak hour operation is the most critical, with LOS D. Overall, the mainline is operating at acceptable levels of service under the existing traffic demands.

From a safety perspective the Highway 401 mainline, through the study area, is operating at an acceptable level-of-service-safety (LOSS) with a LOSS of II. A LOSS II indicates that the Highway 401 corridor is operating below the predicted safety performance given the corridor's annual average daily traffic. Over the five-year period from 2012 to 2016, one incident resulted in a fatality. This incident occurred on the westbound lanes of Highway 401, 2.3 km west of County Road 40 and involved a rear-end collision between a stopped truck and a passenger vehicle. The most memorable incident occurred on the westbound lanes in 2015 and involved 39 vehicles. This incident resulted in property damage only and occurred during freezing rain when there was ice on the road surface.

The corridor was assessed for the 2031 and 2041 planning horizons as a comparative review of the do-nothing scenarios and the widened scenarios. The fall and summer weekend peak periods are the critical time periods for this section of Highway 401. During the 2031 do-nothing scenario, the Highway 401 corridor, in the peak direction, operates at LOS D and LOS E during the fall and summer seasons. Highway 401 generally operates under free-flow conditions with simulated speeds of greater than or slightly below 100 km/h during the weekday AM and PM peak hours. Under the weekend peak hour condition, the simulated speeds fall slightly below 100 km/h due to high traffic demand. With the widening of the Highway 401 corridor to 6 lanes, the LOS improves to C or better under the 2031 planning horizon and the travel times decrease by 0.1-0.4 minutes across all time periods, and vehicles travel at the posted speed limit of 100 km/hr. The greatest improvement in the operating speed corresponds to the weekend conditions where the mainline vehicular demands are the highest.

By 2041, under a do-nothing scenario, the Highway 401 corridor is anticipated to operate at a LOS of C or better during the weekday peak hours similar to the 2031 do-nothing scenario. The LOS degrades during the weekend peak hours given the high volume of traffic. The highway segments are anticipated to operate at capacity (LOS E) during fall and over capacity (LOS F) under the summer conditions. With the widening of the Highway 401 corridor to 6 lanes, the LOS improves to C or better. Vehicles travel at or near the posted speed limit, and the greatest increase in the operating speed corresponds to the weekend conditions where the mainline vehicular demands are the highest.

This study also assessed the construction staging required to accommodate for the replacement/rehabilitation of structures, along Highway 401 from 0.8 km east of Percy Street to 0.4 km west of Christiani Road. Highway 401, Herley Road, Lake Road, and County Road 26 must be temporarily closed. Highway 401 mainline traffic will be diverted onto the emergency detour route (EDR) during the replacement of the structures along Highway 401. During the mainline closures, it is recommended to have police officers present at the constraining intersections to minimize the delays by monitoring the in-field intersection. To emulate the presence of police officers in the model, stop-controlled intersections were modelled as signalized intersections to minimize the delays and the queues. The mainline closures were assessed for both the 2031 and 2041 planning horizons, for a 12-hour period commencing at 9:00 PM on a Friday and ending at 9:00 AM on a Saturday, during the summer months. Travel times, for the full length of the EDR, were measured in Vissim and the average of 5 simulation runs were reported for the 2031 and 2041 planning horizons. The average travel time between County Road 25 and County Road 40 increases from 15 minutes (along Highway 401) to 53-56 minutes under the 2031 planning horizon and to 57-63 minutes under the 2041 conditions (along the EDR). Average speeds along the detour route are approximately 45 km/hr to 47 km/hr under the 2031 planning horizon and 40 km/hr to 44 km/hr under the 2041 planning horizon.

The bridge structures along the study area were built in the late 1950s and are nearing the end of their lives. These structures are also insufficient to accommodate for the widening of Highway 401 and must be replaced. The Herley

Road Underpass has a recommended replacement year of 2035 and was modelled for the planning horizon. The Lake Road Underpass has a recommended replacement year of 2025 and was evaluated for the 2031 planning horizon, and the County Road 26 Underpass has a recommended replacement year of 2041 and was modelled for the 2041 planning horizon. These closures were assumed to be continuous for several months and over multiple seasons. Traffic from these crossing roads were diverted onto the nearest parallel regional road. The traffic from Herley Road was assumed to use County Road 25, and the traffic from Lake Road and County Road 26 was assigned to County Road 30. Traffic performance was evaluated for a typical summer weekday PM peak hour. The ramp terminals at Highway 401 continue to operate well during these construction detours. The north ramp terminal at County Road 30 operates at LOS B but does have westbound movements operating at LOS E or F due to the increase in traffic from County Road 26 during the 2041 planning horizon. The traffic operations at this north ramp terminal can be improved with the addition of a traffic signal.

APPENDIX

A GEH SUMMARY



APPENDIX

Fall Conditions

Table A-1: GEH summary – Highway 401 mainline – weekday AM peak hour (8-9 AM)

| Mainline | Direction | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|------------|-----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| W of CR 25 | EB | 919 | 843 | 9% | 913 | 0.2 | 2.4 |
| | WB | 997 | 968 | 3% | 953 | 1.4 | -0.5 |
| W of CR 30 | EB | 863 | 812 | 6% | 873 | 0.3 | 2.1 |
| | WB | 886 | 850 | 4% | 846 | 1.4 | -0.1 |
| W of CR 40 | EB | 878 | 878 | 0% | 882 | 0.1 | 0.1 |
| | WB | 845 | 845 | 0% | 819 | 0.9 | -0.9 |
| E of CR 40 | EB | 1,034 | 1,034 | 0% | 1,057 | 0.7 | 0.7 |
| | WB | 898 | 898 | 0% | 895 | 0.1 | -0.1 |

Table A-2: GEH summary – Highway 401 ramps – weekday AM peak hour (8-9 AM)

| Ramps | Direction | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|---------------------|-----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| Hwy 401 to CR 25 EB | W-N/S | 115 | 112 | 3% | 114 | 0.1 | 0.2 |
| Hwy 401 to CR 25 WB | E-N/S | 66 | 58 | 13% | 66 | 0.0 | 1.0 |
| CR 25 to Hwy 401 EB | N/S-E | 59 | 51 | 16% | 72 | 1.6 | 2.7 |
| CR 25 to Hwy 401 WB | N/S-W | 176 | 176 | 0% | 176 | 0.0 | 0.0 |
| Hwy 401 to CR 30 EB | W-N/S | 125 | 125 | 0% | 126 | 0.1 | 0.1 |
| Hwy 401 to CR 30 WB | E-N/S | 101 | 101 | 0% | 99 | 0.2 | -0.2 |
| CR 30 to Hwy 401 EB | N/S-E | 139 | 135 | 3% | 127 | 1.0 | -0.7 |
| CR 30 to Hwy 401 WB | N/S-W | 143 | 143 | 0% | 141 | 0.1 | -0.1 |
| Hwy 401 to CR 40 EB | W-N/S | 95 | 95 | 0% | 112 | 1.7 | 1.7 |
| Hwy 401 to CR 40 WB | E-N/S | 152 | 152 | 0% | 157 | 0.4 | 0.4 |
| CR 40 to Hwy 401 EB | N/S-E | 251 | 233 | 8% | 258 | 0.4 | 1.6 |
| CR 40 to Hwy 401 WB | N/S-W | 99 | 98 | 1% | 100 | 0.1 | 0.2 |

APPENDIX

Table A-3: GEH summary – Highway 401 ramps terminals – weekday AM peak hour (8-9 AM)

| Ramp terminals | Movement | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|---------------------------|----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| CR 25 North Ramp Terminal | WBL | 56 | 56 | 0% | 59 | 0.4 | 0.4 |
| | WBR | 10 | 10 | 0% | 7 | 1.0 | -1.0 |
| | NBT | 78 | 78 | 0% | 80 | 0.2 | 0.2 |
| | NBR | 132 | 127 | 4% | 130 | 0.2 | 0.3 |
| | SBL | 44 | 42 | 5% | 46 | 0.3 | 0.6 |
| | SBT | 112 | 111 | 1% | 103 | 0.9 | -0.8 |
| CR 25 South Ramp Terminal | EBL | 28 | 28 | 0% | 27 | 0.2 | -0.2 |
| | EBR | 87 | 87 | 0% | 87 | 0.0 | 0.0 |
| | NBL | 42 | 42 | 0% | 44 | 0.3 | 0.3 |
| | NBT | 182 | 181 | 1% | 183 | 0.1 | 0.1 |
| | SBT | 151 | 151 | 0% | 136 | 1.3 | -1.3 |
| | SBR | 17 | 17 | 0% | 28 | 2.3 | 2.3 |
| CR 30 North Ramp Terminal | EBL | 10 | 10 | 0% | 1 | 3.8 | -3.8 |
| | EBT | 0 | 0 | 0% | 0 | 0.0 | 0.0 |
| | EBR | 22 | 22 | 0% | 36 | 2.6 | 2.6 |
| | WBL | 63 | 63 | 0% | 65 | 0.3 | 0.3 |
| | WBT | 1 | 1 | 0% | 3 | 1.4 | 1.4 |
| | WBR | 37 | 37 | 0% | 30 | 1.2 | -1.2 |
| | NBL | 10 | 10 | 0% | 8 | 0.7 | -0.7 |
| | NBT | 100 | 96 | 4% | 106 | 0.6 | 1.0 |
| | NBR | 96 | 94 | 2% | 92 | 0.4 | -0.2 |
| | SBL | 47 | 46 | 2% | 50 | 0.4 | 0.6 |
| CR 30 South Ramp Terminal | EBL | 34 | 27 | 26% | 31 | 0.5 | 0.7 |
| | EBT | 35 | 28 | 25% | 36 | 0.2 | 1.4 |
| | EBR | 55 | 44 | 25% | 59 | 0.5 | 2.1 |
| | WBL | 31 | 31 | 0% | 33 | 0.4 | 0.4 |
| | WBT | 40 | 40 | 0% | 30 | 1.7 | -1.7 |
| | WBR | 52 | 52 | 0% | 48 | 0.6 | -0.6 |
| | NBL | 56 | 56 | 0% | 42 | 2.0 | -2.0 |
| | NBT | 120 | 120 | 0% | 128 | 0.7 | 0.7 |
| | NBR | 38 | 38 | 0% | 38 | 0.0 | 0.0 |
| | SBL | 51 | 51 | 0% | 57 | 0.8 | 0.8 |
| CR 40 North Ramp Terminal | EBL | 107 | 94 | 14% | 110 | 0.3 | 1.6 |
| | WBR | 45 | 40 | 13% | 48 | 0.4 | 1.2 |
| | NBT | 114 | 114 | 0% | 115 | 0.1 | 0.1 |
| | NBR | 94 | 94 | 0% | 92 | 0.2 | -0.2 |
| | SBL | 5 | 5 | 0% | 9 | 1.5 | 1.5 |
| | SBT | 246 | 246 | 0% | 247 | 0.1 | 0.1 |
| CR 40 South Ramp Terminal | EBL | 6 | 6 | 0% | 1 | 2.7 | -2.7 |
| | EBR | 89 | 89 | 0% | 110 | 2.1 | 2.1 |
| | NBL | 155 | 155 | 0% | 158 | 0.2 | 0.2 |
| | NBT | 202 | 202 | 0% | 206 | 0.3 | 0.3 |
| | SBT | 257 | 244 | 5% | 257 | 0.0 | 0.8 |
| | SBR | 96 | 96 | 0% | 101 | 0.5 | 0.5 |

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Table A-4: GEH summary – Highway 401 mainline – weekday PM peak hour (4-5 PM)

| Mainline | Direction | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|------------|-----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| W of CR 25 | EB | 1,396 | 1,348 | 4% | 1,391 | 0.1 | 1.2 |
| | WB | 1,339 | 1,331 | 1% | 1,335 | 0.1 | 0.1 |
| W of CR 30 | EB | 1,250 | 1,230 | 2% | 1,252 | 0.0 | 0.6 |
| | WB | 1,257 | 1,254 | 0% | 1,254 | 0.1 | 0.0 |
| W of CR 40 | EB | 1,198 | 1,198 | 0% | 1,218 | 0.6 | 0.6 |
| | WB | 1,319 | 1,319 | 0% | 1,309 | 0.3 | -0.3 |
| E of CR 40 | EB | 1,215 | 1,215 | 0% | 1,248 | 0.9 | 0.9 |
| | WB | 1,545 | 1,545 | 0% | 1,545 | 0.0 | 0.0 |

Table A-5: GEH summary – Highway 401 ramps – weekday PM peak hour (4-5 PM)

| Ramps | Direction | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|---------------------|-----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| Hwy 401 to CR 25 EB | W-N/S | 244 | 244 | 0% | 243 | 0.0 | 0.0 |
| Hwy 401 to CR 25 WB | E-N/S | 83 | 83 | 0% | 90 | 0.7 | 0.7 |
| CR 25 to Hwy 401 EB | N/S-E | 98 | 98 | 0% | 101 | 0.3 | 0.3 |
| CR 25 to Hwy 401 WB | N/S-W | 165 | 165 | 0% | 168 | 0.2 | 0.2 |
| Hwy 401 to CR 30 EB | W-N/S | 216 | 167 | 29% | 220 | 0.3 | 3.8 |
| Hwy 401 to CR 30 WB | E-N/S | 185 | 180 | 3% | 164 | 1.6 | -1.2 |
| CR 30 to Hwy 401 EB | N/S-E | 164 | 164 | 0% | 165 | 0.1 | 0.1 |
| CR 30 to Hwy 401 WB | N/S-W | 123 | 115 | 7% | 118 | 0.5 | 0.3 |
| Hwy 401 to CR 40 EB | W-N/S | 216 | 194 | 11% | 220 | 0.3 | 1.8 |
| Hwy 401 to CR 40 WB | E-N/S | 356 | 352 | 1% | 352 | 0.2 | 0.0 |
| CR 40 to Hwy 401 EB | N/S-E | 233 | 233 | 0% | 237 | 0.3 | 0.3 |
| CR 40 to Hwy 401 WB | N/S-W | 130 | 124 | 5% | 138 | 0.7 | 1.3 |

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Table A-6: GEH summary – Highway 401 ramps terminals – weekday PM peak hour (4-5 PM)

| Ramp terminals | Movement | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|----------------|----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| CR 25 NRT | WBL | 65 | 62 | 5% | 65 | 0.0 | 0.4 |
| | WBR | 18 | 17 | 6% | 24 | 1.3 | 1.5 |
| | NBT | 197 | 173 | 14% | 194 | 0.2 | 1.6 |
| | NBR | 136 | 134 | 1% | 140 | 0.3 | 0.5 |
| | SBL | 29 | 28 | 4% | 28 | 0.2 | 0.0 |
| | SBT | 110 | 110 | 0% | 106 | 0.4 | -0.4 |
| CR 25 SRT | EBL | 60 | 57 | 5% | 61 | 0.1 | 0.5 |
| | EBR | 184 | 173 | 6% | 181 | 0.2 | 0.6 |
| | NBL | 78 | 78 | 0% | 81 | 0.3 | 0.3 |
| | NBT | 273 | 273 | 0% | 273 | 0.0 | 0.0 |
| | SBT | 155 | 152 | 2% | 152 | 0.2 | 0.0 |
| | SBR | 20 | 20 | 0% | 20 | 0.0 | 0.0 |
| CR 30 NRT | EBL | 3 | 3 | 0% | 2 | 0.6 | -0.6 |
| | EBT | 1 | 1 | 0% | 0 | 0.0 | 0.0 |
| | EBR | 18 | 18 | 0% | 23 | 1.1 | 1.1 |
| | WBL | 114 | 114 | 0% | 100 | 1.4 | -1.4 |
| | WBT | 13 | 13 | 0% | 17 | 1.0 | 1.0 |
| | WBR | 58 | 58 | 0% | 48 | 1.4 | -1.4 |
| | NBL | 23 | 23 | 0% | 25 | 0.4 | 0.4 |
| | NBT | 164 | 163 | 1% | 167 | 0.2 | 0.3 |
| | NBR | 84 | 84 | 0% | 82 | 0.2 | -0.2 |
| | SBL | 38 | 38 | 0% | 35 | 0.5 | -0.5 |
| CR 30 SRT | EBL | 48 | 48 | 0% | 55 | 1.0 | 1.0 |
| | EBT | 58 | 58 | 0% | 42 | 2.3 | -2.3 |
| | EBR | 110 | 110 | 0% | 123 | 1.2 | 1.2 |
| | WBL | 30 | 30 | 0% | 30 | 0.0 | 0.0 |
| | WBT | 29 | 25 | 16% | 31 | 0.4 | 1.1 |
| | WBR | 67 | 67 | 0% | 67 | 0.0 | 0.0 |
| | NBL | 81 | 68 | 19% | 87 | 0.7 | 2.2 |
| | NBT | 156 | 156 | 0% | 154 | 0.2 | -0.2 |
| | NBR | 49 | 49 | 0% | 42 | 1.0 | -1.0 |
| | SBL | 46 | 46 | 0% | 55 | 1.3 | 1.3 |
| CR 40 NRT | WBL | 206 | 206 | 0% | 202 | 0.3 | -0.3 |
| | WBR | 150 | 150 | 0% | 151 | 0.1 | 0.1 |
| | NBT | 207 | 207 | 0% | 202 | 0.3 | -0.3 |
| | NBR | 112 | 112 | 0% | 108 | 0.4 | -0.4 |
| | SBL | 18 | 18 | 0% | 31 | 2.6 | 2.6 |
| | SBT | 255 | 253 | 1% | 251 | 0.3 | -0.1 |
| CR 40 SRT | EBL | 23 | 23 | 0% | 17 | 1.3 | -1.3 |
| | EBR | 193 | 193 | 0% | 202 | 0.6 | 0.6 |
| | NBL | 131 | 129 | 2% | 131 | 0.0 | 0.2 |
| | NBT | 296 | 290 | 2% | 293 | 0.2 | 0.2 |
| | SBT | 359 | 359 | 0% | 348 | 0.6 | -0.6 |
| | SBR | 102 | 100 | 2% | 105 | 0.3 | 0.5 |

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Table A-7: GEH summary – Highway 401 mainline – weekend mid-day peak hour (2-3 PM)

| Mainline | Direction | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|------------|-----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| W of CR 25 | EB | 2,028 | 1,878 | 8% | 2,029 | 0.0 | 3.4 |
| | WB | 2,856 | 2,831 | 1% | 2,761 | 1.8 | -1.3 |
| W of CR 30 | EB | 1,921 | 1,785 | 8% | 1,942 | 0.5 | 3.6 |
| | WB | 2,838 | 2,793 | 2% | 2,728 | 2.1 | -1.2 |
| W of CR 40 | EB | 1,920 | 1,920 | 0% | 1,967 | 1.1 | 1.1 |
| | WB | 2,832 | 2,832 | 0% | 2,755 | 1.5 | -1.5 |
| E of CR 40 | EB | 1,919 | 1,919 | 0% | 2,005 | 1.9 | 1.9 |
| | WB | 2,880 | 2,880 | 0% | 2,879 | 0.0 | 0.0 |

Table A-8: GEH summary – Highway 401 ramps – weekend mid-day peak hour (2-3 PM)

| Ramps | Direction | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|---------------------|-----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| Hwy 401 to CR 25 EB | W-N/S | 181 | 175 | 3% | 172 | 0.7 | -0.2 |
| Hwy 401 to CR 25 WB | E-N/S | 95 | 95 | 0% | 94 | 0.1 | -0.1 |
| CR 25 to Hwy 401 EB | N/S-E | 74 | 74 | 0% | 83 | 1.0 | 1.0 |
| CR 25 to Hwy 401 WB | N/S-W | 113 | 113 | 0% | 117 | 0.4 | 0.4 |
| Hwy 401 to CR 30 EB | W-N/S | 143 | 141 | 1% | 152 | 0.7 | 0.9 |
| Hwy 401 to CR 30 WB | E-N/S | 104 | 104 | 0% | 101 | 0.3 | -0.3 |
| CR 30 to Hwy 401 EB | N/S-E | 142 | 142 | 0% | 133 | 0.8 | -0.8 |
| CR 30 to Hwy 401 WB | N/S-W | 110 | 110 | 0% | 113 | 0.3 | 0.3 |
| Hwy 401 to CR 40 EB | W-N/S | 159 | 159 | 0% | 134 | 2.1 | -2.1 |
| Hwy 401 to CR 40 WB | E-N/S | 195 | 195 | 0% | 196 | 0.1 | 0.1 |
| CR 40 to Hwy 401 EB | N/S-E | 158 | 158 | 0% | 159 | 0.1 | 0.1 |
| CR 40 to Hwy 401 WB | N/S-W | 147 | 147 | 0% | 142 | 0.4 | -0.4 |

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Table A-9: GEH summary – Highway 401 ramps terminals – weekend mid-day peak hour (2-3 PM)

| Ramp terminals | Movement | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|----------------|----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| CR 25 NRT | WBL | 78 | 49 | 59% | 83 | 0.6 | 4.2 |
| | WBR | 17 | 11 | 55% | 12 | 1.3 | 0.3 |
| | NBT | 103 | 103 | 0% | 92 | 1.1 | -1.1 |
| | NBR | 90 | 90 | 0% | 95 | 0.5 | 0.5 |
| | SBL | 23 | 23 | 0% | 23 | 0.0 | 0.0 |
| | SBT | 102 | 102 | 0% | 99 | 0.3 | -0.3 |
| CR 25 SRT | EBL | 24 | 24 | 0% | 23 | 0.2 | -0.2 |
| | EBR | 157 | 157 | 0% | 150 | 0.6 | -0.6 |
| | NBL | 62 | 61 | 2% | 64 | 0.3 | 0.4 |
| | NBT | 169 | 169 | 0% | 163 | 0.5 | -0.5 |
| | SBT | 168 | 137 | 23% | 164 | 0.3 | 2.2 |
| | SBR | 12 | 12 | 0% | 18 | 1.5 | 1.5 |
| CR 30 NRT | EBL | 5 | 5 | 0% | 4 | 0.5 | -0.5 |
| | EBT | 2 | 2 | 0% | 2 | 0.0 | 0.0 |
| | EBR | 15 | 15 | 0% | 18 | 0.7 | 0.7 |
| | WBL | 84 | 84 | 0% | 78 | 0.7 | -0.7 |
| | WBT | 5 | 5 | 0% | 4 | 0.5 | -0.5 |
| | WBR | 15 | 15 | 0% | 18 | 0.7 | 0.7 |
| | NBL | 16 | 16 | 0% | 15 | 0.3 | -0.3 |
| | NBT | 151 | 149 | 1% | 153 | 0.2 | 0.3 |
| | NBR | 81 | 79 | 3% | 83 | 0.2 | 0.4 |
| | SBL | 27 | 26 | 4% | 29 | 0.4 | 0.6 |
| | SBT | 158 | 158 | 0% | 154 | 0.3 | -0.3 |
| SBR | 11 | 11 | 0% | 11 | 0.0 | 0.0 | |
| CR 30 SRT | EBL | 34 | 34 | 0% | 44 | 1.6 | 1.6 |
| | EBT | 41 | 41 | 0% | 41 | 0.0 | 0.0 |
| | EBR | 68 | 68 | 0% | 69 | 0.1 | 0.1 |
| | WBL | 37 | 37 | 0% | 38 | 0.2 | 0.2 |
| | WBT | 42 | 42 | 0% | 40 | 0.3 | -0.3 |
| | WBR | 77 | 77 | 0% | 78 | 0.1 | 0.1 |
| | NBL | 49 | 49 | 0% | 55 | 0.8 | 0.8 |
| | NBT | 137 | 137 | 0% | 130 | 0.6 | -0.6 |
| | NBR | 55 | 55 | 0% | 55 | 0.0 | 0.0 |
| | SBL | 54 | 54 | 0% | 56 | 0.3 | 0.3 |
| | SBT | 152 | 152 | 0% | 157 | 0.4 | 0.4 |
| SBR | 51 | 51 | 0% | 39 | 1.8 | -1.8 | |
| CR 40 NRT | WBL | 128 | 116 | 10% | 129 | 0.1 | 1.2 |
| | WBR | 67 | 61 | 10% | 66 | 0.1 | 0.6 |
| | NBT | 145 | 145 | 0% | 137 | 0.7 | -0.7 |
| | NBR | 133 | 77 | 73% | 132 | 0.1 | 5.4 |
| | SBL | 14 | 8 | 75% | 11 | 0.8 | 1.0 |
| | SBT | 190 | 190 | 0% | 191 | 0.1 | 0.1 |
| CR 40 SRT | EBL | 14 | 14 | 0% | 6 | 2.5 | -2.5 |
| | EBR | 145 | 145 | 0% | 128 | 1.5 | -1.5 |
| | NBL | 100 | 100 | 0% | 100 | 0.0 | 0.0 |
| | NBT | 264 | 208 | 27% | 263 | 0.1 | 3.6 |
| | SBT | 260 | 251 | 4% | 262 | 0.1 | 0.7 |
| | SBR | 58 | 58 | 0% | 58 | 0.0 | 0.0 |

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Table A-10: GEH summary – Highway 401 mainline – weekday AM peak hour (8-9 AM)

| Mainline | Direction | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|------------|-----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| W of CR 25 | EB | 1,164 | 1,108 | 5% | 1,164 | 0.0 | 1.7 |
| | WB | 1,234 | 1,119 | 10% | 1,172 | 1.8 | 1.6 |
| W of CR 30 | EB | 1,080 | 1,028 | 5% | 1,072 | 0.2 | 1.4 |
| | WB | 1,068 | 1,015 | 5% | 989 | 2.5 | -0.8 |
| W of CR 40 | EB | 1,102 | 1,102 | 0% | 1,121 | 0.6 | 0.6 |
| | WB | 1,007 | 1,007 | 0% | 982 | 0.8 | -0.8 |
| E of CR 40 | EB | 1,336 | 1,336 | 0% | 1,379 | 1.2 | 1.2 |
| | WB | 1,086 | 1,086 | 0% | 1,126 | 1.2 | 1.2 |

Table A-11: GEH summary – Highway 401 ramps – weekday AM peak hour (8-9 AM)

| Ramps | Direction | Balanced volume (vph) | Simulated volume (vph) | GEH (Simulated vs. Balanced) |
|---------------------|-----------|-----------------------|------------------------|------------------------------|
| Hwy 401 to CR 25 EB | W-N/S | 173 | 186 | 1.0 |
| Hwy 401 to CR 25 WB | E-N/S | 99 | 73 | 2.8 |
| CR 25 to Hwy 401 EB | N/S-E | 89 | 95 | 0.6 |
| CR 25 to Hwy 401 WB | N/S-W | 265 | 260 | 0.3 |
| Hwy 401 to CR 30 EB | W-N/S | 187 | 189 | 0.1 |
| Hwy 401 to CR 30 WB | E-N/S | 153 | 172 | 1.5 |
| CR 30 to Hwy 401 EB | N/S-E | 209 | 224 | 1.0 |
| CR 30 to Hwy 401 WB | N/S-W | 214 | 214 | 0.0 |
| Hwy 401 to CR 40 EB | W-N/S | 143 | 129 | 1.2 |
| Hwy 401 to CR 40 WB | E-N/S | 228 | 254 | 1.7 |
| CR 40 to Hwy 401 EB | N/S-E | 377 | 374 | 0.2 |
| CR 40 to Hwy 401 WB | N/S-W | 149 | 139 | 0.8 |

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Table A-12: GEH summary – Highway 401 ramp terminals – weekday AM peak hour (8-9 AM)

| Ramp terminals | Movement | Balanced volume (vph) | Simulated volume (vph) | GEH (Simulated vs. Balanced) |
|---------------------------|----------|-----------------------|------------------------|------------------------------|
| CR 25 North Ramp Terminal | WBL | 84 | 61 | 2.7 |
| | WBR | 15 | 13 | 0.5 |
| | NBT | 117 | 122 | 0.5 |
| | NBR | 198 | 194 | 0.3 |
| | SBL | 67 | 65 | 0.2 |
| | SBT | 169 | 177 | 0.6 |
| CR 25 South Ramp Terminal | EBL | 42 | 41 | 0.2 |
| | EBR | 131 | 145 | 1.2 |
| | NBL | 63 | 59 | 0.5 |
| | NBT | 273 | 274 | 0.1 |
| | SBT | 227 | 204 | 1.6 |
| | SBR | 26 | 35 | 1.6 |
| CR 30 North Ramp Terminal | EBL | 15 | 18 | 0.7 |
| | EBT | 0 | 0 | 0.0 |
| | EBR | 33 | 29 | 0.7 |
| | WBL | 95 | 103 | 0.8 |
| | WBT | 2 | 2 | 0.0 |
| | WBR | 56 | 67 | 1.4 |
| | NBL | 15 | 15 | 0.0 |
| | NBT | 150 | 130 | 1.7 |
| | NBR | 144 | 140 | 0.3 |
| | SBL | 70 | 75 | 0.6 |
| | SBT | 206 | 206 | 0.0 |
| SBR | 0 | 0 | 0.0 | |
| CR 30 South Ramp Terminal | EBL | 51 | 59 | 1.1 |
| | EBT | 53 | 46 | 1.0 |
| | EBR | 83 | 83 | 0.0 |
| | WBL | 47 | 46 | 0.1 |
| | WBT | 60 | 61 | 0.1 |
| | WBR | 78 | 79 | 0.1 |
| | NBL | 84 | 103 | 2.0 |
| | NBT | 180 | 146 | 2.7 |
| | NBR | 57 | 54 | 0.4 |
| | SBL | 77 | 82 | 0.6 |
| | SBT | 192 | 195 | 0.2 |
| SBR | 65 | 61 | 0.5 | |
| CR 40 North Ramp Terminal | WBL | 160 | 191 | 2.3 |
| | WBR | 68 | 64 | 0.5 |
| | NBT | 171 | 178 | 0.5 |
| | NBR | 141 | 125 | 1.4 |
| | SBL | 8 | 16 | 2.3 |
| | SBT | 369 | 360 | 0.5 |
| CR 40 South Ramp Terminal | EBL | 9 | 10 | 0.3 |
| | EBR | 134 | 119 | 1.3 |
| | NBL | 233 | 227 | 0.4 |
| | NBT | 303 | 293 | 0.6 |
| | SBT | 385 | 404 | 1.0 |
| SBR | 144 | 147 | 0.2 | |

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Table A-13: GEH summary – Highway 401 mainline – weekday PM peak hour (4-5 PM)

| Mainline | Direction | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|------------|-----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| W of CR 25 | EB | 1,740 | 1,589 | 9% | 1,705 | 0.8 | 2.9 |
| | WB | 1,826 | 1,817 | 0% | 1,866 | 0.9 | 1.1 |
| W of CR 30 | EB | 1,522 | 1,345 | 12% | 1,497 | 0.6 | 4.0 |
| | WB | 1,703 | 1,520 | 11% | 1,726 | 0.6 | 5.1 |
| W of CR 40 | EB | 1,444 | 1,444 | 0% | 1,506 | 1.6 | 1.6 |
| | WB | 1,796 | 1,796 | 0% | 1,778 | 0.4 | -0.4 |
| E of CR 40 | EB | 1,468 | 1,468 | 0% | 1,578 | 2.8 | 2.8 |
| | WB | 2,135 | 2,135 | 0% | 2,133 | 0.0 | -0.04 |

Table A-14: GEH summary – Highway 401 ramps – weekday PM peak hour (4-5 PM)

| Ramps | Direction | Balanced volume (vph) | Simulated volume (vph) | GEH (Simulated vs. Balanced) |
|---------------------|-----------|-----------------------|------------------------|------------------------------|
| Hwy 401 to CR 25 EB | W-N/S | 366 | 367 | 0.1 |
| Hwy 401 to CR 25 WB | E-N/S | 125 | 117 | 0.7 |
| CR 25 to Hwy 401 EB | N/S-E | 148 | 150 | 0.2 |
| CR 25 to Hwy 401 WB | N/S-W | 248 | 251 | 0.2 |
| Hwy 401 to CR 30 EB | W-N/S | 324 | 277 | 2.7 |
| Hwy 401 to CR 30 WB | E-N/S | 278 | 236 | 2.6 |
| CR 30 to Hwy 401 EB | N/S-E | 246 | 238 | 0.5 |
| CR 30 to Hwy 401 WB | N/S-W | 185 | 181 | 0.3 |
| Hwy 401 to CR 40 EB | W-N/S | 325 | 321 | 0.2 |
| Hwy 401 to CR 40 WB | E-N/S | 534 | 539 | 0.2 |
| CR 40 to Hwy 401 EB | N/S-E | 349 | 337 | 0.6 |
| CR 40 to Hwy 401 WB | N/S-W | 195 | 191 | 0.3 |

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Table A-15: GEH summary – Highway 401 ramp terminals – weekday PM peak hour (4-5 PM)

| Ramp terminals | Movement | Balanced volume (vph) | Simulated volume (vph) | GEH (Simulated vs. Balanced) |
|---------------------------|----------|-----------------------|------------------------|------------------------------|
| CR 25 North Ramp Terminal | WBL | 98 | 92 | 0.6 |
| | WBR | 27 | 26 | 0.2 |
| | NBT | 296 | 294 | 0.1 |
| | NBR | 205 | 210 | 0.3 |
| | SBL | 43 | 41 | 0.3 |
| | SBT | 165 | 175 | 0.8 |
| CR 25 South Ramp Terminal | EBL | 91 | 91 | 0.0 |
| | EBR | 275 | 276 | 0.1 |
| | NBL | 118 | 112 | 0.6 |
| | NBT | 410 | 413 | 0.1 |
| | SBT | 233 | 229 | 0.3 |
| | SBR | 30 | 38 | 1.4 |
| CR 30 North Ramp Terminal | EBL | 5 | 4 | 0.5 |
| | EBT | 2 | 3 | 0.0 |
| | EBR | 27 | 27 | 0.0 |
| | WBL | 171 | 140 | 2.5 |
| | WBT | 20 | 17 | 0.7 |
| | WBR | 87 | 78 | 1.0 |
| | NBL | 35 | 37 | 0.3 |
| | NBT | 246 | 241 | 0.3 |
| | NBR | 126 | 122 | 0.4 |
| | SBL | 57 | 56 | 0.1 |
| | SBT | 218 | 231 | 0.9 |
| SBR | 8 | 8 | 0.0 | |
| CR 30 South Ramp Terminal | EBL | 72 | 58 | 1.7 |
| | EBT | 87 | 73 | 1.6 |
| | EBR | 165 | 148 | 1.4 |
| | WBL | 45 | 46 | 0.1 |
| | WBT | 44 | 49 | 0.7 |
| | WBR | 101 | 100 | 0.1 |
| | NBL | 121 | 115 | 0.6 |
| | NBT | 234 | 243 | 0.6 |
| | NBR | 74 | 80 | 0.7 |
| | SBL | 69 | 68 | 0.1 |
| | SBT | 266 | 254 | 0.7 |
| SBR | 81 | 74 | 0.8 | |
| CR 40 North Ramp Terminal | WBL | 309 | 303 | 0.3 |
| | WBR | 225 | 234 | 0.6 |
| | NBT | 311 | 307 | 0.2 |
| | NBR | 168 | 168 | 0.0 |
| | SBL | 27 | 23 | 0.8 |
| | SBT | 382 | 381 | 0.1 |
| CR 40 South Ramp Terminal | EBL | 35 | 32 | 0.5 |
| | EBR | 290 | 289 | 0.1 |
| | NBL | 197 | 191 | 0.4 |
| | NBT | 444 | 444 | 0.0 |
| | SBT | 539 | 536 | 0.1 |
| | SBR | 152 | 146 | 0.5 |

APPENDIX

Table A-16: GEH summary – Highway 401 mainline – weekend mid-day peak hour (2-3 PM)

| Mainline | Direction | Balanced volume (vph) | Observed volume (vph) | % Difference (Balanced vs. observed) | Simulated volume (vph) | GEH (Simulated vs. Balanced) | GEH (Simulated vs. Observed) |
|------------|-----------|-----------------------|-----------------------|--------------------------------------|------------------------|------------------------------|------------------------------|
| W of CR 25 | EB | 2,470 | 2,389 | 3% | 2,438 | 0.6 | -1.0 |
| | WB | 3,115 | 3,115 | 0% | 3,115 | 0.0 | 0.0 |
| W of CR 30 | EB | 2,309 | 2,309 | 0% | 2,295 | 0.3 | -0.3 |
| | WB | 3,088 | 3,034 | 2% | 3,078 | 0.2 | 0.8 |
| W of CR 40 | EB | 2,308 | 2,272 | 2% | 2,301 | 0.1 | 0.6 |
| | WB | 3,080 | 3,070 | 0% | 3,080 | 0.0 | 0.2 |
| E of CR 40 | EB | 2,306 | 2,306 | 0% | 2,285 | 0.4 | -0.4 |
| | WB | 3,152 | 3,152 | 0% | 3,215 | 1.1 | 1.1 |

Table A-17: GEH summary – Highway 401 ramps – weekend mid-day peak hour (2-3 PM)

| Ramps | Direction | Balanced volume (vph) | Simulated volume (vph) | GEH (Simulated vs. Balanced) |
|---------------------|-----------|-----------------------|------------------------|------------------------------|
| Hwy 401 to CR 25 EB | W-N/S | 272 | 260 | 0.7 |
| Hwy 401 to CR 25 WB | E-N/S | 143 | 142 | 0.1 |
| CR 25 to Hwy 401 EB | N/S-E | 111 | 116 | 0.5 |
| CR 25 to Hwy 401 WB | N/S-W | 170 | 175 | 0.4 |
| Hwy 401 to CR 30 EB | W-N/S | 215 | 191 | 1.7 |
| Hwy 401 to CR 30 WB | E-N/S | 157 | 153 | 0.3 |
| CR 30 to Hwy 401 EB | N/S-E | 214 | 205 | 0.6 |
| CR 30 to Hwy 401 WB | N/S-W | 165 | 168 | 0.2 |
| Hwy 401 to CR 40 EB | W-N/S | 239 | 235 | 0.3 |
| Hwy 401 to CR 40 WB | E-N/S | 293 | 292 | 0.1 |
| CR 40 to Hwy 401 EB | N/S-E | 237 | 238 | 0.1 |
| CR 40 to Hwy 401 WB | N/S-W | 221 | 204 | 1.2 |

APPENDIX

Table A-18: GEH summary – Highway 401 ramp terminals – weekend mid-day peak hour (2-3 PM)

| Ramp terminals | Movement | Balanced volume (vph) | Simulated volume (vph) | GEH (Simulated vs. Balanced) |
|---------------------------|----------|-----------------------|------------------------|------------------------------|
| CR 25 North Ramp Terminal | WBL | 117 | 110 | 0.7 |
| | WBR | 26 | 30 | 0.8 |
| | NBT | 155 | 149 | 0.5 |
| | NBR | 135 | 143 | 0.7 |
| | SBL | 35 | 32 | 0.5 |
| | SBT | 153 | 162 | 0.7 |
| CR 25 South Ramp Terminal | EBL | 36 | 37 | 0.2 |
| | EBR | 236 | 224 | 0.8 |
| | NBL | 93 | 92 | 0.1 |
| | NBT | 254 | 253 | 0.1 |
| | SBT | 252 | 250 | 0.1 |
| | SBR | 18 | 23 | 1.1 |
| CR 30 North Ramp Terminal | EBL | 8 | 7 | 0.4 |
| | EBT | 3 | 2 | 0.0 |
| | EBR | 23 | 25 | 0.4 |
| | WBL | 126 | 124 | 0.2 |
| | WBT | 8 | 8 | 0.0 |
| | WBR | 23 | 21 | 0.4 |
| | NBL | 24 | 22 | 0.4 |
| | NBT | 227 | 222 | 0.3 |
| | NBR | 122 | 130 | 0.7 |
| | SBL | 40 | 36 | 0.6 |
| | SBT | 237 | 252 | 1.0 |
| | SBR | 17 | 15 | 0.0 |
| CR 30 South Ramp Terminal | EBL | 51 | 47 | 0.6 |
| | EBT | 62 | 58 | 0.5 |
| | EBR | 102 | 86 | 1.7 |
| | WBL | 56 | 52 | 0.5 |
| | WBT | 63 | 56 | 0.9 |
| | WBR | 116 | 127 | 1.0 |
| | NBL | 74 | 79 | 0.6 |
| | NBT | 206 | 201 | 0.4 |
| | NBR | 83 | 86 | 0.3 |
| | SBL | 81 | 91 | 1.1 |
| | SBT | 228 | 240 | 0.8 |
| | SBR | 77 | 71 | 0.7 |
| CR 40 North Ramp Terminal | WBL | 192 | 198 | 0.4 |
| | WBR | 101 | 96 | 0.5 |
| | NBT | 218 | 214 | 0.3 |
| | NBR | 200 | 185 | 1.1 |
| | SBL | 21 | 18 | 0.7 |
| | SBT | 285 | 284 | 0.1 |
| CR 40 South Ramp Terminal | EBL | 21 | 20 | 0.2 |
| | EBR | 218 | 214 | 0.3 |
| | NBL | 150 | 152 | 0.2 |
| | NBT | 397 | 380 | 0.9 |
| | SBL | 390 | 396 | 0.3 |
| | SBR | 87 | 85 | 0.2 |