Appendix B Traffic Analysis

Bramalea Road Environmental Assessment Study

Transportation and Traffic Study – Existing Conditions Transportation Assessment Report

September 18, 2020

Prepared for:

City of Brampton

Prepared by:

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Sign-off Sheet

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1.0 INTRODUCTION

The City of Brampton is a rapidly growing municipality that has been transitioning from a suburban to a more urban context. More recently, the City has begun shifting their approach for the identification of required transportation infrastructure improvements to one that is less focused on accommodating automobile movement and more focused on promoting alternative modes of transportation to move the highest amount of people throughout the corridors while maintaining a high degree of safety and comfort. The City of Brampton's 2040 Vision identifies modal prioritization, from highest to lowest, of pedestrians, cyclists, transit, trucks, and automobiles. Bramalea Road between Bovaird Drive and Steeles Avenue is identified in the City of Brampton Transportation Master Plan Update, August 2015, as a potential Bus Rapid Transit (BRT) corridor, and the City is actively seeking capital funding to make it a reality. All of these planned changes along the Bramalea Road corridor will require a less traditional approach to identify the most suitable improvements.

Stantec was retained by the City of Brampton (the City) to conduct a multi-modal level of service (MMLOS) analysis for the Bramalea Road corridor between Queen Street East and the southern City limits as part of the Bramalea Road Class Environmental Assessment (EA). The MMLOS analysis for Bramalea Road was initiated by the City of Brampton to identify the transportation problems in the corridor and evaluate alternatives along the corridor which best serve all modes of transportation, including transit, bicycles, pedestrians, and automobiles.

The Study Area is illustrated in **Figure 1**.

The key components of the Transportation and Traffic Study include:

1. A review and summary of existing intersection and segment conditions for pedestrians, bicycles, transit, trucks, and automobiles;
2. Select Link Analysis, and Screenline Capacity Analysis using outputs from the GTA v4 EMME model;
3. Assessment of existing and forecast conditions using the methodologies consistent with those outlined in the City of Ottawa Multi-Modal Level of Service (MMLOS) Guidelines; and
4. Evaluation of alternatives and identification of the preferred alternative based on the set evaluation criteria.

This report presents the assessment of existing 2018 conditions and future baseline conditions for the 2041 horizon year.

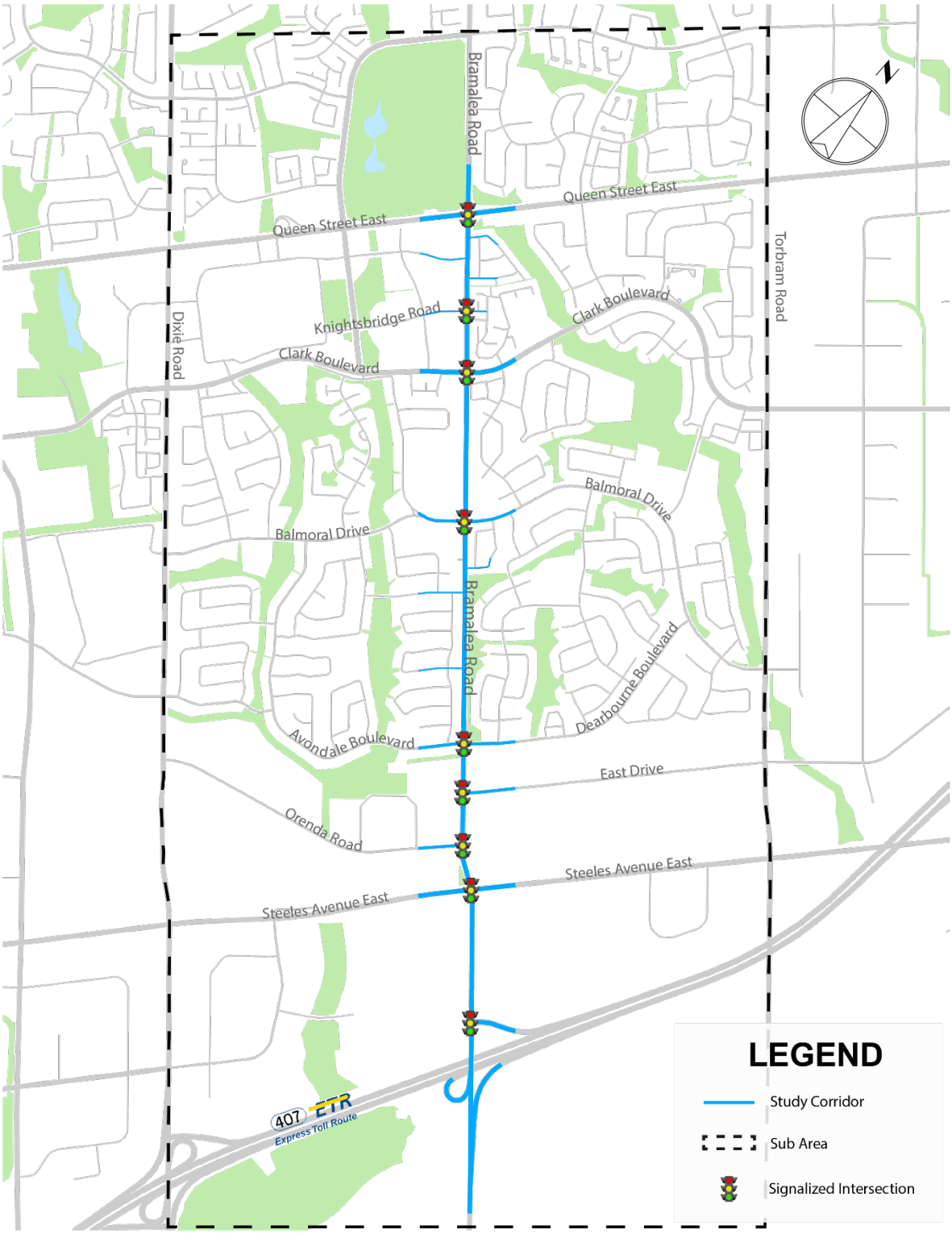

Figure 1 – Study Area

2.0 BACKGROUND

2.1 POPULATION AND EMPLOYMENT

With a population of 617,944 as of 2016, Brampton is the third-largest city in the Greater Toronto Area, and the ninth-largest city in Canada. Between 2011 and 2016, Brampton's population has grown by 13%. The population is expected to grow by 275,700 between 2016 and 2041. Between 2011 and 2016, Brampton's employment has grown by 30,900 jobs; from 172,100 to 203,000. The city has forecasted an additional 121,900 jobs by 2041.

The 2016 population density and employment density per hectare in the City of Brampton are illustrated in **Figure 2** and **Figure 3**, respectively. The 2016 population and employment statistics per hectare were extracted from the Transportation Tomorrow Survey (TTS) per TTS zone within the City of Brampton. As shown in the figures, the population density around the corridor is relatively low while the northern portion of the City of Brampton has a higher density of population. The southern portion of the corridor around Orenda Road has an employment density of 25 to 50 people per hectare, with the highest nearby employment density being located on the south-west quadrant of the intersection of Bramalea Road with Queen Street East, which has an employment density of 75 to 100 people per hectare. The high density in employment on this zone is due to the Bramalea City Centre.

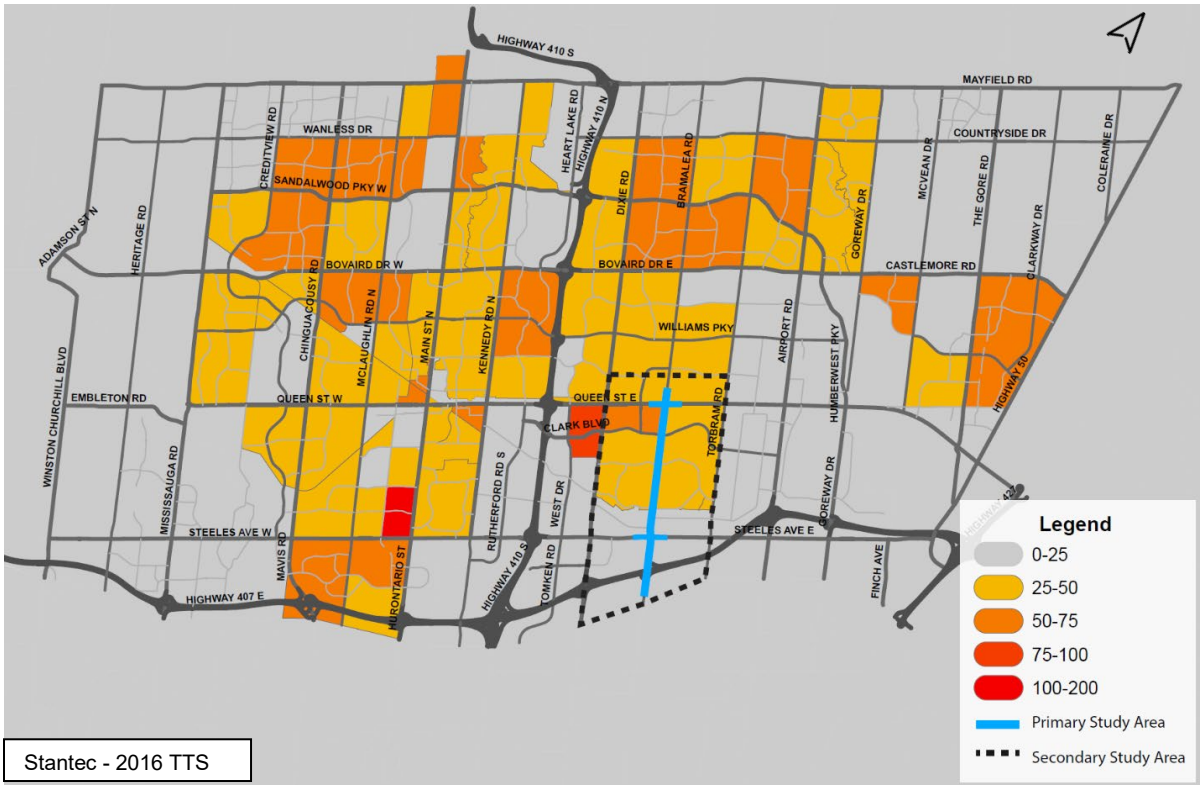

Figure 2 – City of Brampton 2016 Population Density Per Hectare

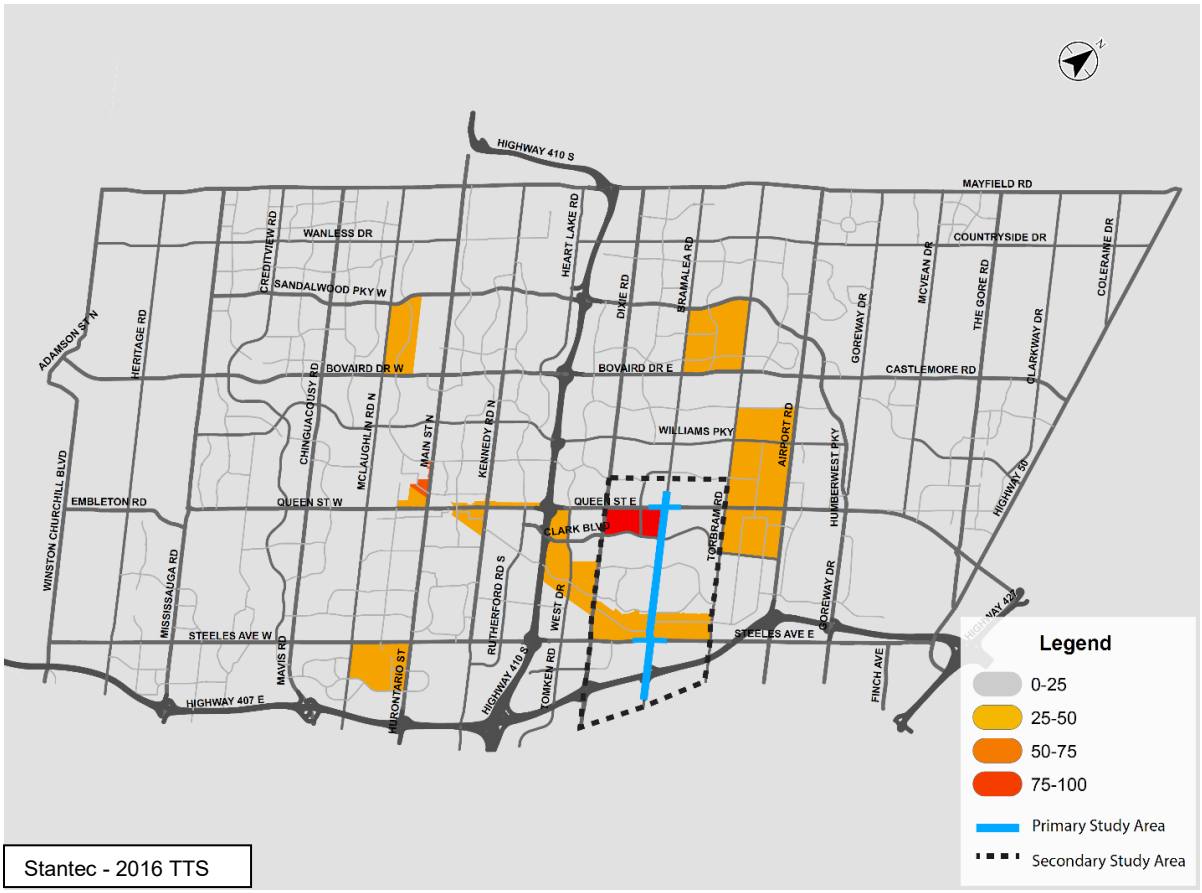

Figure 3 – City of Brampton 2016 Employment Density Per Hectare

2.2 LAND USE

The Bramalea Road corridor is largely zoned as residential land north of Avondale Boulevard-Dearbourne Boulevard, and industrial land towards the south, as illustrated in **Figure 4**. Institutional areas are currently located within the Study corridor, including the Bramalea Secondary School at Balmoral Drive / Bramalea Road, St. John Fisher Catholic Church at Balmoral Drive / Avondale Boulevard, and Redeemer Lutheran Church Brampton at Bramalea Road / Clark Boulevard. The largest commercial area along the corridor is located on the south-west quadrant of the intersection of Queen Street East / Bramalea Road and includes a grocery store, fast-food restaurant, and gas stations.

The land uses along the Bramalea Road corridor are mostly segregated into large areas of similarly zoned lands which may result in residents having to complete long trips for their day-to-day activities. Intensification of the density and the introduction of a greater mix of land uses along the Bramalea Road corridor would improve the potential to reduce the average length of trips and promote corridor characteristics that are more conducive to the use of transit and active transportation modes. It is noted that the “Bramalea South Gateway” area around the intersection of Bramalea Road / Steeles Avenue East is envisioned in the City’s 2006 Official Plan to transform into an office centre over time to attract higher order office and employment uses.

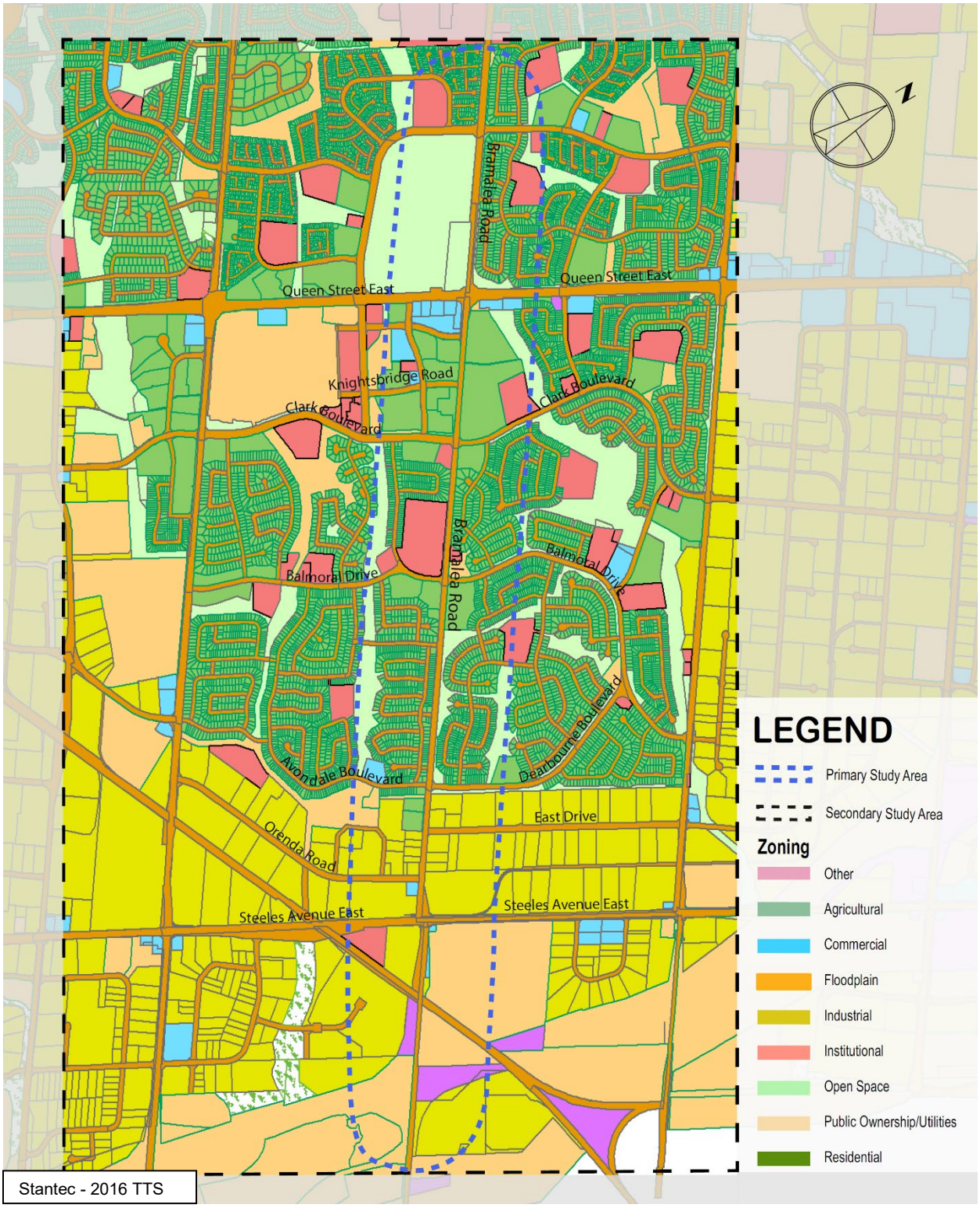

Figure 4 – Existing Land Use

2.3 STRATEGIC TRANSPORTATION ANALYSIS METHODOLOGY

A strategic transportation analysis is conducted using outputs from the City of Brampton's GTAv4 EMME model. Traversal matrices were extracted to identify trips within the Study corridor zones while directional paths of volumes were extracted for the Select Link Analysis (SLA) to determine the broader area travel trends. Model outputs for link volumes, link speeds, link capacities, and number of lanes were used in a sub-area screenline capacity analysis to identify the degree of capacity utilization throughout the sub area.

2.3.1 Traversal Matrix Calibration

Traversal matrices extracted from the City's EMME model for the existing AM and PM peak hours are calibrated to match the existing volumes counted along the corridor. The process for the matrix calibration is as follows:

- Traversal origin-destination matrices were extracted by the City from their EMME models to determine vehicular paths within the Study corridor during the AM and PM peak hours.
- The Traffic Analysis Zones (TAZs) used at the macroscopic level in the EMME models were refined into Internal Zones at the Micro Level (IZML) to model the travel demand at the microscopic level.
- Manual adjustments were made to the traversal matrices estimated with the IZML to ensure that logical origin and destination routes are available during the Furness adjustment.
- The manually adjusted traversal matrices were adjusted according to the counted traffic volumes using the Furness method for matrix adjustment to match the matrix volumes with the counted volumes entering and exiting the zones.

2.3.2 Select Link Analysis

A Select Link Analysis is conducted on Bramalea Road at two locations: just south of Queen Street, and just north of Steeles Avenue. The SLA provides a numerical and graphical representation of the volumes and paths that vehicles take once passing the analysis point and allows for the assessment of the function that the corridor serves. Separate SLA for the northbound and southbound directions are extracted from the City's EMME models.

2.3.3 Sub Area Screenline Capacity Analysis

A screenline capacity analysis is conducted at locations in the sub-area bound by Queen Street East to the north, Torbram Road to the east, Highway 407 ETR to the south, and Dixie Road to the west to assess whether links are currently operating within their available capacity. The base volumes are extracted from the City's GTAv4 EMME model and calibrated using the available turning movement counts. The calibration of the volumes uses the same thresholds as outlined in **Section 2.3.1** for the calibration of the VISSIM model volumes. The modelled EMME volumes are only adjusted when the total screenline GEH exceeds 10; priority for adjustment is placed on the Bramalea Road approaches and then the approaches with the highest GEH. The volumes are adjusted using the absolute difference between the modelled volume and the volume required to achieve a GEH below 10.

2.4 MODELLING METHODOLOGY

Models have been developed for the Study corridor using Synchro 10.2 and VISSIM 11.0 software packages to feed in to the MMLOS analysis. The Synchro software is used to analyze signalized intersection operations for automobiles via the HCM 6th Edition methodology for Signalized Intersections. The VISSIM software is used to simulate, and generate performance metric outputs for, vehicular operating speeds, average transit travel speed along segments, and the average transit delay at intersections. This performance output was then used as an input for the MMLOS analysis.

The models developed were calibrated and validated to the available existing volume data, collected travel time data, and through on-site observations. The VISSIM Model Development and Calibration Report which provides detailed information on the calibration and validation process is attached for reference in **Appendix A.1.**

Traversal matrices exported from the GTAv4 EMME model were provided by the City to determine the vehicular access and egress volumes of the Study corridor network for the AM and PM peak hours. The Traffic Analysis Zones (TAZs) used at the macro level in the EMME model were split into northbound and southbound Internal Zones at the Micro Level (IZML) to model the travel demand at the micro level for the corridor; the eastbound through and westbound through volumes along the network were excluded from the matrix adjustments so that these volumes remain the same as the balanced 2018 volumes. The traversal matrices estimated with the IZML were then adjusted to reflect the zoning structure of the VISSIM model. Manual adjustments were made to ensure that all likely paths between origin and destination pairs were considered in the matrix balancing. Once the northbound and southbound balanced VISSIM matrices were prepared, the matrices were combined and the eastbound through and westbound through volumes were incorporated, reflecting the total vehicular travel demand dynamics during the existing AM and PM peak hours. Once the total vehicular demand matrices were prepared, truck matrices were prepared for the AM and PM using the existing truck proportions along the network. The microscopic travel demand car and truck matrices were then fed into the existing AM and PM VISSIM microsimulation models, after which the models were calibrated and validated based on observations of existing traffic volumes and operations.

A Dynamic Assignment method was used to assign the vehicles based on origin-destination paths. Instead of applying static routes with volumes pre-selected at the intersection level, dynamic assignment determines the paths that vehicles will take based on the observed cost (time) to the drivers and simulates driving behaviours that are representative of experienced drivers travelling through the network by avoiding problematic areas to reduce delays. This approach results in a more realistic estimate of network operations, as drivers will divert to paths that represent the minimal time-based operation available at the time. The GEH statistic (Geoffrey E. Havers formula that has become industry standard) was used to confirm that the base year model outputs were within acceptable ranges at both the turning movement, and link level. GEH values provide an indication of the goodness of fit of modelled flows to observed flows.

It should be noted that all transit operations were coded and simulated within the models developed in VISSIM, hence the interaction between the different transportation modes is considered in the analysis.

The following intersections comprise the Study corridor and have been incorporated in the Synchro and VISSIM models:

1. Queen Street East / Bramalea Road (Signalized)
2. Gates of Bramalea (N) / Bramalea Road (Unsignalized)
3. Kensington Road / Bramalea Road (Unsignalized)
4. Gates of Bramalea (S) / Bramalea Road (Unsignalized)
5. Fleetwood Crescent-Knightsbridge Road / Bramalea Road (Signalized;
6. Clark Boulevard / Bramalea Road (Signalized)
7. Balmoral Drive / Bramalea Road (Signalized)
8. Darras Court / Bramalea Road (Unsignalized)
9. Algonquin Boulevard / Bramalea Road (Unsignalized)
10. Alexandria Gate / Bramalea Road (Unsignalized)
11. Dearbourne Boulevard / Bramalea Road (Signalized)
12. East Drive / Bramalea Road (Signalized)
13. Orenda Road / Bramalea Road (Signalized)
14. Steeles Avenue East / Bramalea Road (Signalized)
15. GO Access / Bramalea Road (Unsignalized)
16. Highway 407 / Bramalea Road North Ramp Terminal (Signalized)
17. Highway 407 / Bramalea Road South Ramp Terminal (Unsignalized)

2.4.1 VISSIM Model Calibration Results

This section summarizes the model calibration results for the VISSIM modelling component of the Study. Additional information on calibration efforts can be found in **Appendix A.1**.

The GEH statistic was used to confirm the base year model output at both the turning movement, and link level. The formula for calculating the GEH is as follows:

GEH = $\sqrt{\frac{2(M-C)^2}{M+C}}$, where M = modelled hourly volume, C = observed hourly counts

GEH values provide an indication of the goodness of fit of modelled flows to observed flows as outlined below:

GEH < 5	Flows can be considered a good fit
5 < GEH < 10	Flows may require further investigation
GEH > 10	Flows cannot be considered to be a good fit

The GEH is used extensively in transportation modelling to measure the compatibility of traffic models. The non-linear nature of the GEH allows a single acceptance threshold to be applied in a wide range of traffic volumes without adjustments and hence can be utilized in networks of different road types.

The modelled calibration criteria are summarized in **Table 1**. As shown, the model outputs provide a very good fit with the observed volumes on movements and links. It is observed that all of the modelled volumes result in GEHs below 5.

Table 1 - Model Calibration Criteria for Traffic Volumes

Criteria	AM Peak Hour		PM Peak Hour	
	Target	Model	Target	Model
Turns with GEH ≤5	>75%	100%	>75%	100%
Turns with GEH ≤10	>85%	100%	>85%	100%
Turns with GEH >10	<15%	0%	<15%	0%
GEH Total	<4	0.34	<4	0.48
Links with GEH ≤5	>75%	100%	>75%	100%
Links with GEH ≤10	>85%	100%	>85%	100%
Links with GEH >10	<15%	0%	<15%	0%
GEH Total	<4	1.00	<4	1.28
Difference in Sum of All Link Flows	<4%	0.8%	<4%	1.2%
Links with Modelled Flows within 100 vph of Observed	>75%	100%	>75%	100%
Links with Modelled Flows within 15% of Observed	>75%	100%	>75%	100%

2.5 MMLOS METHODOLOGY

A Multi-Modal Level of Service (MMLOS) assessment is a quantitative approach that is used to determine the convenience and comfort experienced by all users (i.e. motorists, cyclists, pedestrians, and transit users) along roadway corridors and at signalized intersections. Using the City of Ottawa's Multi-Modal Level of Service Guidelines, an assessment of Pedestrian Level of Service (PLOS) will be conducted which looks at criteria such as sidewalk widths, boulevard widths, operating speed of the road, corner radii at intersections, and length of pedestrian crosswalks. An assessment of Bicycle Level of Service (BLOS) will examine criteria such as types of bicycle facilities, number of vehicle lanes, and operating speeds of the road. An assessment of Transit Level of Service (TLOS) will look at types of transit facilities, transit headways, frequency of driveways along the road, and vehicle delay at intersections. The Truck Level of Service (TkLOS) looks at the number of lanes in each direction, curb lane width, effective radius, and the number of receiving lanes on the departing leg. The Automobile Level of Service (ALOS) will evaluate the speeds along segments and utilize the methodologies in the HCM 6th Edition for vehicular operations at signalized intersections. The ALOS analysis methodology utilized in this Study is an addition to the Ottawa's MMLOS Guideline as it does not provide an analysis methodology for the analysis of road sections.

The findings of the MMLOS analysis will be used to determine the improvements needed along the corridor based on the increasing need to move more people, as opposed to purely vehicles, to accommodate growing the population and sustainability goals. Multi-modal level of service (MMLOS) is an important tool used to evaluate the tradeoffs among users of different modes as the corridor design elements and the function of the public spaces are adjusted. The MMLOS analysis evaluates the existing conditions for transit, bicycles, pedestrians, trucks, and vehicles at both an intersection level and a link/segment level. This approach will allow the impacts of the future roadway configuration alternatives to be assessed and will properly define the needs at the intersection and segment levels, as opposed to solely considering intersection operations/delay for automobiles.

This section provides a description of each mode; the detailed instruction from City of Ottawa Multi-Modal Level of Service (MMLOS) Guidelines and a summary of the inputs incorporated into the evaluation can be found in **Appendix A.2**.

2.5.1 Transit Level of Service (TLOS)

The Transit Level of Service (TLOS) aims to quantify the relative attractiveness of the service along the analyzed segment or signalized intersection based on the transit travel time, transit priority, segment conditions, and facility type. In addition to the TLOS methodology outlined in the City of Ottawa MMLOS Guidelines, the TLOS analysis also considers the headways of buses along segments using the scheduled arrivals during the peak hours and the thresholds outlined in Exhibit 5-5 of the Transit Capacity and Quality of Service Manual (TCQSM). The lower of the levels of service for the City of Ottawa methodology and the TCQSM methodology are the final TLOS for the segment. The TCQSM methodology is applied only to the segment TLOS and not for signalized intersections.

2.5.2 Bicycle Level of Service (BLOS)

The Bicycle Level of Service is used to evaluate the degree of comfort experienced by a cyclist using a facility. The evaluation of BLOS is based on the degree of separation between cyclists and vehicles along segments and at signalized intersections. Based on instructions received from the City of Brampton, the average results for all approaches of an intersection were used to calculate the BLOS based on through movement and left turning cyclist experiences. The worst of these two BLOS values were used as the intersection PLOS.

2.5.3 Pedestrian Level of Service (PLOS)

The Pedestrian Level of Service is used to evaluate the pedestrian comfort, safety, and convenience on the existing or proposed facility. The segment PLOS focuses on the available mid-block facility and the effects from the adjacent roadway, such as operating speeds, vehicular volumes, and on-street parking. The signalized intersection PLOS incorporates the delay imposed on pedestrians by signals, and exposure to traffic based on the turn phases and the intersection geometry. It has to be noted that based on instructions received from the City of Brampton, the average results (PETSI score and pedestrian delay) for all approaches of an intersection were used to calculate the PLOS based on exposure to traffic and pedestrian delay. The worst of these two PLOS values were used as the intersection PLOS.

Application of Methodology Clarifications:

The following points expand on the methodology applied to individual inputs for the PLOS to eliminate subjectivity in the MMLOS evaluation process. The clarifications in methodology are consistent with the *Addendum to the City's Multi-Modal Level of Service Guidelines* released by the City of Ottawa.

- The "Total Travel Lanes Crossed" input assumes a typical lane width of 3.5 metres. In locations which have greater crossing widths (wide lanes, bicycle lanes, large corner radii), the number of lanes crossed is increased to better represent the actual width crossed by pedestrians.
- The "Median" input is marked as not present when the median is narrower than 2.4 metres or the median does not provide a refuge area for pedestrians by extending into the crosswalk.
- The "Corner Radius" input is intended to coincide with the direction of right turning traffic that conflicts with the crosswalk on a green phase. This includes the traffic travelling parallel with the crosswalk, but also must consider

perpendicular traffic when a channelized right turn is provided on the approach. The larger of the two corner radii in this situation are applied, as a higher corner radius results in a lower PLOS.

2.5.4 Truck Level of Service (TkLOS)

The Truck Level of Service complements the Vehicular Level of Service by evaluating the ability of trucks to operate with ease along segments and signalized intersections. The TLOS considers geometric variables including street width, curb lane width, effective radius, and the number of receiving lanes on a departing leg. The average of intersection approaches TkLOS was used as the TkLOS of the intersection.

It has to be noted that the heavy vehicles are restricted on Bramalea Road north of East Drive and only limited number of medium trucks (emergency or service trucks, etc.) will use this part of the corridor and experience the analyzed TkLOS at segments and intersections north of East Drive.

2.5.5 Automobile Level of Service (ALOS)

The Automobile Level of Service for signalized intersections is evaluated with Synchro 10.2 using the HCM 6th Edition methodology for Signalized Intersections and the City of Ottawa MMLOS thresholds for levels of service. The intersection ALOS takes into consideration the vehicular flow rate, heavy vehicle percentages, peak hour factor, lane configuration, link speed, conflicting pedestrians, and conflicting bicycles. Through discussion with the City, it was agreed that in addition to the signalized intersection analysis of ALOS, the Study will also take into consideration the segment ALOS, as the current City of Ottawa MMLOS methodology does not analyze these operations. The ALOS will consider the modelled travel speed along the Bramalea Road segments using the HCM 6th Edition methodology for Urban Street Segments. It is noted that the intersection and segment ALOS are analyzed separately to identify opportunities for each type of facility.

2.5.6 MMLOS Targets

MMLOS targets are developed to identify the desired level of service for each mode along the corridor, to help with the identification of potential improvements based on the existing and future baseline conditions, and to recognize necessary trade-offs between modes. The MMLOS targets should reflect the goals and policies of the City, the function of the corridor, and account for the expected development of the corridor to the ultimate horizon year. **Table 2** summarizes the current designations associated with the Bramalea Road corridor within the Study limits, the LOS targets per mode, and MMLOS targets along the corridor. The overall corridor MMLOS targets reflect that of the "Rapid Transit" designation, due to the expectation that Bramalea Road will become a Zum bus corridor in the future.

Table 2 - Bramalea Road Designations

Designation	PLOS	BLOS	TLOS	TkLOS	ALOS
Arterial Road	C	B	C	D	D
Rapid Transit	A	A	B	D	E
School	A	A	B	D	E
Corridor	**A**	**A**	**B**	**D**	**E**

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3.0 EXISTING CONDITIONS

3.1 EXISTING TRANSIT SERVICES

The Study corridor is well served by public transit, with bus options available via GO Transit, Brampton Transit, and Züm. Bramalea GO Station, located at the intersection of Bramalea Road / Steeles Avenue East, is a mobility hub which services bus and GO rail connections. Bus stops are provided along the Bramalea Road corridor and intersection roads, with east-west transit queue jump lanes provided on the far side of the intersection of Bramalea Road / Queen Street East. A transit queue jump lane is also provided on the west side of the intersection of Bramalea Road / Steeles Avenue East. The Bramalea GO Station and the nearby area are the subject of an on-going Study to assess the opportunities and constraints for future development and will likely see significant intensification. Transit routes servicing the stops within the Study corridor are summarized in **Table 3** with the routes illustrated in **Figure 5**.

This section reviews the existing conditions for transit vehicles within the Study corridor including bus capacity and modelled progression of transit vehicles.

Table 3 - Existing Study Corridor Transit Routes

Transit Agency	Route Number	Route Name
Brampton Transit	1	Queen
	11	Steeles
	12	Grenoble
	13	Avondale
	15	Bramalea
	16	Southgate
	20	East Industrial
	40	Central Industrial Loop
	92	Bramalea GO Shuttle
	115	Pearson Airport Express
GO Transit	25	Waterloo Hwy 401 Service
	31	Georgetown Train-Bus Service
	32	Brampton Hwy 407 Service
	36	Brampton via Hwy 427 Express Service
	46	Oakville Hwy 407 Service
	47	Hamilton Hwy 407 Service
	48	Guelph Hwy 407 Service
Züm	501	Züm Queen
	511	Züm Steeles

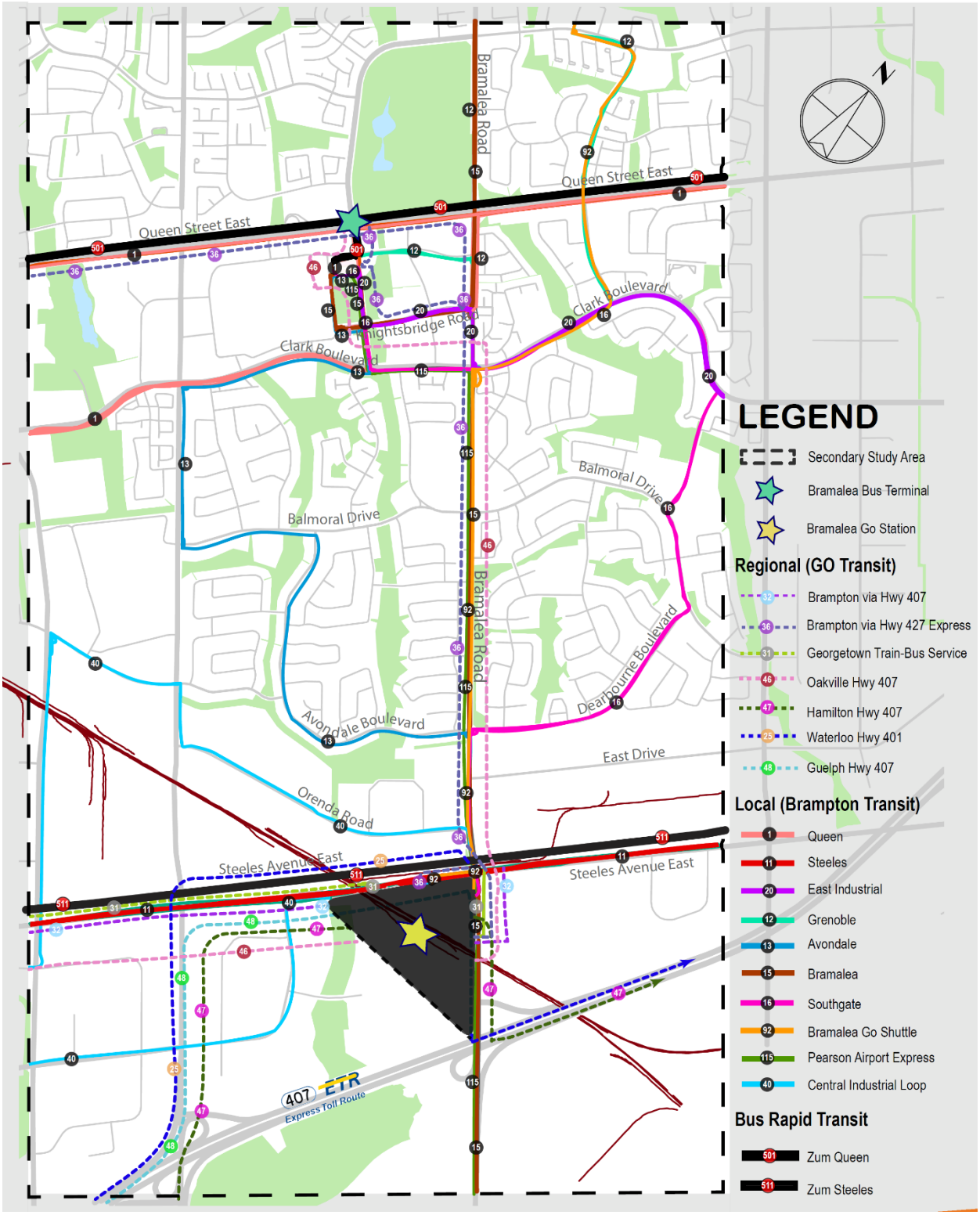

Figure 5 – Existing Transit Routes

3.1.1 Bus Route Capacity

Bus capacity information was provided by Brampton Transit staff as follows:

- Non- Züm Buses: Standard loads are 58 for 40' buses (including 115 Airport Express) during weekday peak periods, and 39 during weekday off-peaks and weekends.
- Züm Buses: Standard loads are 52 for 40' buses and 74 for 60' buses during weekday peak periods and 39 for 40' buses and 56 for 60' buses during off-peaks and weekends.

The estimated daily and peak hour capacity of the Brampton Transit routes is summarized in **Table 4**. The peak hour transit passenger capacities are calculated based on assuming 60' buses will be used in Züm routes during the peak hour. Under the existing conditions, the buses within the Study corridor operate within the available capacity. **Appendix A.3** includes the typical weekday total boarding and alighting information for bus routes traveling along Bramalea corridor by route at stops located along Bramalea corridor within the Study Area.

Table 4 - Bus Route Capacity and Frequency

Route		Direction	Daily Buses	Capacity (Passengers)	Peak Frequency	Peak Hour Capacity (Passenger)
Number	Name					
1 / 1A	Queen	Eastbound	90	3,800	~ 10 min	406
		Westbound	93	3,900	~ 10 min	406
11 / 11A	Steeles	Eastbound	92	3,900	10 min	406
		Westbound	96	4,000	10 min	406
12	Grenoble	Northbound	34	1,400	30 min	174
		Southbound	34	1,400	30 min	174
13	Avondale	Northbound	35	1,500	30 min	174
		Southbound	33	1,400	30 min	174
15 / 15A	Bramalea	Northbound	80	3,400	~ 10 min	406
		Southbound	77	3,200	~ 10 min	406
16	SouthGate	Northbound	33	1,400	30 min	174
		Southbound	33	1,400	30 min	174
20 / 20A	East Industrial	Eastbound	29	1,200	~ 25 min	174
		Westbound	30	1,300	~ 25 min	174
40	Central Industrial Loop	Cntr-Clockwise	33	1,400	30 min	174
92	Bramalea GO Shuttle	Northbound	4	200	~ 30 min	174
		Southbound	5	200	~ 20 min	232
115	Pearson Airport Express	Northbound	46	1,900	~ 20 min	232
		Southbound	46	1,900	~ 25 min	174
501 / 501A / 501C	Züm Queen	Eastbound	150	8,900	~ 5 min	962
		Westbound	160	9,400	~ 7.5 min	666

Route		Direction	Daily Buses	Capacity (Passengers)	Peak Frequency	Peak Hour Capacity (Passenger)
Number	Name					
511 / 511A / 511C	Züm Steeles	Eastbound	127	7,500	~ 7.5 min	666
		Westbound	123	7,300	~ 7.5 min	666

3.2 EXISTING ACTIVE TRANSPORTATION FACILITIES

Overall, the Study corridor is able to accommodate pedestrian movements through sidewalks and multi-use paths, however, some segments of the corridor do not currently have pedestrian facilities available. Multi-use paths are provided along the north-west and south-east quadrants of Bramalea Road / Queen Street East, and along the east side of Bramalea Road between Darras Court and Avondale Boulevard-Dearbourne Boulevard. The following areas do not have pedestrian facilities available:

1. Gates of Bramalea, north and south sides;
2. Darras Court, north side;
3. Algonquin Boulevard, south side;
4. Alexandria Gate, north side;
5. Bramalea Road, east side between Steeles Avenue East and Bramalea GO Access; and
6. Bramalea Road, east and west sides between Bramalea GO Access and south City limits.

It is noted that although pedestrian facilities are provided adjacent to Bramalea Road, connections are occasionally not provided to bus stops and shelters, such as opposite to Algonquin Boulevard and Alexandria Gate.

Currently, there are no designated bicycle facilities provided within the Study corridor. Cyclists travelling through the Study Area are therefore required to travel within the vehicle travelled portion of the roadway, or along the multi-use paths. The existing active transportation facilities are illustrated in **Figure 6**.

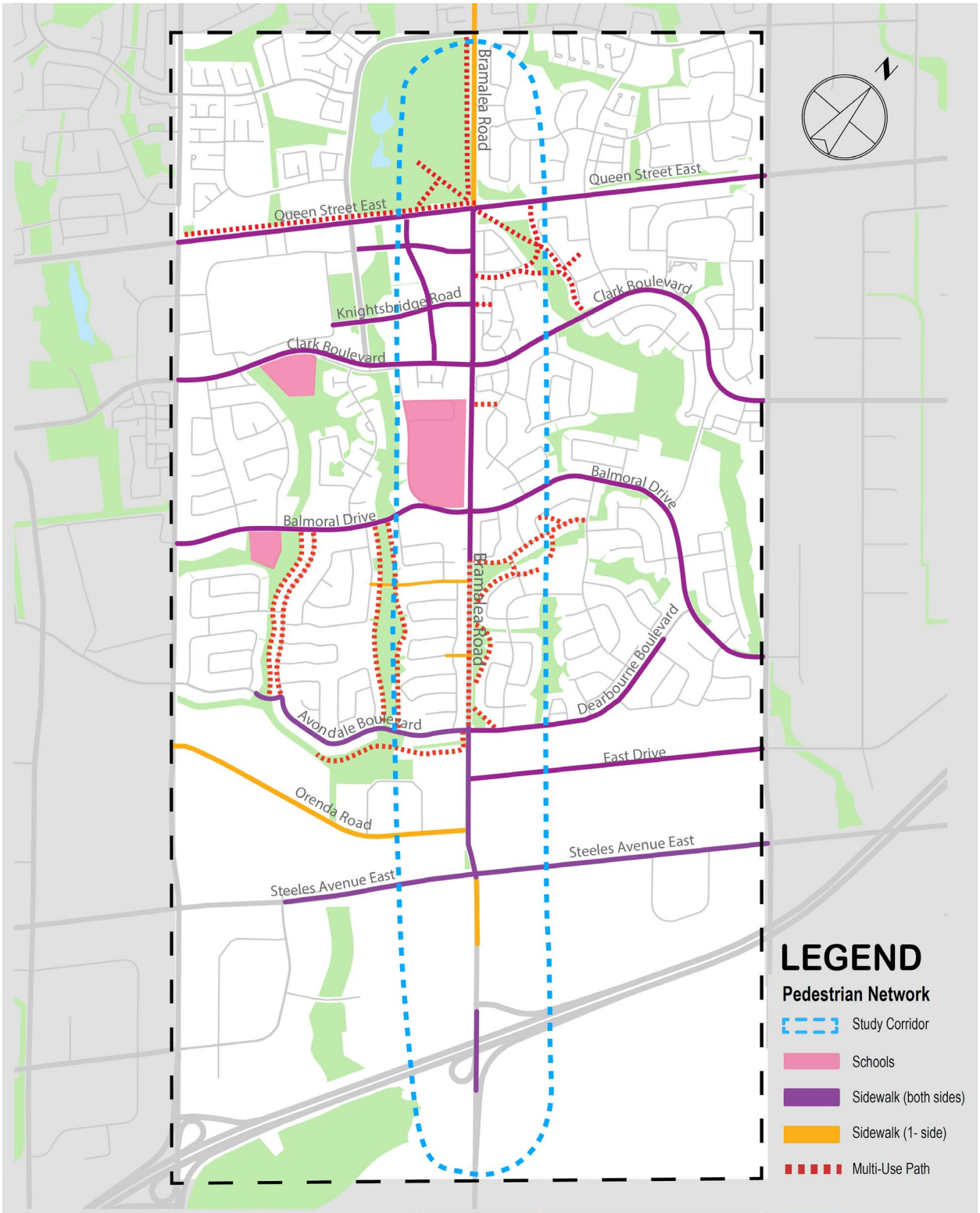

Figure 6 - Existing Active Transportation Facilities

3.3 EXISTING VEHICLE NETWORK

The majority of the roadways in the Study corridor operate under the jurisdiction of the City of Brampton, with the Highway 407 interchange operating under the jurisdiction of Highway 407 ETR. The site conditions of the roads and intersections within the Study Area are described below with reference made to the City of Brampton Official Plan Schedule B. The road classifications are illustrated in **Figure 7**.

Bramalea Road: A four-lane minor arterial roadway which runs north-south and has a posted speed limit of 60 km/h. As per the City of Brampton Traffic Bylaws, trucks are restricted from driving along Bramalea Road from East Drive to beyond Queen Street East. Bramalea Road is identified within the City of Brampton Transportation Master Plan as a candidate for widening from four to six lanes by 2021 for the segments from Queen Street East to the south City limits, and Bovaird Drive East (north of the Study Area) to Queen Street East. In addition, a Züm corridor is proposed, between Bovaird Drive and Steeles Avenue by 2031. Queue jump lanes may be implemented along Bramalea Road at the far-side of the intersections with Queen Street and Steeles Avenue.

Queen Street East: A six-lane major arterial roadway under the jurisdiction of Peel Region which runs east-west. Queen Street East has a posted speed limit of 60 km/h. Bus queue jump lanes are provided far-side at the signalized intersection of Queen Street East with Bramalea Road.

Fleetwood Crescent-Knightsbridge Road: A local roadway with a four-lane cross-section west of Bramalea Road and an unmarked two-lane cross-section east of Bramalea Road. There is no posted speed limit along Fleetwood Crescent and Knightsbridge Road, therefore it is assumed that the statutory speed limit of 50 km/h applies. Fleetwood Crescent-Knightsbridge Road forms a signalized intersection with Bramalea Road.

Clark Boulevard: A four-lane collector roadway which runs east-west and has a posted speed limit of 50 km/h. Clark Boulevard forms a signalized intersection with Bramalea Road.

Balmoral Drive: A four-lane collector roadway which runs east-west and has a posted speed limit of 50 km/h. Balmoral Drive tapers down to a two-lane cross-section approximately 100 metres west of Bramalea Road. Balmoral Drive forms a signalized intersection with Bramalea Road.

Avondale Boulevard-Dearbourne Boulevard: A collector roadway with a four-lane cross-section east of Bramalea Road and a two-lane cross-section west of Bramalea Road. The posted speed limit along Avondale Boulevard and Dearbourne Boulevard is 50 km/h. Avondale Boulevard-Dearbourne Boulevard forms a signalized intersection with Bramalea Road.

East Drive: A two-lane collector roadway which runs east-west and has a posted speed limit of 60 km/h. East Drive forms a signalized intersection with Bramalea Road.

Orenda Road: A two-lane collector roadway which runs east-west and has a posted speed limit of 60 km/h. Orenda Road forms a signalized intersection with Bramalea Road.

Steeles Avenue East: A six-lane major arterial roadway under the jurisdiction of Peel Region which runs east-west and has a posted speed limit of 70 km/h. Steeles Avenue East forms a signalized intersection with Bramalea Road. Steeles Avenue is identified within the City of Brampton TMP as having improved transit operations by 2041, possibly in the form of rail or bus services operating in their own exclusive lanes.

Highway 407: An eight-lane provincial highway which runs east-west and has a posted speed limit of 60 km/h on the westbound off-ramp to Bramalea Road. The Highway 407 Westbound Off-ramp forms a signalized intersection with Bramalea Road. The interchange is a "partial" in that is has east-oriented on and off-ramps only, with no access to / from the west.

3.3.1 Traffic Volumes

Turning movement count (TMC) data for the intersections within the Study Area were provided by City of Brampton, Highway 407 ETR, and collected by Stantec. All intersections along the Study Area corridor apart from the intersections of Bramalea Road with Queen Street East, Orenda Road, Steeles Avenue East, Bramalea GO Access, and Highway 407 South Ramps were counted by Stantec. Traffic data was collected by Stantec on September 18, 2018 with the exception of the intersection of Bramalea Road / Gates of Bramalea (S) which was collected on October 17, 2018. Data was provided by the City of Brampton for the intersections of Bramalea Road / Queen Street East (collected March 20, 2018), Bramalea Road / Orenda Road (collected November 22, 2017), and Bramalea Road / Steeles Avenue East (collected March 8, 2018). Data for the Highway 407 Ramps (collected October 18, 2017) was provided by Highway 407 ETR. Traffic count data for the intersections of Bramalea Road / Bramalea GO Access (collected June 24, 2015) and Steeles Avenue East / GO Access (collected October 29, 2014) were extracted from the Bramalea GO Station: Station Improvements and Parking Expansion report prepared by BA Group in October 2016.

Hourly volumes at all intersections within the Study Area were calculated for 15-minute increments and summed to determine the representative AM and PM peak hour of the Study Area network. Representative peak hours of 7:45 AM to 8:45 AM, and 5:00 PM to 6:00 PM were used in the analysis as they represent the highest total volumes present on the network during the AM and PM peak periods, respectively. The hourly counts were balanced to represent 2018 conditions. Signal timing plans were provided by the City of Brampton and incorporated in to the VISSIM micro-simulation models. The unbalanced traffic volumes for the AM and PM peak hours are shown in **Figure 8** and **Figure 9**, respectively. **Figure 10** and **Figure 11** show the balanced traffic volumes for the AM and PM peak hours. The balanced existing conditions traffic volumes were used to calculate Bramalea Road sections' volume capacity ratios withing the Study Area. **Table 5** illustrates Bramalea Road sections volume capacity ratio analysis results. Turning movement counts and signal timing plans are attached in **AppendixA.3** for reference. A summary of multi-modal volumes is attached in **Appendix A.4**.

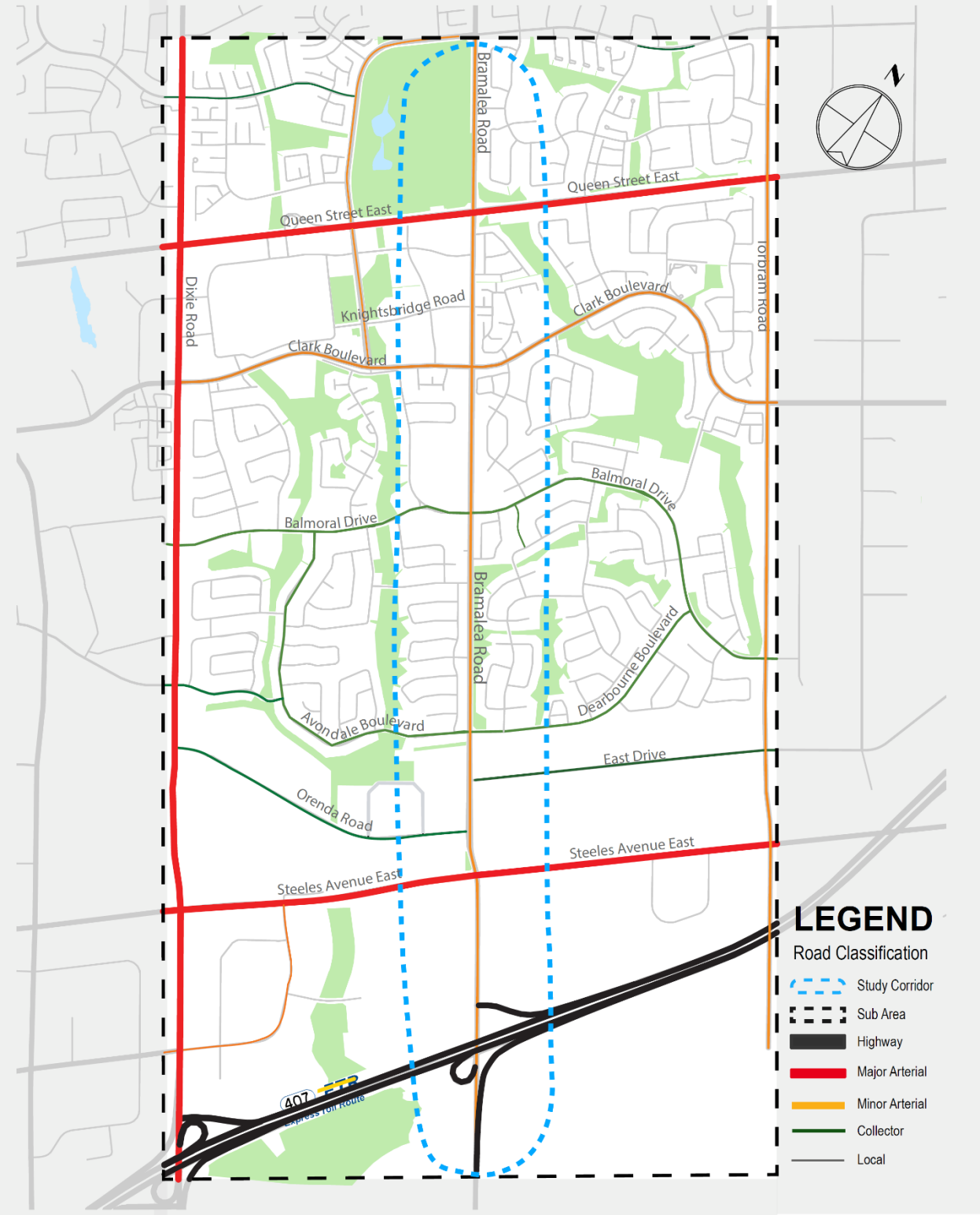

Figure 7 - Study Area Road Classifications

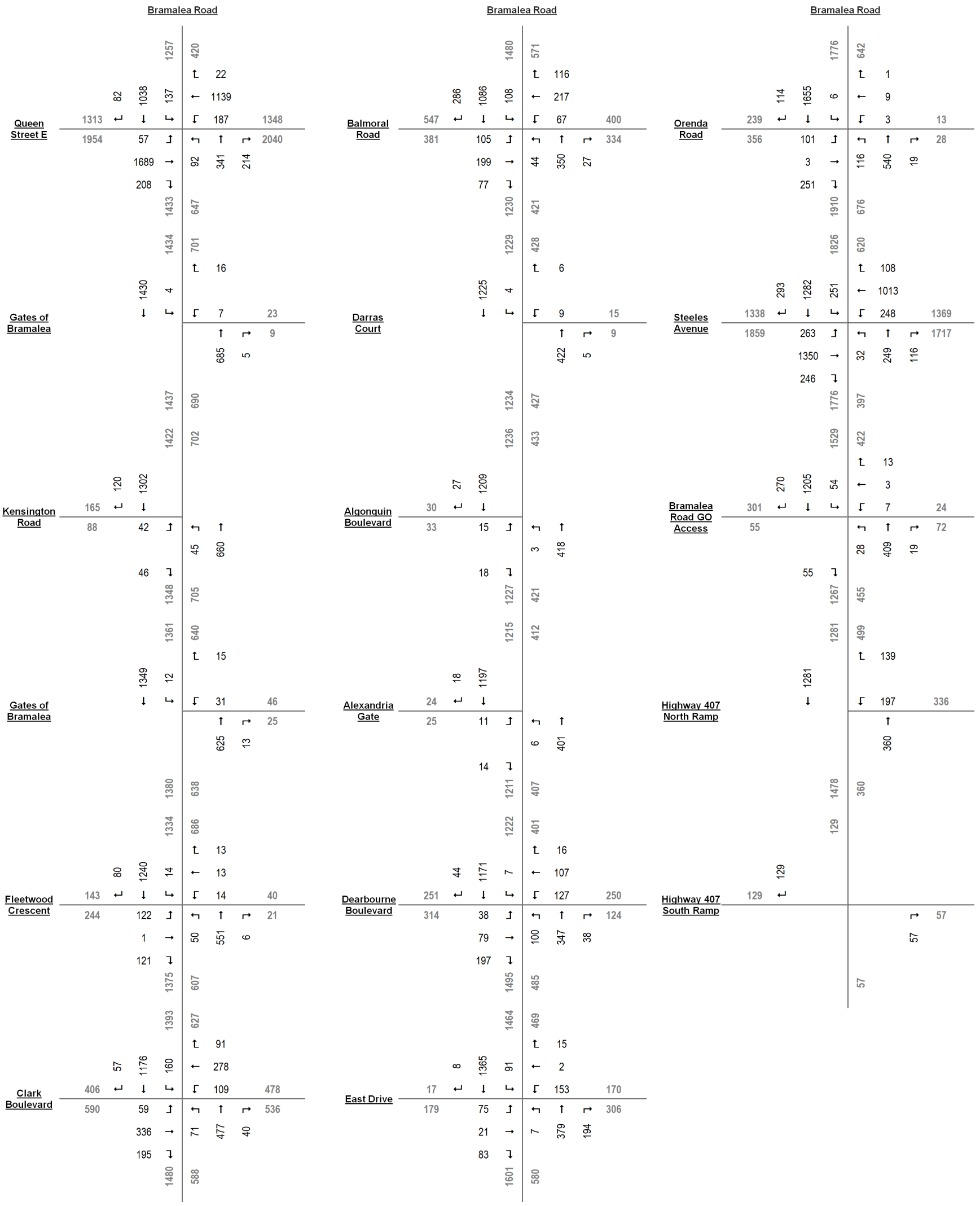

Figure 8 - 2018 Existing Unbalanced Traffic Volumes AM Peak Hour

Existing Conditions
September 18, 2020

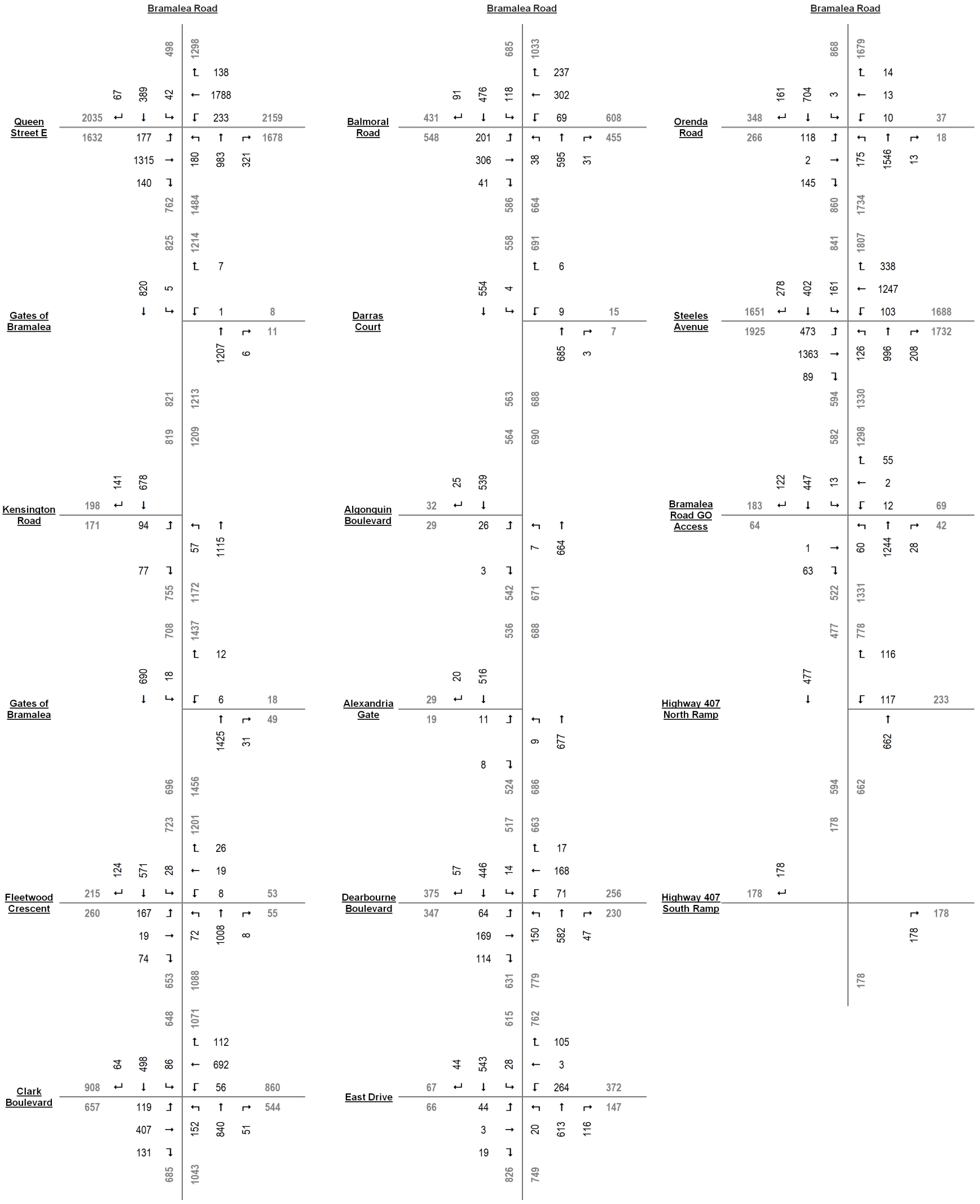

Figure 9 - 2018 Existing Unbalanced Traffic Volumes PM Peak Hour

Existing Conditions
September 18, 2020

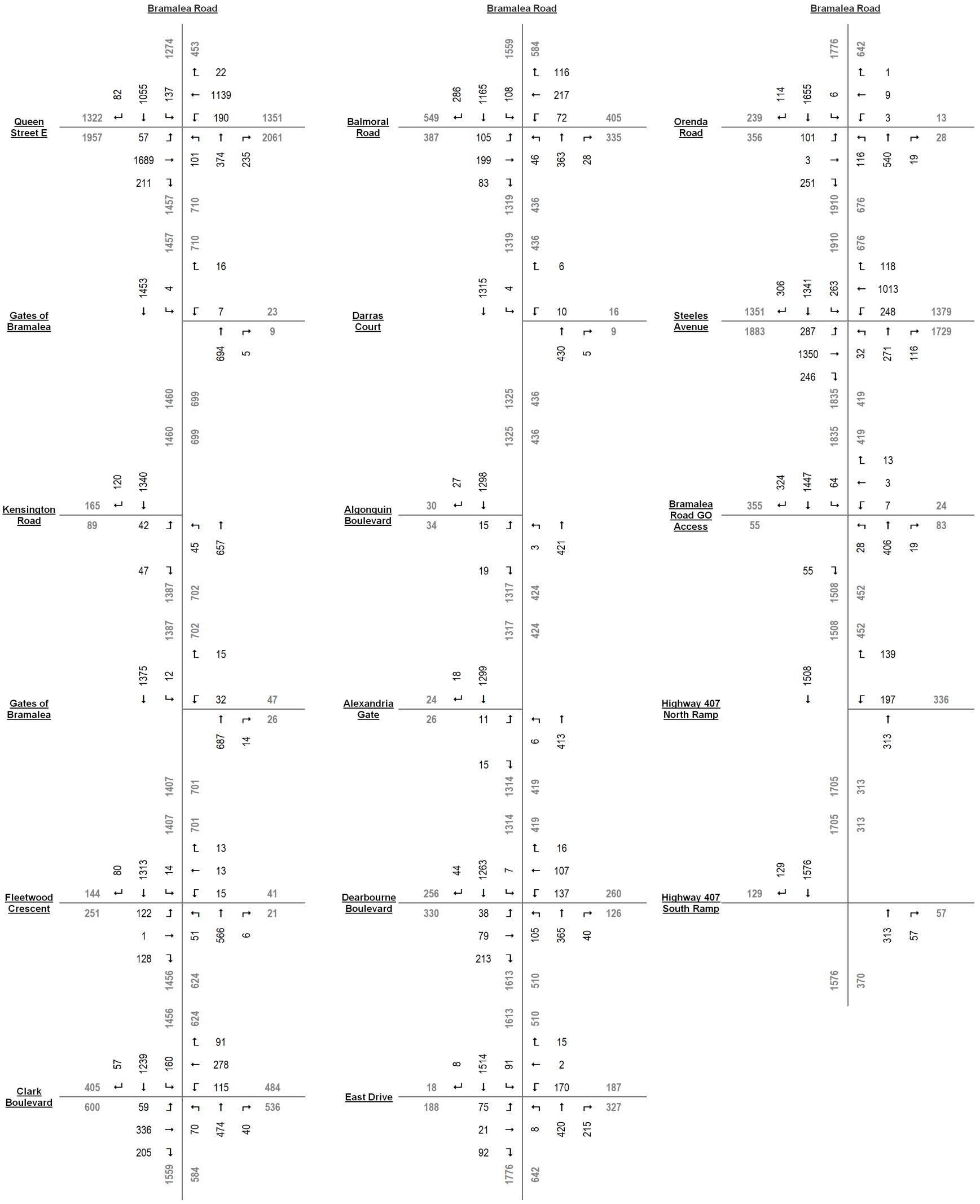

Figure 10 - 2018 Existing Balanced Traffic Volumes AM Peak Hour

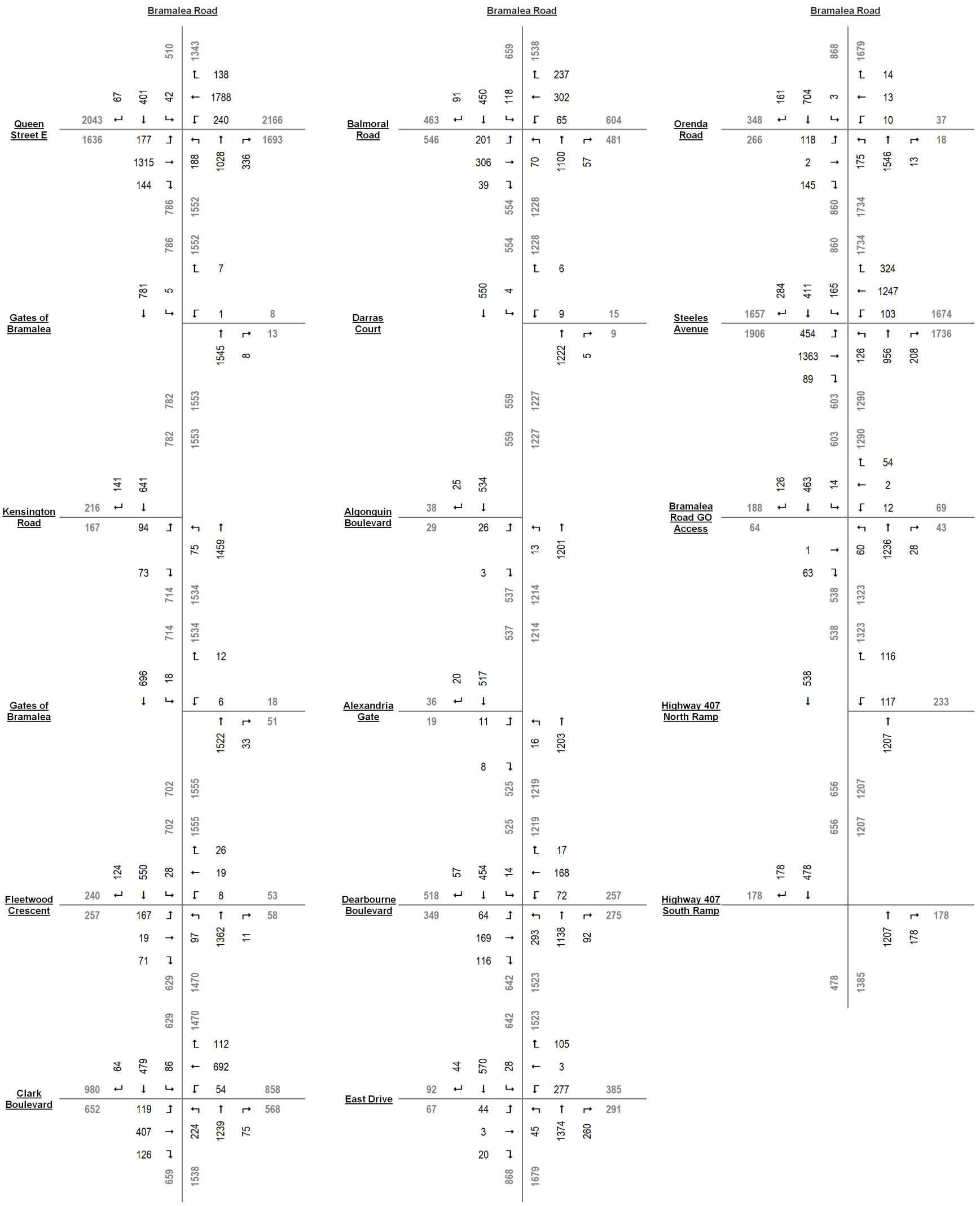

Figure 11 - 2018 Existing Balanced Traffic Volumes PM Peak Hour

Table 5: Bramalea Road Sections Volume Capacity Ratio - Existing Conditions

Intersection	Existing Conditions							
	AM Peak				PM Peak			
	SB		NB		SB		NB	
	Volume	V/C*	Volume	V/C*	Volume	V/C*	Volume	V/C*
Queen Street E / Bramalea Road	1,274	0.64	710	0.35	510	0.26	1,552	0.78
Gates of Bramalea (N) / Bramalea Road	1,457	0.73	699	0.35	786	0.39	1,553	0.78
Kensington Road / Bramalea Road	1,460	0.73	702	0.35	782	0.39	1,534	0.77
Gates of Bramalea (S) / Bramalea Road	1,387	0.69	701	0.35	714	0.36	1,555	0.78
Fleetwood Crescent-Knightsbridge Road / Bramalea Road	1,407	0.70	624	0.31	702	0.35	1,470	0.73
Clark Boulevard / Bramalea Road	1,456	0.73	584	0.29	629	0.31	1,538	0.77
Balmoral Road / Bramalea Road	1,559	0.78	436	0.22	659	0.33	1,228	0.61
Darras Court / Bramalea Road	1,319	0.66	436	0.22	554	0.28	1,227	0.61
Algonquin Boulevard / Bramalea Road	1,325	0.66	424	0.21	559	0.28	1,214	0.61
Alexandria Gate / Bramalea Road	1,317	0.66	419	0.21	537	0.27	1,219	0.61
Dearbourne Boulevard / Bramalea Road	1,314	0.66	510	0.25	525	0.26	1,523	0.76
East Drive / Bramalea Road	1,613	0.81	642	0.32	642	0.32	1,679	0.84
Orenda Road / Bramalea Road	1,776	0.89	676	0.34	868	0.43	1,734	0.87
Steeles Avenue / Bramalea Road	1,910	0.95	419	0.21	860	0.43	1,290	0.64
Highway 407 / Bramalea Road North Ramp Terminal	1,508	0.75	313	0.16	538	0.27	1,207	0.60
Highway 407 / Bramalea Road South Ramp Terminal	1,705	0.85	370	0.18	656	0.33	1,385	0.69
GO Access / Bramalea Road	1,835	0.92	452	0.23	603	0.30	1,323	0.66

*Capacity was assumed as 1000 veh/h per lane based on the existing conditions traffic volumes.

3.4 EXISTING MODAL SPLITS

The 2016 Transportation Tomorrow Survey (TTS) data for the AM and PM peak periods was queried to determine the existing modal splits in the Study area. TTS zones #3364, #3363, #3358, #3357, #3511, #3356, #3506, #3338, #3339, #3504, #3329, #3424, #3507, and #3503 were filtered to represent the zones that cover the Study area. Both inbound and outbound trips to and from the zones were queried by mode of travel and incorporated into the modal split calculation. The zone coverage for the selected zones is illustrated in **Figure 12**.

Figure 12 - Bramalea Road TTS Zone Coverage

The resulting mode splits are highlighted in **Figure 13**. It is observed that the trips in the Study area are primarily completed through automobile trips. Very few trips in the area are completed through cycling trips, only comprising 1% during the AM peak period and 0% during the PM peak period. A significantly higher proportion of walking trips is observed during the AM peak period.

EMME model outputs provided by the City indicate that the City's 2011 base model has a 11% outbound and 3% inbound transit mode split during the AM peak hour and an 8% inbound and 10% outbound transit mode split during the PM peak hour. These results indicate that, overall, the EMME model underestimates the transit mode split during the existing AM and PM peak hours, however, the EMME model traversal matrices are calibrated to the existing turning movement counts to represent the latest automobile and truck trips.

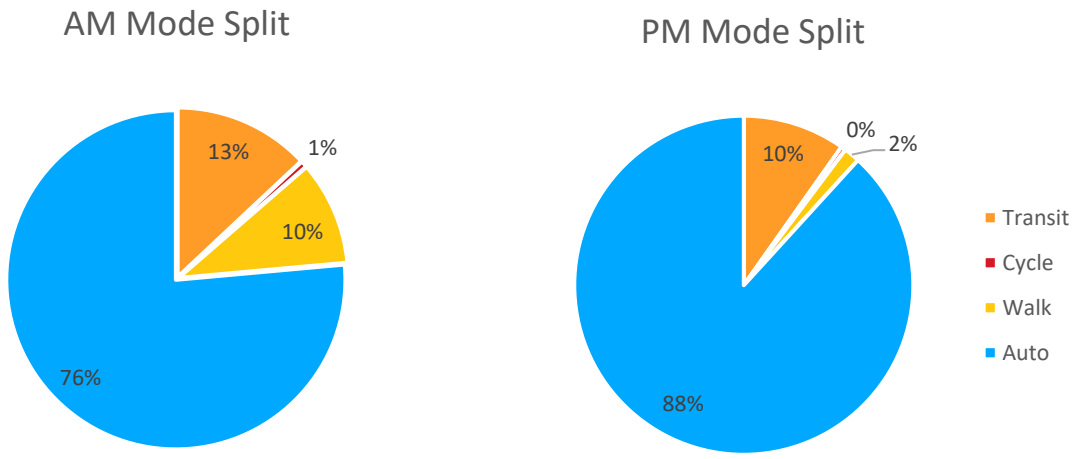

Figure 13 - Study Area Mode Split

3.5 SUMMARY OF EMME OUTPUTS FOR BASELINE CONDITIONS

Model results extracted from the City's GTAv4 EMME model were provided to Stantec by the City. These outputs included automobile link volumes, road network link capacities, road network link speeds, number of lanes, and selected link directional volumes for the base 2011 year modelled in EMME.

3.6 SELECT LINK ANALYSIS

This section reviews the existing travel patterns on the network through the selected link volumes extracted from the City's EMME model. The Select Link Analysis (SLA) is conducted on Bramalea Road at two locations; just south of Queen Street, and just north of Steeles Avenue. Separate SLA for the northbound and southbound directions are extracted from the City's EMME models. Figures illustrating results of the SLA are attached for reference in **Appendix A.5**

The SLA indicates that vehicles travelling just south of Queen Street East during the AM peak hour largely arrive from the north-east quadrant of the City of Brampton, east of Bramalea Road, and are largely destined for the area surrounding the Bramalea GO station, and towards the City of Mississauga. The flow of vehicles during the AM peak hour is significantly higher in the southbound direction. The noted trends reverse during the PM peak hour.

The SLA conducted at the location just north of Steeles Avenue East experiences different travel patterns than observed at the location just south of Queen Street East. This location is shown to have a wider spread in trips, with significant volumes arriving from Highway 407, Steeles Avenue East, Bramalea Road, and Orenda Road. The directional distribution of trips along Bramalea Road during the AM peak hour continues to be significantly assigned to the southbound direction. The trips along Steeles Avenue East and Orenda Road are observed to be relatively even in the east and west directions. The vehicles travelling southbound at this SLA point are distributing relatively evenly among eastbound Steeles Avenue East, southbound Bramalea Road, and westbound Steeles Avenue East.

The majority of trips observed travelling northbound at the SLA continue on to Orenda Road. During the PM peak hour, the reverse trends are observed.

3.7 SUB AREA SCREENLINE CAPACITY ANALYSIS

A screenline capacity analysis was conducted at locations in the sub-area bounded by Queen Street East to the north, Torbram Road to the east, Highway 407 ETR to the south, and Dixie Road to the west to assess whether links are currently operating within their available capacity. The screenline locations are illustrated in **Figure 14** The subarea screenline capacity analysis follows the methodology outlined in section 2.4.3. The adjusted modelled volumes for the AM and PM peak hours are summarized in **Table 6** and **Table 7**. The capacity utilization is summarized in **Table 8** and **Table 9** based on the number of lanes and the lane capacity coded into the City's EMME model.

The screenlines largely operate within their available capacities during the AM peak hour; only the southbound volume on the screenline north of Steeles Avenue East is observed to exceed the available capacity. The southbound direction experiences a significantly higher capacity utilization during the AM peak hour compared to the northbound direction. The screenline north of Steeles Avenue East continues to be the only screenline that exceeds the available capacity during the PM peak hour, exceeding a volume to capacity ratio of 1.00 in the northbound direction.

The volume to capacity ratios indicates that most screenlines can accommodate future travel demand growth in the area. An exception is noted for the screenline north of Steeles Avenue East where the vehicle demand exceeds the available capacity in the primary direction of flow during the AM and PM peak hours. This indicates that additional travel demand cannot immediately be accommodated along Bramalea Road at this location during the AM and PM peak hours, and that there is little opportunity for the redistribution of these volumes through adjacent corridors.

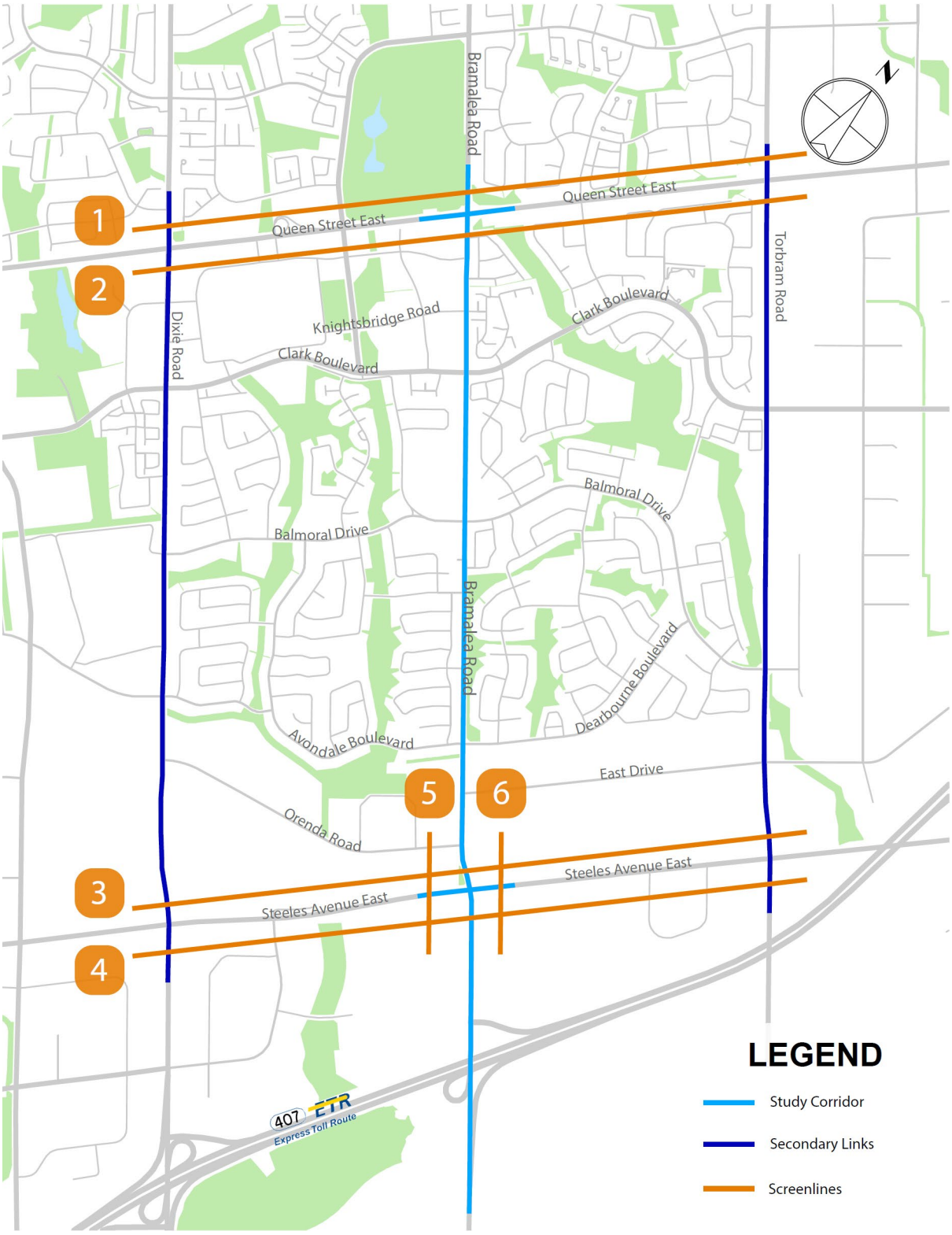

Figure 14 - Screenline Locations

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Table 6 - 2011 Volume Calibration to 2018 Conditions | AM Peak Hour Modelled Volumes

Screenline		Roadway	Northbound / Eastbound						Southbound / Westbound					
			Counted	Unadjusted (2011)		Adjustment	Adjusted (2018)		Counted	Unadjusted (2011)		Adjustment	Adjusted (2018)	
				Modelled	GEH		Modelled	GEH		Modelled	GEH		Modelled	GEH
1	North of Queen Street E	Dixie Road	486	239	13.0	130	369	5.7	2,021	1,652	8.6		1,652	8.6
		Bramalea Road	420	227	10.7	100	327	4.8	1,257	1,382	3.4		1,382	3.4
		Torbram Road	592	442	6.6		442	6.6	1,590	1,625	0.9		1,625	0.9
		Total	1,498	908	17.0	230	1,138	9.9	4,868	4,659	3.0		4,659	3.0
2	South of Queen Street E	Dixie Road	628	320	14.1	170	490	5.8	2,026	2,015	0.2		2,015	0.2
		Bramalea Road	647	189	22.4	320	509	5.7	1,433	962	13.6		962	13.6
		Torbram Road	405	201	11.7	100	301	5.5	1,585	1,679	2.3		1,679	2.3
		Total	1,680	710	28.1	590	1,300	9.8	5,044	4,656	5.6		4,656	5.6
3	North of Steeles Avenue E	Dixie Road	756	373	16.1		373	16.1	2,259	1,575	15.6		1,575	15.6
		Bramalea Road	620	879	9.5		879	9.5	1,826	2,121	6.6		2,121	6.6
		Torbram Road	652	444	8.9		444	8.9	1,482	1,831	8.6		1,831	8.6
		Total	2,028	1,696	7.7		1,696	7.7	5,567	5,527	0.5		5,527	0.5
4	South of Steeles Avenue E	Dixie Road	602	371	10.5		371	10.5	2,008	1,980	0.6		1,980	0.6
		Bramalea Road	397	701	13.0		701	13.0	1,776	1,013	20.4		1,013	20.4
		Torbram Road	337	44	21.2		44	21.2	694	1,219	17.0		1,219	17.0
		Total	1,336	1,116	6.3		1,116	6.3	4,478	4,212	4.0		4,212	4.0
5	West of Bramalea Road	Steeles Avenue E	1,859	2,356	10.8	-50	2,306	9.8	1,338	1,626	7.5		1,626	7.5
6	East of Bramalea Road	Steeles Avenue E	1,717	2,352	14.1	-200	2,152	9.9	1,369	1,524	4.1		1,524	4.1

Table 7 – 2011 Volume Calibration to 2018 Conditions | PM Peak Hour Modelled Volumes

Screenline		Roadway	Northbound / Eastbound						Southbound / Westbound					
			Counted	Unadjusted (2011)		Adjustment	Adjusted (2018)		Counted	Unadjusted (2011)		Adjustment	Adjusted (2018)	
				Modelled	GEH		Modelled	GEH		Modelled	GEH		Modelled	GEH
1	North of Queen Street E	Dixie Road	2,123	1,452	15.9	100	1,552	13.3	855	556	11.3	30	586	10.0
		Bramalea Road	1,298	1,261	1.0		1,261	1.0	498	426	3.3		426	3.3
		Torbram Road	1,401	1,340	1.6		1,340	1.6	564	496	3.0		496	3.0
		Total	4,822	4,053	11.5	100	4,153	10.0	1,917	1,478	10.7	30	1,508	9.9
2	South of Queen Street E	Dixie Road	1,996	1,855	3.2		1,855	3.2	1,032	654	13.0	150	804	7.5
		Bramalea Road	1,484	994	13.9		994	13.9	762	332	18.4	360	692	2.6
		Torbram Road	1,251	1,497	6.6		1,497	6.6	454	308	7.5		308	7.5
		Total	4,731	4,346	5.7		4,346	5.7	2,248	1,294	22.7	510	1,804	9.9
3	North of Steeles Avenue E	Dixie Road	2,227	1,334	21.2	140	1,474	17.5	1,112	644	15.8		644	15.8
		Bramalea Road	1,807	1,849	1.0		1,849	1.0	841	913	2.4		913	2.4
		Torbram Road	1,504	1,502	0.1		1,502	0.1	704	687	0.6		687	0.6
		Total	5,538	4,685	11.9	140	4,825	9.9	2,657	2,244	8.3		2,244	8.3
4	South of Steeles Avenue E	Dixie Road	1,993	1,663	7.7		1,663	7.7	958	986	0.9		986	0.9
		Bramalea Road	1,330	966	10.7		966	10.7	594	49	30.4	300	349	11.3
		Torbram Road	923	1,015	3.0		1,015	3.0	333	124	13.8	20	144	12.2
		Total	4,246	3,644	9.6		3,644	9.6	1,885	1,159	18.6	320	1,479	9.9
5	West of Bramalea Road	Steeles Avenue E	1,925	1,647	6.6		1,647	6.6	1,651	2,294	14.5	-220	2,074	9.8
6	East of Bramalea Road	Steeles Avenue E	1,732	2,060	7.5		2,060	7.5	1,688	2,225	12.1	-110	2,115	9.8

Table 8 – Existing 2018 AM Peak Hour Screenline Capacity Utilization

Screenline		Roadway	Northbound / Eastbound					Southbound / Westbound				
			Adjusted Volume	No. Lanes	Lane Capacity	Link Capacity	V/C	Adjusted Volume	No. Lanes	Lane Capacity	Link Capacity	V/C
1	North of Queen Street E	Dixie Road	369	3	700	2,100	0.18	1,652	3	700	2,100	0.79
		Bramalea Road	327	2	800	1,600	0.20	1,382	2	800	1,600	0.86
		Torbram Road	442	2	800	1,600	0.28	1,625	2	800	1,600	1.02
		Total	1,138	-	-	5,300	0.21	4,659	-	-	5,300	0.88
2	South of Queen Street E	Dixie Road	490	3	800	2,400	0.20	2,015	3	800	2,400	0.84
		Bramalea Road	509	2	800	1,600	0.32	962	2	800	1,600	0.60
		Torbram Road	301	2	800	1,600	0.19	1,679	2	800	1,600	1.05
		Total	1,300	-	-	5,600	0.23	4,656	-	-	5,600	0.83
3	North of Steeles Avenue E	Dixie Road	373	2	800	1,600	0.23	1,575	2	800	1,600	0.98
		Bramalea Road	879	2	800	1,600	0.55	2,121	2	800	1,600	1.33
		Torbram Road	444	2	800	1,600	0.28	1,831	2	800	1,600	1.14
		Total	1,696	-	-	4,800	0.35	5,527	-	-	4,800	1.15
4	South of Steeles Avenue E	Dixie Road	371	3	900	2,700	0.14	1,980	3	900	2,700	0.73
		Bramalea Road	701	2	800	1,600	0.44	1,013	2	800	1,600	0.63
		Torbram Road	44	2	800	1,600	0.03	1,219	2	800	1,600	0.76
		Total	1,116	-	-	5,900	0.19	4,212	-	-	5,900	0.71
5	West of Bramalea Road	Steeles Avenue E	2,306	3	900	2,700	0.85	1,626	3	900	2,700	0.60
6	East of Bramalea Road	Steeles Avenue E	2,152	3	900	2,700	0.80	1,524	3	900	2,700	0.56

Table 9 – Existing 2018 PM Peak Hour Screenline Capacity Utilization

Screenline		Roadway	Northbound / Eastbound					Southbound / Westbound				
			Adjusted Volume	No. Lanes	Lane Capacity	Link Capacity	V/C	Adjusted Volume	No. Lanes	Lane Capacity	Link Capacity	V/C
1	North of Queen Street E	Dixie Road	1,552	3	700	2,100	0.74	586	3	700	2,100	0.28
		Bramalea Road	1,261	2	800	1,600	0.79	426	2	800	1,600	0.27
		Torbram Road	1,340	2	800	1,600	0.84	496	2	800	1,600	0.31
		Total	4,153	-	-	5,300	0.78	1,508	-	-	5,300	0.28
2	South of Queen Street E	Dixie Road	1,855	3	800	2,400	0.77	804	3	800	2,400	0.34
		Bramalea Road	994	2	800	1,600	0.62	692	2	800	1,600	0.43
		Torbram Road	1,497	2	800	1,600	0.94	308	2	800	1,600	0.19
		Total	4,346	-	-	5,600	0.78	1,804	-	-	5,600	0.32
3	North of Steeles Avenue E	Dixie Road	1,474	2	800	1,600	0.92	644	2	800	1,600	0.40
		Bramalea Road	1,849	2	800	1,600	1.16	913	2	800	1,600	0.57
		Torbram Road	1,502	2	800	1,600	0.94	687	2	800	1,600	0.43
		Total	4,825	-	-	4,800	1.01	2,244	-	-	4,800	0.47
4	South of Steeles Avenue E	Dixie Road	1,663	3	900	2,700	0.62	986	3	900	2,700	0.37
		Bramalea Road	966	2	800	1,600	0.60	349	2	800	1,600	0.22
		Torbram Road	1,015	2	800	1,600	0.63	144	2	800	1,600	0.09
		Total	3,644	-	-	5,900	0.62	1,479	-	-	5,900	0.25
5	West of Bramalea Road	Steeles Avenue E	1,647	3	900	2,700	0.61	2,074	3	900	2,700	0.77
6	East of Bramalea Road	Steeles Avenue E	2,060	3	900	2,700	0.76	2,115	3	900	2,700	0.78

3.8 MMLOS ASSESSMENT

The multi-modal operations along the corridor segments and signalized intersections are assessed using the *City of Ottawa Multi-Modal Level of Service (MMLOS) Guidelines* methodology, as outlined in section 2.5. The operations for transit, bicycles, pedestrians, trucks, and automobiles are considered. The existing MMLOS operations will be used to determine the impact of future growth on the network by the 2041 horizon year.

3.8.1 Transit

The transit level of service for segments and signalized intersections along the Study corridor area is illustrated in **Figure 15** and **Figure 16** for the AM and PM peak hours, respectively. As shown in **Figure 15** and **Figure 16**, the segments along the corridor operate at LOS "E" and LOS "F" during the AM and PM peak hours. The majority of the LOS "F" operations along segments are a result of the buses travelling in mixed traffic and travelling at slow average speeds compared to the posted speed limit. The segments of Bramalea Road between Knightsbridge Road and Clark Boulevard, Steeles Avenue and the Highway 407 Westbound Off-Ramp (northbound), and Orenda Road and Steeles Avenue (southbound) operate at an LOS of "F" due to the absence of bus stops and routes which results in zero vehicles per hour stopping along the segments. It has to be noted that although no stop is located between Knightsbridge Road and Clark Boulevard (section length is less than 300 metres), and Orenda Road and Steeles Avenue (southbound) (section length is less than less than 200 metres), bus stops are located adjacent to these sections as stops are located less than 400 metres from each other along Bramalea Road.

The intersections along Bramalea Road generally operate at LOS "D", LOS "E" and LOS "F" during the AM and PM peak hours, with the exception of the intersection of Bramalea Road / East Drive and Bramalea Road / Highway 407 WB Off-Ramp which operates at a LOS of "C" in the MA Peak hour and intersection of Bramalea Road / Highway 407 eastbound off -ramp which operates at LOS of "C" in both AM and PM peak hours. The transit level of service at intersections is a reflection of the amount of delay that buses experience at signalized intersections. The intersection TLOS results show that the transit improvement alternatives such as provision of transit signal priority at the signalized intersections, provision of queue jump lanes for transit at intersections, or provision of dedicated transit/HOV lanes need to be considered to improve the transit modes along Bramalea Road Corridor.

3.8.2 Bicycles

The bicycle level of service for segments and signalized intersections along the Study corridor is illustrated in **Figure 17**. As shown in **Figure 17**, the majority of the sections and intersections along the corridor currently operate at an LOS of "F". The only exception to this is the segment of Bramalea Road between Balmoral Drive and Dearbourne Boulevard which operates with a LOS of "A", indicating that this segment of the corridor is very comfortable for cyclists. This segment operates at a good LOS due to the multi-use path that is currently provided on the east side of Bramalea Road for the majority of the segment which can accommodate northbound and southbound travel. The multi-use path provides a physical separation between cyclists and automobiles, eliminating conflicts between the two modes and significantly improving comfort and attractiveness for cycling.

The intersections along the corridor operate at a LOS of 'E' and "F" due to the number of lanes and high speed of traffic along Bramalea Road. Auxiliary left turn lanes on signalized intersection approaches and the two general purpose lanes per direction along Bramalea Road generally result in cyclists having to cross at least two lanes to complete a left turn which increases the level of traffic stress for cyclists and reduces their comfort. The only exception is the intersection of Bramalea Road and Highway 407 Westbound Off-ramp where no left or right conflicting turns along Bramalea Road is available. The posted speed limit of 60 km/h along Bramalea Road results in automobiles travelling significantly faster than cyclists, potentially leading to increased risk for cyclists. A two-stage turn with a left-turn box would be required at intersections to satisfy the LOS "A" target for cyclists, however, it is noted that this improvement would not be necessary with the implementation of a multi-use path facility as cyclists would instead cross the roadway along with the pedestrian crossing signals or through bicycle signals.

3.8.3 Pedestrians

The pedestrian level of service for segments and signalized intersections along the Study corridor is illustrated in **Figure 18**. As shown in **Figure 18**, the corridor operations are largely characterized by PLOS "E" for segments and LOS "E" and "F" for signalized intersections. The segment between Steeles Avenue East and Highway 407 is shown as LOS "F" mainly due to the lack and discontinuity of sidewalks, (i.e. no accommodation of pedestrian trips south of the Bramalea GO station). The poor pedestrian level of service along the Bramalea Road corridor segments is due to a combination of high traffic volumes and high operating speeds.

Many of the intersections along the corridor operate at a PLOS of "E" or "F" in both the "pedestrian exposure to traffic LOS" and the "average pedestrian delay LOS" portions of the PLOS calculation; the overall approach and intersection PLOSs reflect the worst operations of the average PLOS calculated for intersection approaches based on the exposure LOS and delay LOS. Higher effective walk times will be required to improve the delay LOS portion of the PLOS calculation. The effective walk time represents the duration of time which the white "walking pedestrian" symbol is displayed; an increase to the length of the split which coincides with the analyzed pedestrian phase will reduce the average delay for the pedestrian movement and improve the delay LOS. The largest contributing factor to the poor exposure LOSs is the number of lanes crossed by pedestrians; due to the wide lanes along Bramalea Road, pedestrians are effectively crossing six 3.5-metre-wide lanes when walking across Bramalea Road.

3.8.4 Trucks

The truck level of service for segments and signalized intersections along the Study corridor is illustrated in **Figure 19**. As shown in **Figure 19**, the corridor segments experience very good truck levels of service. The signalized intersections largely experience a good TkLOS. The TkLOS for the intersections is based on the average of approach TkLOS results. The TkLOS is notably geometry based; the TkLOS for signalized intersections is derived from the effective corner radius and the number of receiving lanes on departure from the intersection.

To improve the TkLOS results, the effective corner radius would have to be increased to 10 metres or greater on the south-east corner of Bramalea Road / Knightsbridge Road, north-west corner of Bramalea Road / Dearbourne Boulevard, and the north-west corner of Bramalea Road / East Drive. It is noted that these corners lead into residential areas and may not need to accommodate the movements of heavy trucks.

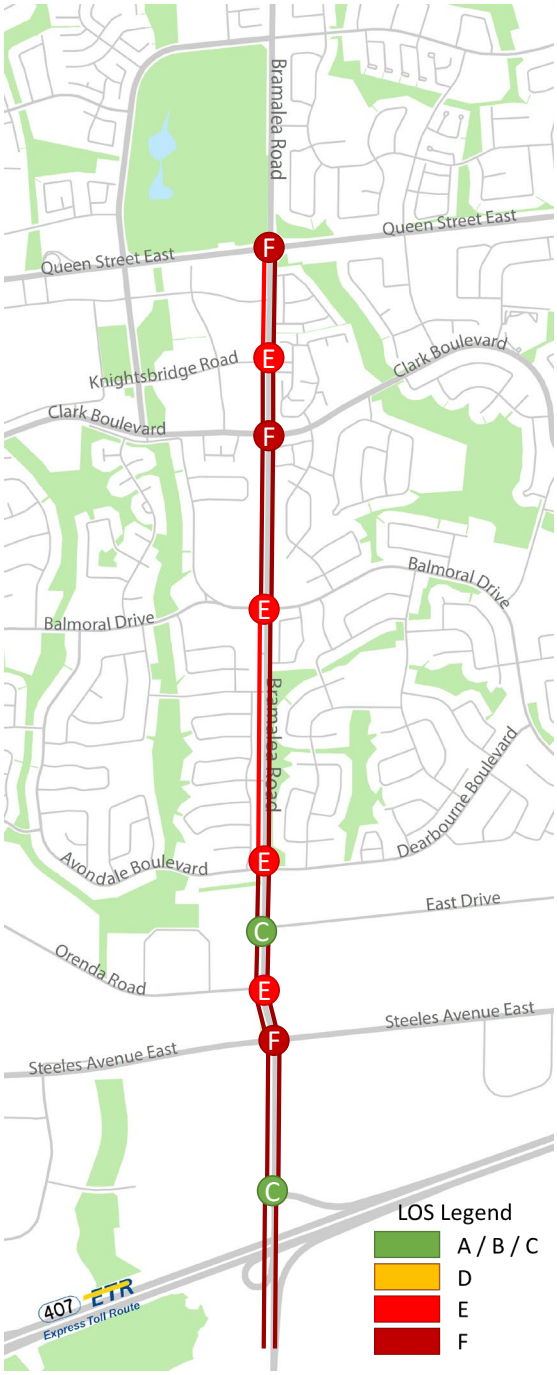

Figure 15 - TLOS | AM Peak Hour

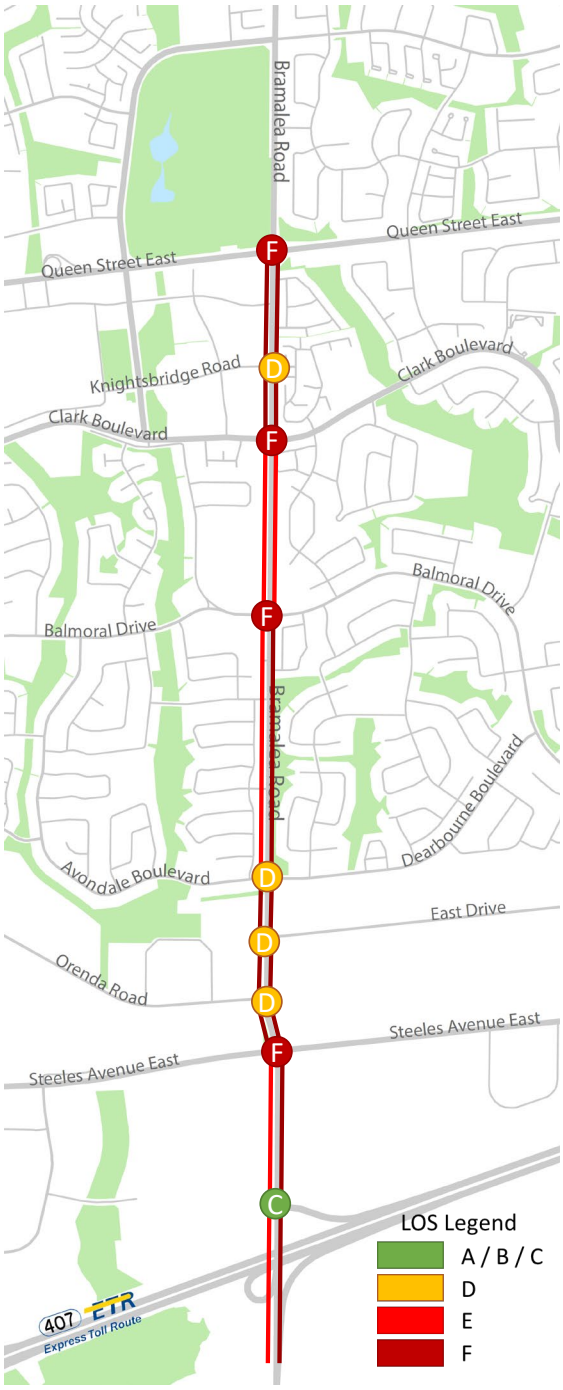

Figure 16 - TLOS | PM Peak Hour

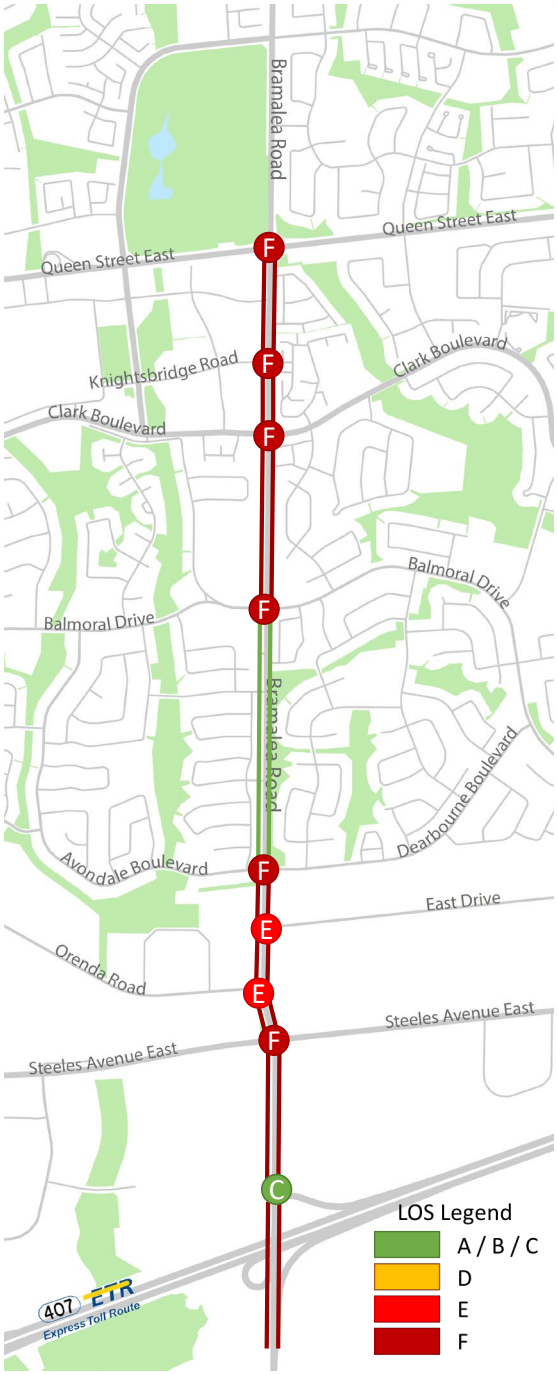

Figure 17 - BLOS | AM & PM Peak Hour

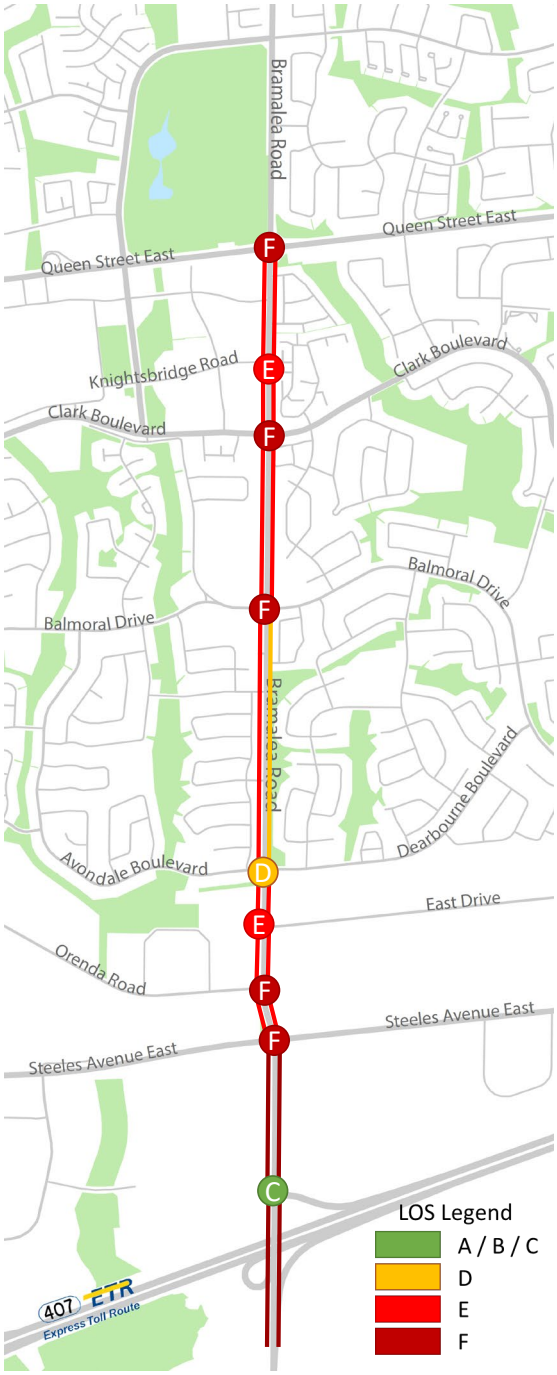

Figure 18 - PLOS | AM & PM Peak Hour

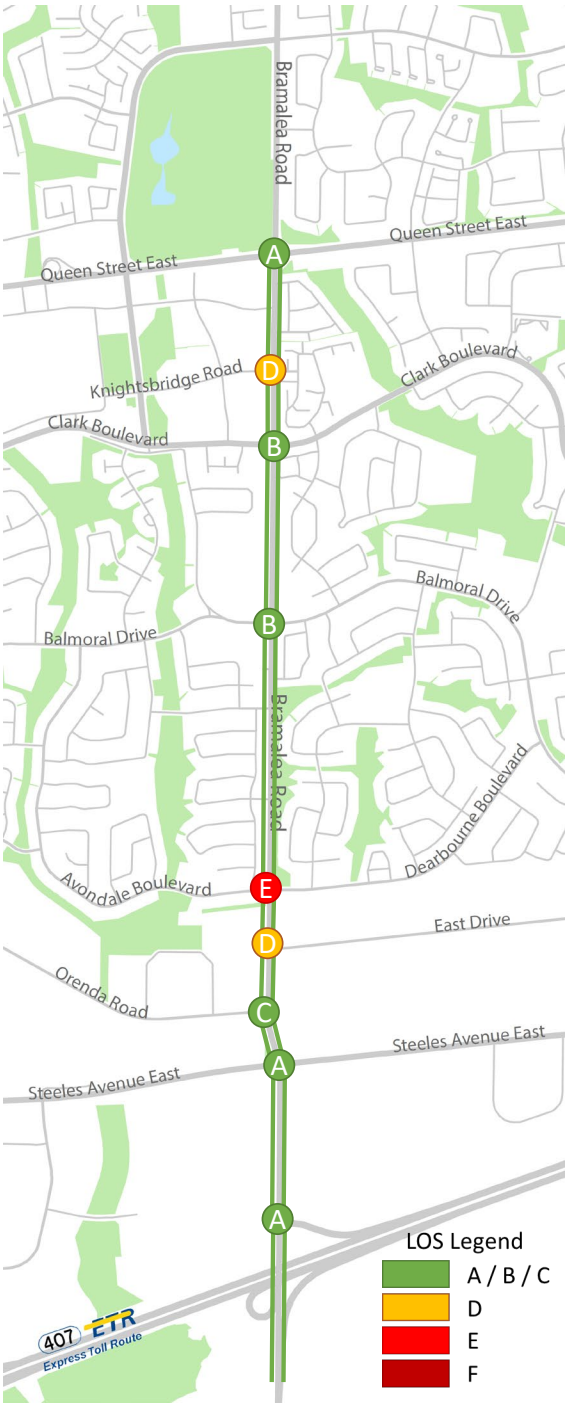

Figure 19 - TkLOS | AM & PM Peak Hour

3.8.5 Automobiles

The automobile level of service for segments and signalized intersections along the Study corridor is illustrated in **Figure 20** and **Figure 21** for the AM and PM peak hours, respectively. **Appendix A.7** includes the detailed intersection analysis results. Synchro reports are also provided in the same appendix.

The Study area corridor segments and signalized intersections are largely characterized by good levels of service for automobiles. The intersection of Bramalea Road with Steeles Avenue East operates at an ALOS of “F” during the PM peak hour, however, all other intersections operate at ALOS of “E” or better which satisfy the ALOS “E” target. The ALOS for signalized intersections is derived from the intersection volume to capacity ratio; the overall intersection of Bramalea Road with Steeles Avenue East operates above capacity during the PM peak hour, resulting in an ALOS of “F”. The overall intersection of Bramalea Road with Steeles Avenue East can be improved to a LOS of “E” for automobiles by optimizing the signal timings.

The segment ALOS is derived from the peak hour speeds relative to the free-flow speed on the Bramalea Road corridor segments. An ALOS of “F” for segments coincides with an average segment speed of 30% of the free-flow speed or less. The southbound segment between Orenda Road and Steeles Avenue East and the northbound segment between Queen Street East and Knightsbridge Road operate at ALOS “F” during the AM and PM peak hours, respectively. The locations of the ALOS “F”s during the AM and PM peak hours coincide with the peak flow directions along the corridor and are caused by congestion at the Bramalea Road / Steeles Avenue East and Bramalea Road / Queen Street East intersections. Remedial measures will need to be explored in the analysis of alternatives to alleviate the delay incurred on these segments; remedial measures can include signal timing and offset optimization, advanced turn phases, geometric improvements, or modal shift away from single occupant vehicles.

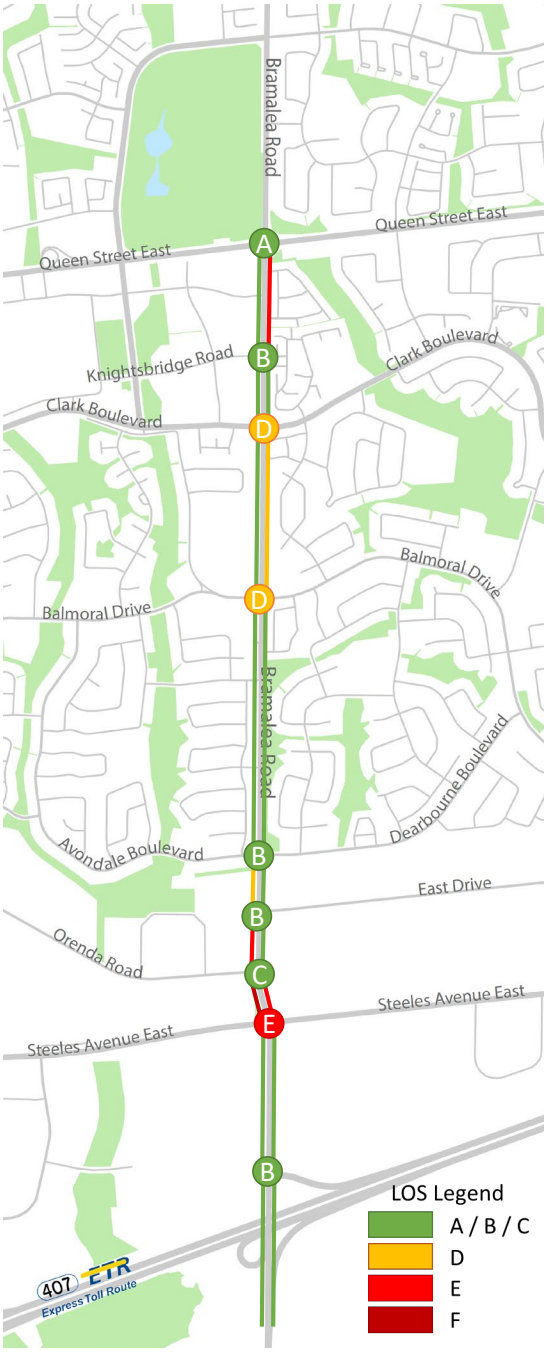

Figure 20 - ALOS | AM Peak Hour

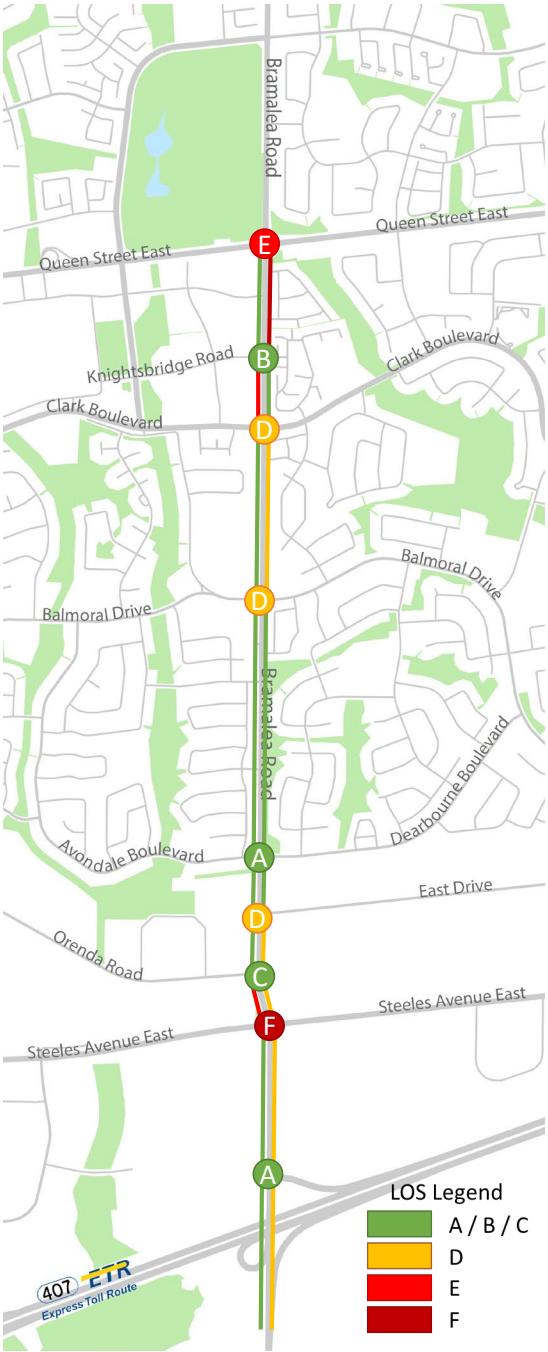

Figure 21 - ALOS | PM Peak Hour

3.8.6 Summary

The segment MMLOS results are summarized in **Table 10** and **Table 11** for the AM and PM peak hours, respectively. The signalized intersection MMLOS results are summarized in **Table 12** and **Table 13** for the AM and PM peak hours, respectively. As discussed previously, there are significant deficiencies at the corridor intersections and segments for transit, bicycle, and pedestrian modes. There are opportunities to improve the levels of service in the Study area, however, the trade-offs between the modes will have to be weighed in line with the identified MMLOS targets to ensure that individual modes are not overly prioritized at the expense of others. Detailed results for segments and intersections, including the directional levels of service and calculation inputs are presented in **Appendix A.6** for reference.

Table 10 - Segment MMLOS Summary | AM Peak Hour

Bramalea Road Segment		Transit LOS	Bike LOS	Ped LOS	Truck LOS	Auto LOS
From	To					
Queen St	Knightsbridge Rd	F	F	E	A	E
Knightsbridge Rd	Clark Blvd	F	F	E	A	C
Clark Blvd	Balmoral Dr	F	F	E	A	D
Balmoral Dr	Dearbourne Blvd	F	A	E	A	C
Dearbourne Blvd	East Dr	F	F	E	A	D
East Dr	Orenda Rd	F	F	E	A	E
Orenda Rd	Steeles Ave	F	F	E	A	F
Steeles Ave	Highway 407	F	F	F	A	C
Highway 407	South Limit	F	F	F	A	C
Target		**A**	**A**	**B**	**D**	**E**

Table 11 - Segment MMLOS Summary | PM Peak Hour

Bramalea Road Segment		Transit LOS	Bike LOS	Ped LOS	Truck LOS	Auto LOS
From	To					
Queen St	Knightsbridge Rd	F	F	E	A	F
Knightsbridge Rd	Clark Blvd	F	F	E	A	E
Clark Blvd	Balmoral Dr	E	F	E	A	D
Balmoral Dr	Dearbourne Blvd	F	A	E	A	B
Dearbourne Blvd	East Dr	F	F	E	A	C
East Dr	Orenda Rd	F	F	E	A	D
Orenda Rd	Steeles Ave	F	F	E	A	E
Steeles Ave	Highway 407	F	F	F	A	D
Highway 407	South Limit	F	F	F	A	D
Target		**A**	**A**	**B**	**D**	**E**

Table 12 - Intersection MMLOS Summary | AM Peak Hour

Bramalea Road Intersection	TLOS	BLOS	PLOS	TkLOS	ALOS
Queen Street E	F	F	F	A	A
Fleetwood Crescent	E	F	E	D	B
Clark Boulevard	F	F	F	B	D
Balmoral Road	E	F	F	B	D
Dearbourne Blvd	E	F	D	E	B
East Drive	C	E	E	D	B
Orenda Road	E	E	F	C	C
Steeles Avenue	F	F	F	A	E
Highway 407 North	C	C	C	A	B
Target	**A**	**A**	**B**	**D**	**E**

Table 13 - Intersection MMLOS Summary | PM Peak Hour

Bramalea Road Intersection	TLOS	BLOS	PLOS	TkLOS	ALOS
Queen Street E	F	F	F	A	E
Fleetwood Crescent	D	F	E	D	B
Clark Boulevard	F	F	F	B	D
Balmoral Road	F	F	F	B	D
Dearbourne Blvd	D	F	D	E	A
East Drive	D	E	E	D	D
Orenda Road	D	E	F	C	C
Steeles Avenue	F	F	F	A	F
Highway 407 North	C	C	C	A	A
Target	**A**	**A**	**B**	**D**	**E**

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4.0 FUTURE DO NOTHING CONDITIONS

4.1 FUTURE BASELINE

4.1.1 Automobile Travel Demand

The 2041 outputs from the City's EMME model were used to determine the traffic growth in the Study area as a result of population and employment growth. Traversal matrices for the 2041 future baseline scenario were provided by the City and used to determine the growth within EMME relative to existing conditions. This travel demand growth was applied to the calibrated traversal matrices for the existing AM and PM peak hours to derive the 2041 future baseline AM and PM travel demand for passenger vehicles and trucks. The final 2041 future baseline AM and PM peak hour traversal matrices were fed into a free-flow (no interactions or obstructions) VISSIM model to identify the total demand at each intersection movement and fed into the future baseline Synchro models. Volumes extracted from VISSIM were applied to Synchro to represent the future baseline travel demand. The projected growth rates at key locations along the Study corridor are summarized in **Table 14**. The travel demand per intersection is summarized in **Appendix A.5**.

Table 14 – Future Do Nothing 2041 Volumes & Growth

Location	Existing 2018		Do Nothing 2041		Growth %	
	AM	PM	AM	PM	AM	PM
Bramalea Road, North of Queen Street	1,727	1,854	2,835	2,933	64%	58%
Bramalea Road, South of Queen Street	2,167	2,339	2,747	2,986	27%	28%
Bramalea Road, North of Steeles Avenue	2,586	2,594	2,834	3,021	10%	16%
Bramalea Road, South of Steeles Avenue	2,254	1,893	2,773	2,440	23%	29%
Steeles Avenue, East of Bramalea Road	3,107	3,410	3,967	4,159	28%	22%
Steeles Avenue, West of Bramalea Road	3,234	3,563	3,948	4,720	22%	32%

The modelled results incorporate future improvements that are expected to be complete by the horizon year. The following network improvements are incorporated within the 2031 and 2041 sub area:

- **Bramalea Road:** Widened from two (2) to three (3) lanes in each direction north of Queen Street East.
- **Torbram Road:** Widened from two (2) to three (3) lanes in each direction.
- **Dixie Road:** Widened from two (2) to three (3) lanes north of Steeles Avenue East.

It is noted that no improvements were applied along the Study corridor. The future Do Nothing traffic volumes were used to calculate the volume capacity ratios at Bramalea Road within the Study Area. **Table 15** illustrates Bramalea Road sections volume capacity ratio analysis results for future baseline conditions. The results show that in several sections the traffic demand volumes are close or slightly higher than capacity.

Table 15: Bramalea Road Sections Volume Capacity Ratio – Future 2041 Do Nothing Conditions

Intersection	Existing Conditions							
	AM Peak				PM Peak			
	SB		NB		SB		NB	
	Volume	V/C	Volume	V/C	Volume	V/C	Volume	V/C
Queen Street E / Bramalea Road[1]	2,241	0.75	795	0.40	697	0.23	2,069	1.03
Gates of Bramalea (N) / Bramalea Road	1,951	0.98	785	0.39	916	0.46	2,073	1.04
Kensington Road / Bramalea Road	1,956	0.98	769	0.38	911	0.46	2,005	1.00
Gates of Bramalea (S) / Bramalea Road	1,934	0.97	768	0.38	815	0.41	2,031	1.02
Fleetwood Crescent-Knightsbridge Road / Bramalea Road	1,959	0.98	665	0.33	805	0.40	1,728	0.86
Clark Boulevard / Bramalea Road	1,769	0.88	679	0.34	706	0.35	1,934	0.97
Balmoral Road / Bramalea Road	1,893	0.95	459	0.23	767	0.38	1,532	0.77
Darras Court / Bramalea Road	1,560	0.78	459	0.23	637	0.32	1,530	0.77
Algonquin Boulevard / Bramalea Road	1,565	0.78	444	0.22	642	0.32	1,527	0.76
Alexandria Gate / Bramalea Road	1,556	0.78	435	0.22	626	0.31	1,538	0.77
Dearbourne Boulevard / Bramalea Road	1,551	0.78	567	0.28	618	0.31	1,608	0.80
East Drive / Bramalea Road	1,615	0.81	744	0.37	773	0.39	1,862	0.93
Orenda Road / Bramalea Road	1,834	0.92	942	0.47	978	0.49	1,910	0.96
Steeles Avenue / Bramalea Road	1,891	0.95	689	0.34	1,110	0.56	1,342	0.67
Highway 407 / Bramalea Road North Ramp Terminal	1,503	0.75	374	0.19	995	0.50	1,286	0.64
Highway 407 / Bramalea Road South Ramp Terminal	1,744	0.87	432	0.22	1,111	0.56	1,553	0.78
GO Access / Bramalea Road	2,083	1.04	856	0.43	1,095	0.55	1,431	0.72

4.1.2 Transit Travel Demand

The future baseline horizon uses the same transit assumptions as existing conditions baseline. The improvement scenarios and proposed configurations will incorporate expected transit changes to identify the impact along the Study corridor.

[1] Number of southbound lanes (north of Queen Street East) is assumed to be 3 in the Future Do Nothing Conditions

4.1.3 Select Link Analysis

The 2041 and existing SLA results were compared to identify what changes in travel patterns are expected in the area by the ultimate horizon year. The travel patterns observed in the 2041 horizon year reflect those observed under the existing conditions. The notable observations under the 2041 horizon year are as follows:

North of Steeles Avenue Screenline AM

- Reduced volumes southbound along Bramalea Road (north of Steeles Avenue), westbound along Steeles Avenue (west of Bramalea Road), and eastbound along Orenda Road.
- Generally higher volumes are observed along the remaining links, however, the increases in volume compared to existing conditions are not significant.

South of Queen Street Screenline AM

- High increase in volume (approximately 200 additional vehicles) accessing Clark Boulevard westbound through Knightsbridge Road.
- The vehicles turning westbound left at the intersection of Queen Street with Bramalea Road are forecast to double to approximately 350 vehicles.
- Higher volumes travelling southbound along Bramalea Road.

North of Steeles Avenue Screenline PM

- Reduced volumes northbound along Bramalea Road, southbound along Bramalea Road, eastbound along Steeles Avenue, and westbound along Orenda Road, however, the volumes are not significantly changed compared to existing conditions.

South of Queen Street Screenline PM

- Reverse AM trends are generally observed during the PM peak hour. The eastbound volumes along Clark Boulevard are observed to significantly increase compared to existing conditions and access Bramalea Road through Knightsbridge Road. Higher volumes are observed northbound along Bramalea Road and northbound right at the intersection of Bramalea Road with Queen Street.

4.1.4 Sub Area Screenline Capacity Analysis

A sub-area screenline capacity analysis was conducted for the 2041 future baseline horizon to identify deficiencies that may arise due to population and employment growth in the City of Brampton and the broader region. The capacity analysis uses the City's EMME outputs for link volume and link capacity and applies the volume adjustments that were applied to the existing conditions screenline capacity analysis. The screenline capacity utilization results for the 2041 AM and PM peak hours are summarized in **Table 16** and **Table 17**.

The 2041 AM peak hour screenline capacity utilization shows that the deficiencies identified under existing conditions are further exacerbated due to increases in travel demand caused by regional growth. The southbound direction volumes for the screenlines located north of Queen Street E, south of Queen Street E, and north of Steeles Avenue East are projected to exceed capacity. It is noted that the volume to capacity ratio of the screenline located north of Steeles Avenue E is improved due to the additional capacity introduced on the Dixie Road and Torbram Road links, as highlighted in Section **4.1.1**.

The 2041 PM peak hour screenline capacity utilization is significantly more congested relative to existing conditions. The vehicle demands on the screenlines south of Queen Street East and north of Steeles Avenue East are forecast to operate above the available capacity, with the screenline north of Queen Street East approaching capacity. Both screenline capacity issues identified above are located within the Study corridor, indicating that Bramalea Road and the adjacent alternative roads will not have sufficient capacity to accommodate projected travel demand growth.

Table 16 - 2041 Do Nothing | AM Peak Hour Screenline Capacity Utilization

Screenline		Roadway	Northbound / Eastbound			Southbound / Westbound		
			Volume	Capacity	V/C	Volume	Capacity	V/C
1	North of Queen Street E	Dixie Road	341	2,100	0.16	2,291	2,100	1.09
		Bramalea Road	465	2,400	0.19	2,343	2,400	0.98
		Torbram Road	501	2,400	0.21	2,623	2,400	1.09
		Total	1,307	6,900	0.19	7,257	6,900	1.05
2	South of Queen Street E	Dixie Road	648	2,400	0.27	2,853	2,400	1.19
		Bramalea Road	596	1,600	0.37	1,427	1,600	0.89
		Torbram Road	347	2,400	0.14	2,897	2,400	1.21
		Total	1,591	6,400	0.25	7,177	6,400	1.12
3	North of Steeles Avenue E	Dixie Road	780	2,400	0.33	2,356	2,400	0.98
		Bramalea Road	1,123	1,600	0.70	2,083	1,600	1.30
		Torbram Road	867	2,400	0.36	2,704	2,400	1.13
		Total	2,770	6,400	0.43	7,143	6,400	1.12
4	South of Steeles Avenue E	Dixie Road	827	2,700	0.31	2,290	2,700	0.85
		Bramalea Road	1,073	1,600	0.67	1,023	1,600	0.64
		Torbram Road	199	2,400	0.08	1,670	2,400	0.70
		Total	2,099	6,700	0.31	4,983	6,700	0.74
5	West of Bramalea Road	Steeles Avenue E	2,574	2,700	0.95	2,007	2,700	0.74
6	East of Bramalea Road	Steeles Avenue E	2,363	2,700	0.88	2,102	2,700	0.78

Table 17 - 2041 Do Nothing | PM Peak Hour Screenline Capacity Utilization

Screenline		Roadway	Northbound / Eastbound			Southbound / Westbound		
			Volume	Capacity	V/C	Volume	Capacity	V/C
1	North of Queen Street E	Dixie Road	2,268	2,100	1.08	613	2,100	0.29
		Bramalea Road	2,153	2,400	0.90	608	2,400	0.25
		Torbram Road	2,239	2,400	0.93	624	2,400	0.26
		Total	6,660	6,900	0.97	1,845	6,900	0.27
2	South of Queen Street E	Dixie Road	2,839	2,400	1.18	1,131	2,400	0.47
		Bramalea Road	1,477	1,600	0.92	817	1,600	0.51
		Torbram Road	2,572	2,400	1.07	442	2,400	0.18
		Total	6,888	6,400	1.08	2,390	6,400	0.37
3	North of Steeles Avenue E	Dixie Road	2,274	2,400	0.95	1,145	2,400	0.48
		Bramalea Road	1,967	1,600	1.23	1,075	1,600	0.67
		Torbram Road	2,417	2,400	1.01	1,169	2,400	0.49
		Total	6,658	6,400	1.04	3,389	6,400	0.53
4	South of Steeles Avenue E	Dixie Road	2,251	2,700	0.83	1,440	2,700	0.53
		Bramalea Road	1,040	1,600	0.65	767	1,600	0.48
		Torbram Road	1,644	2,400	0.69	523	2,400	0.22
		Total	4,935	6,700	0.74	2,730	6,700	0.41
5	West of Bramalea Road	Steeles Avenue E	2,268	2,700	0.84	2,401	2,700	0.89
6	East of Bramalea Road	Steeles Avenue E	2,422	2,700	0.90	2,371	2,700	0.88

4.1.5 MMLOS Assessment for 2041 Do Nothing Scenario

The 2041 future baseline multi-modal operations along the corridor segments and signalized intersections are highlighted below for transit, bicycle, pedestrian, truck, and automobile modes. The future baseline scenario incorporates the planned broader network improvements as highlighted in Section **4.1.1** and assumes a four-lane cross-section for Bramalea Road. The Synchro and VISSIM networks include optimized signal splits to account for the projected change in travel patterns without implementing physical improvements to the network.

4.1.5.1 Transit

The transit level of service for segments and signalized intersections along the Study corridor is illustrated in **Figure 22** and **Figure 23** for the 2041 future baseline AM and PM peak hours, respectively. Generally, the transit network operates worse during the 2041 future baseline scenario compared to existing conditions, however, it is worth noting that a significant portion of travel demand (1,255 vehicles during the AM and 1,271 vehicles during the PM peak hour) was unable to enter the VISSIM network due to the travel demand exceeding the available capacity. As the vehicles

around the edges of the network are unable to enter, operations within the network may operate better than if the full travel demand was routed through the network. The VISSIM and Synchro operations are explored in further detail in Section **4.1.5.5**. As noted in the existing conditions MMLOS assessment, improvements such as queue jump lanes at intersections, dedicated HOV/transit lanes and transit signal priority measures are potential improvements that should be considered in the analysis of alternatives to satisfy the MMLOS targets.

4.1.5.2 Bicycles

The bicycle level of service for segments and signalized intersections along the Study corridor is illustrated in **Figure 24** and **Figure 25** for the 2041 future baseline AM and PM peak hours, respectively. The southbound direction during the AM peak hour and northbound direction during the PM peak hour operate with an improved BLOS in the 2041 future baseline scenario due to the lower speeds recorded through VISSIM. The lower automobile speeds would result in an increased cyclist comfort as they have a lower risk of injury if a collision occurs. It is noted that this should not be considered an implementable improvement for cyclists, as reduced speeds should be a result of the road geometry and posted speeds and not due to congestion, which would increase the potential interactions between automobiles and cyclists and increase driver frustration.

All intersections along the corridor continue to operate at a BLOS of “E” or “F” during the AM and PM peak hours. As noted under the future conditions MMLOS assessment, a segregated cycling facility should be considered for the analysis of alternatives to satisfy the BLOS MMLOS target.

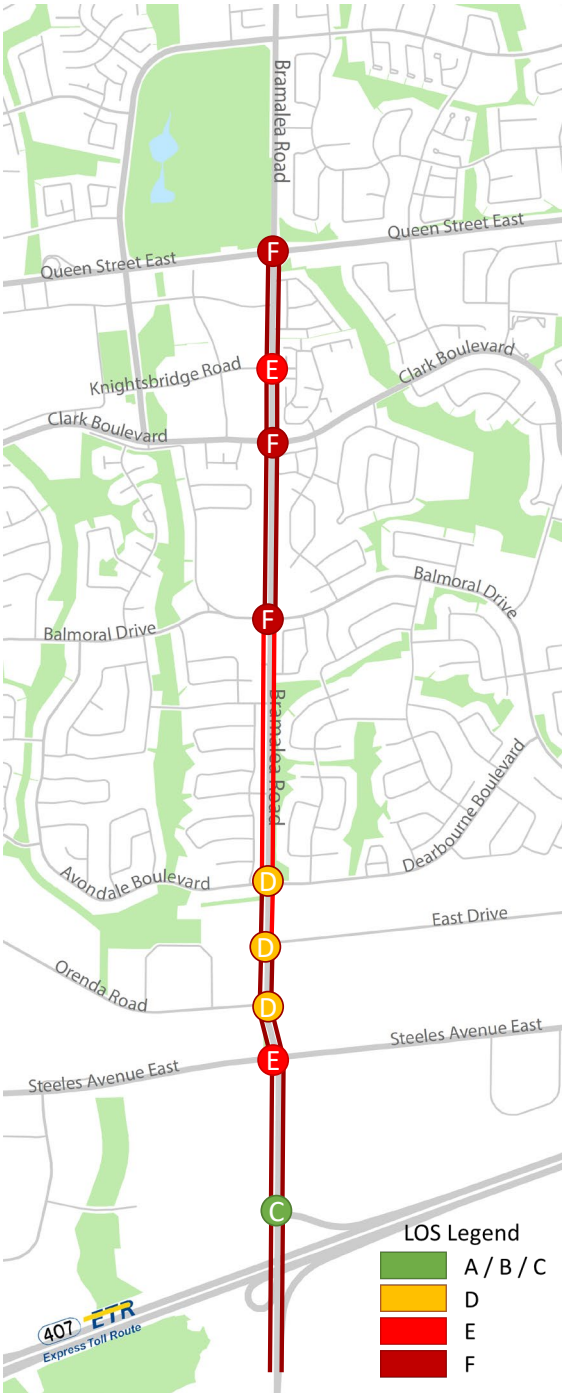

Figure 22 - TLOS | 2041 AM Peak Hour

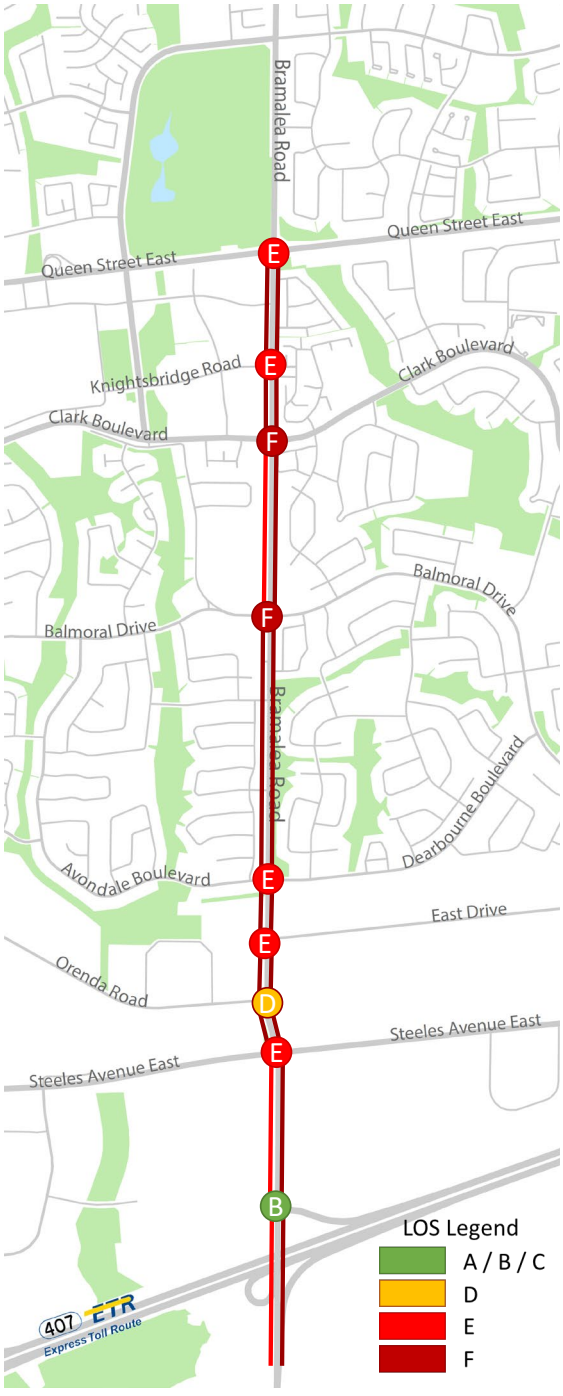

Figure 23 - TLOS | 2041 PM Peak Hour

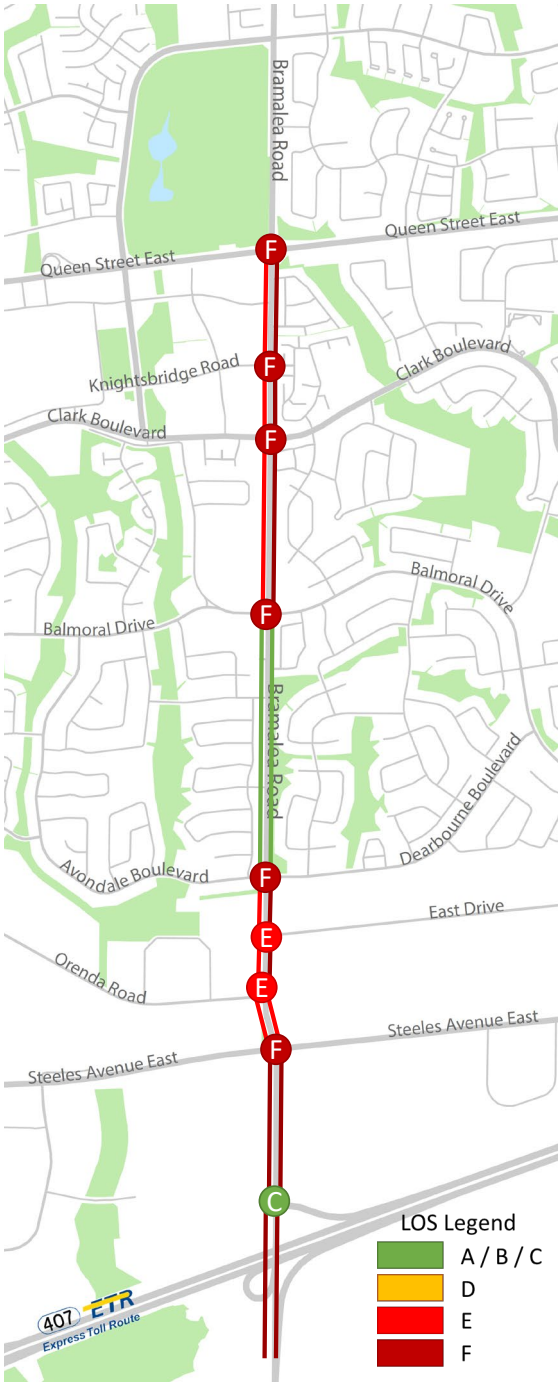

Figure 24 - BLOS | 2041 AM Peak Hour

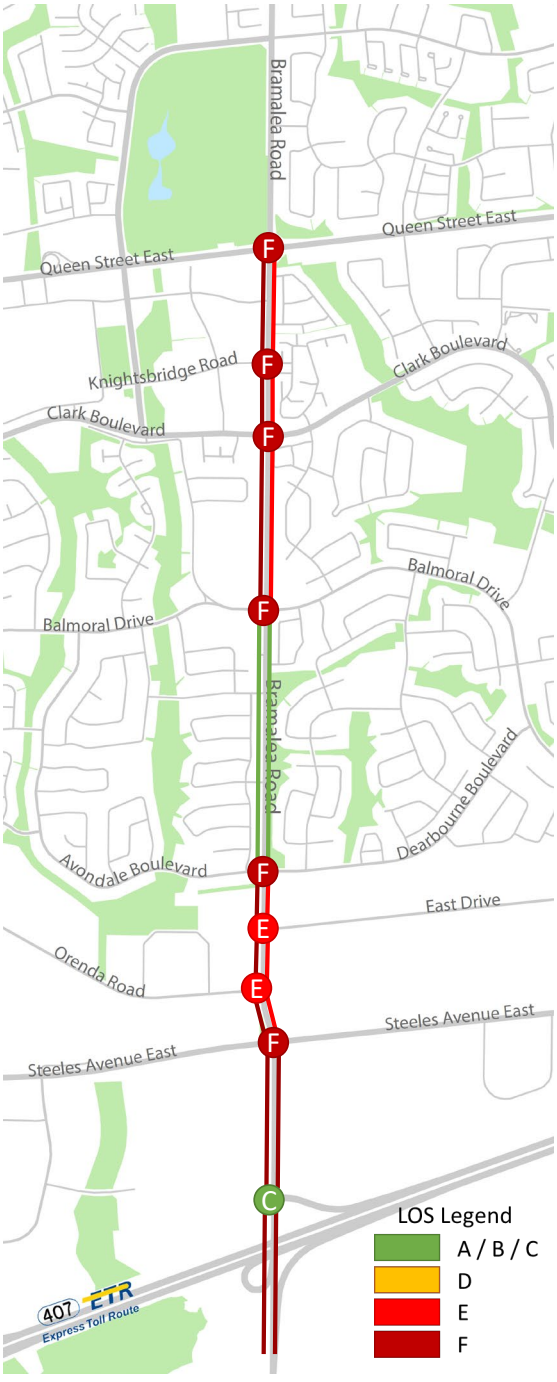

Figure 25 - BLOS | 2041 PM Peak Hour

4.1.5.3 Pedestrians

The pedestrian level of service for segments and signalized intersections along the Study corridor is illustrated in **Figure 26** and **Figure 27** for the 2041 future baseline AM and PM peak hours, respectively. The 2041 future baseline pedestrian levels of service for segments along the corridor resemble that of the existing conditions during the AM and PM peak hour with the following exceptions:

- Southbound between Queen Street East and Knightsbridge Road: During the AM peak hour, this segment experiences an improvement from LOS “E” to LOS “D” due to the reduced speeds recorded southbound during the AM peak hour.
- Northbound between Dearbourne Boulevard and Balmoral Drive: During the PM peak hour, this segment experiences an improvement from LOS “D” to LOS “C” dur to the reduces speeds recorded northbound during the PM peak hour.

All signalized intersection 2041 future baseline PLOS remain unchanged relative to existing conditions for the AM and PM peak hours. As noted under the existing conditions MMLOS assessment, to satisfy the segment PLOS target, sidewalk widths of 1.8 metres, boulevard widths greater than 2 metres, or a multi-use path needs to be considered. Intersection improvements such as reducing lane widths, providing a leading pedestrian interval, reducing corner radii, and increasing the effective walk time should be considered in the analysis of alternatives.

4.1.5.4 Trucks

The truck level of service for segments and signalized intersections along the Study corridor is illustrated in **Figure 28** for the 2041 future baseline AM and PM peak hours. The TkLOS for the 2041 future baseline scenario is unchanged relative to the existing conditions due to the TkLOS being derived from the roadway geometry which has not changed along the Study corridor.

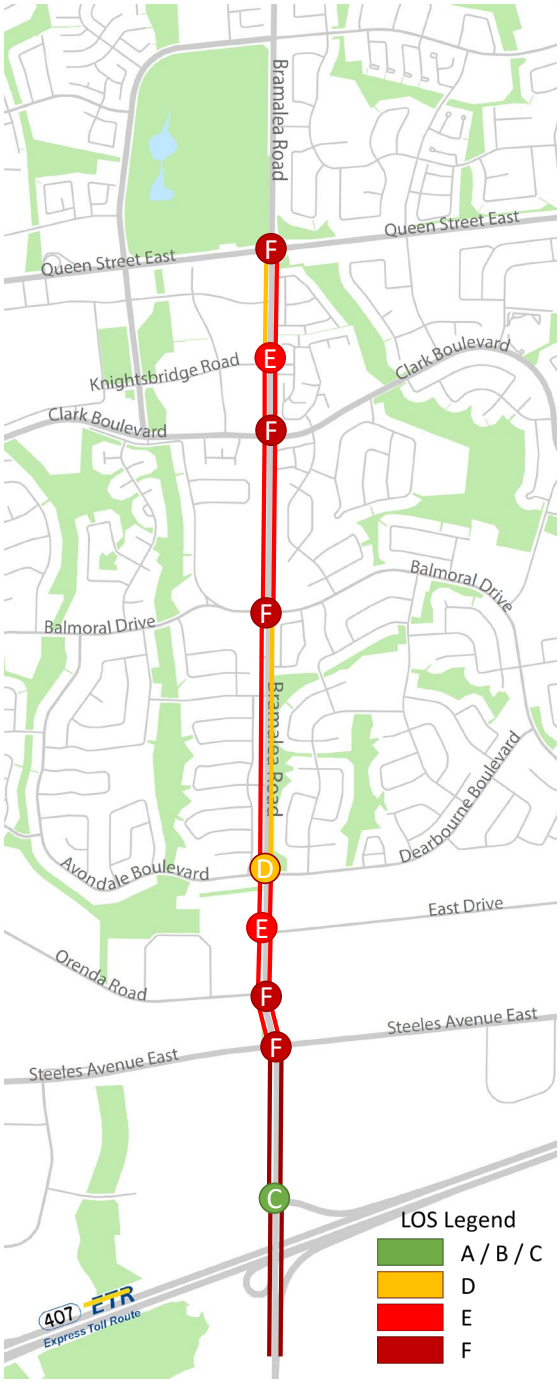

Figure 26 - PLOS | 2041 AM Peak Hour

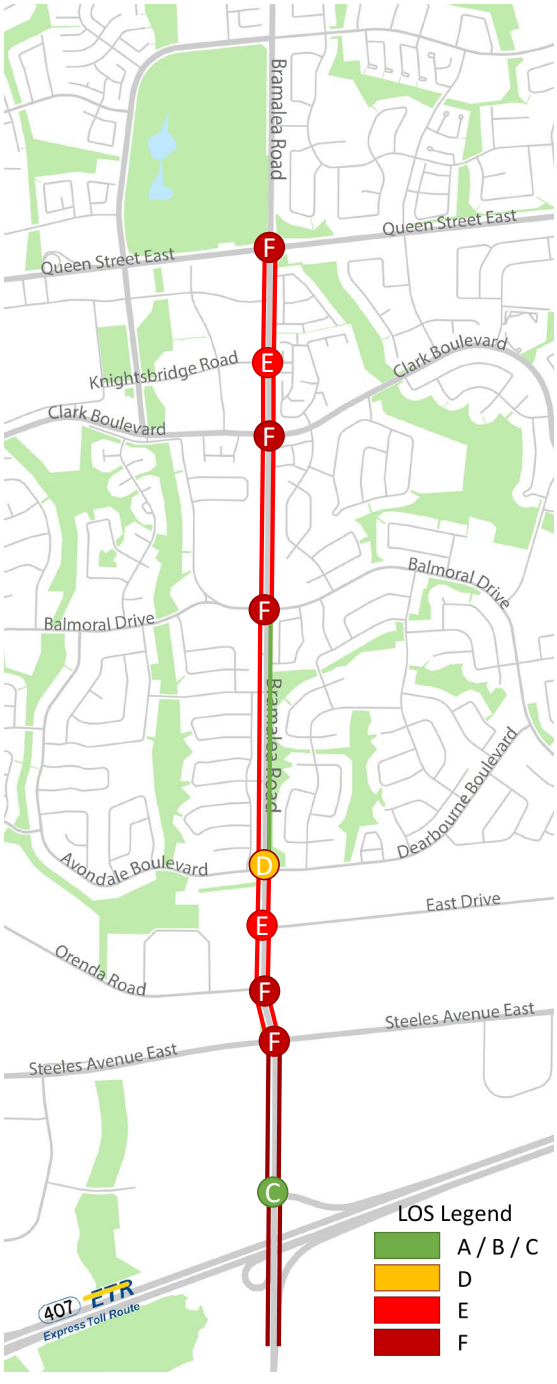

Figure 27 - PLOS | 2041 PM Peak Hour

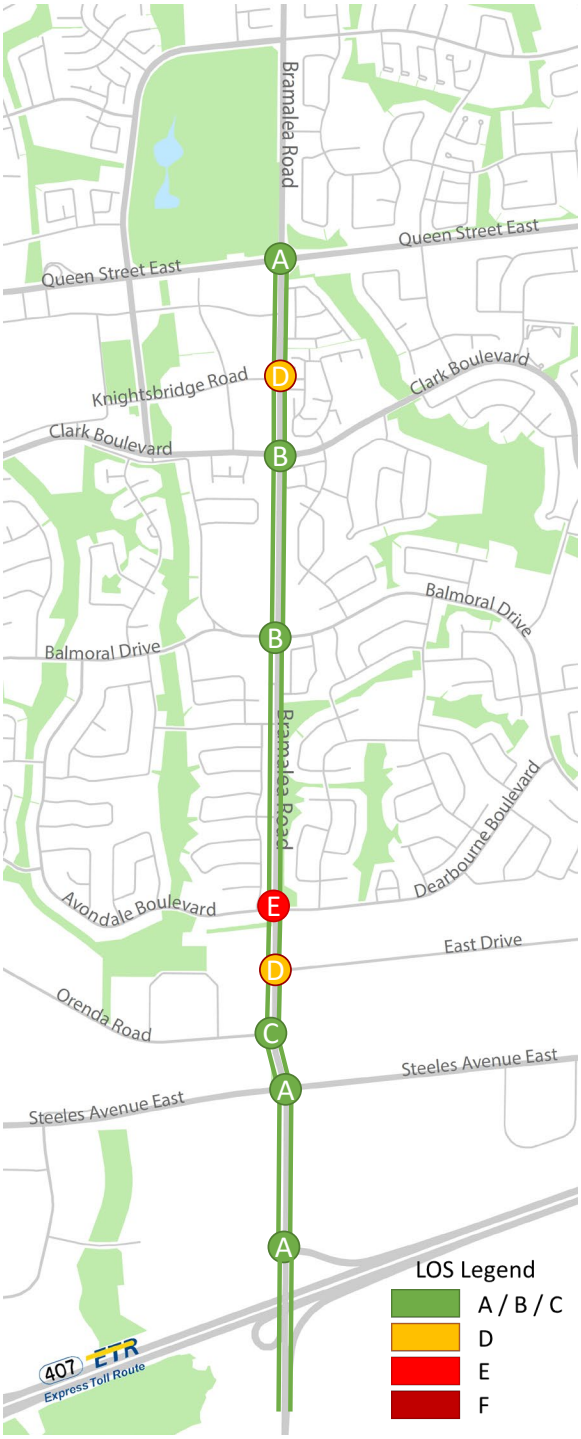

Figure 28 - TkLOS | 2041 AM & PM Peak Hour

4.1.5.5 Automobiles

As noted previously, the 2041 future baseline VISSIM network is unable to process, on average, 1,255 vehicles during the AM and 1,271 vehicles during the PM peak hour. The existing conditions models did not experience blockages at the network edges, indicating that the travel demand growth expected by 2041 will cause some network gateways to exceed their practical capacity. Free-flow conditions were modelled in VISSIM to identify the total demand at the intersection movements to feed into the Synchro models and calibrate the signal splits to best accommodate the travel patterns. The eastbound and westbound gateways feeding volumes to the intersections of Bramalea Road / Queen Street East and Bramalea Road / Steeles Avenue East experience the highest portion of blocked vehicles during the AM and PM peak hours.

The automobile level of service for segments and signalized intersections along the Study corridor is illustrated in **Figure 29** and **Figure 30** for the 2041 future baseline AM and PM peak hours, respectively. **Appendix A.7** includes the detailed intersection analysis results. Synchro reports are also provided in the same appendix.

The roadway segments and signalized intersections during the 2041 future baseline scenario operate with a significantly worsened ALOS during the AM and PM peak hours even with the signal split optimization applied to the Synchro and VISSIM models. The following impacts are observed under the 2041 future baseline scenario:

- The intersections of Bramalea Road with Queen Street East, Knightsbridge Road, Balmoral Drive, and Steeles Avenue East are expected to operate at ALOS “F” during the AM peak hour.
- The intersections of Bramalea Road with Queen Street East, Clark Boulevard, Balmoral Drive, East Drive, and Steeles Avenue East are expected to operate at ALOS “F” during the PM peak hour.
- The northbound segment between Balmoral Drive and Dearbourne Boulevard is expected to operate at ALOS “F” during the PM peak hour.

As signal timing optimization has been applied to the 2041 models, additional mitigation to the operations would require increased capacity through the addition of through or turning lanes. Ideally, the improvements to other modes such as transit, cycling, and walking would shift the mode split away from automobile usage and allow for acceptable ALOS operations along the corridor.

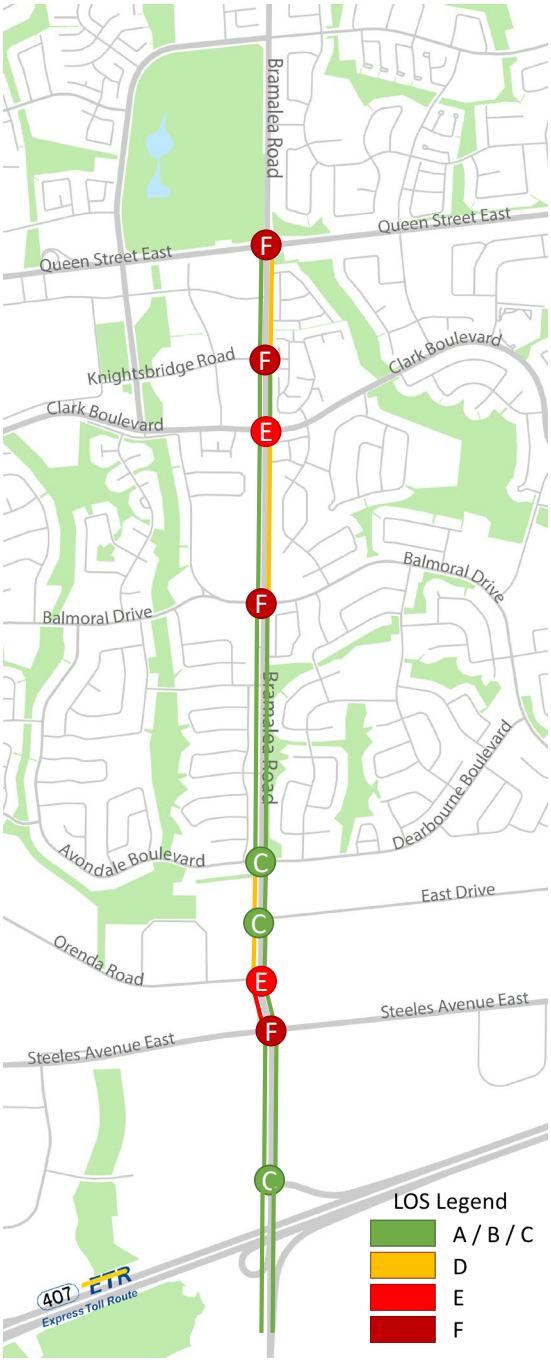

Figure 29 - ALOS | 2041 AM Peak Hour

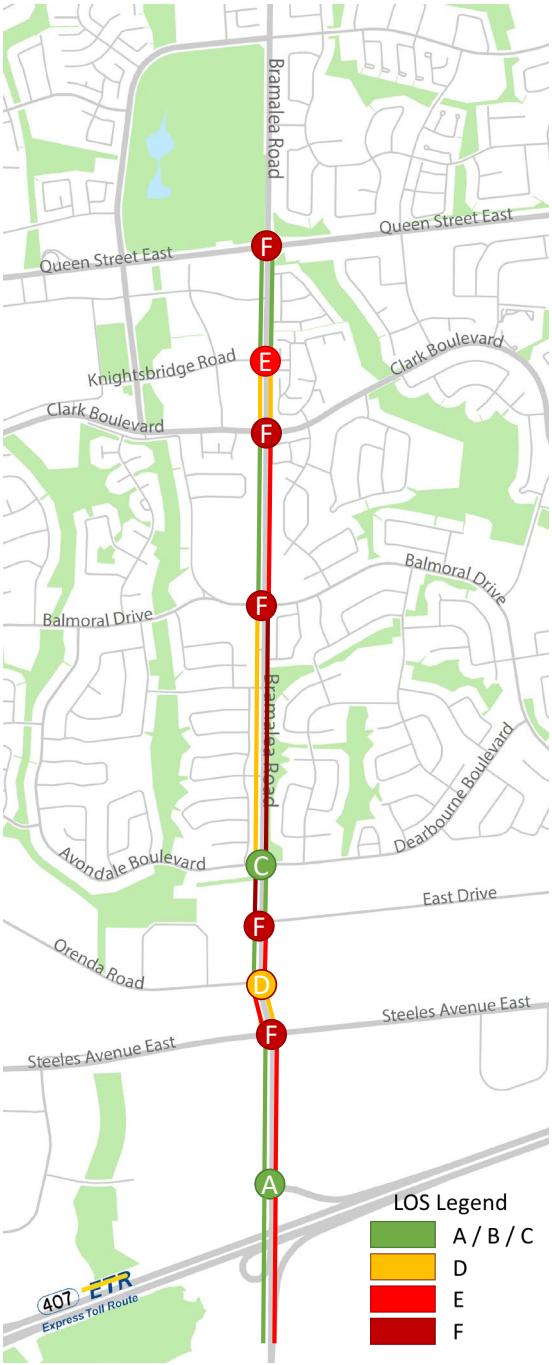

Figure 30 - ALOS | 2041 PM Peak Hour

4.1.5.6 Summary

The segment MMLOS results for the 2041 future baseline scenario are summarized in **Table 18** and **Table 19** for the AM and PM peak hours, respectively. The signalized intersection MMLOS results are summarized in **Table 20** and **Table 21** for the AM and PM peak hours, respectively. As noted in the preceding sections, the travel demand growth forecast by the 2041 horizon year is expected to significantly increase congestion throughout the Study corridor. Although the reduced speeds resulting from the increased congestion result in some minor improvements in operations for non-auto related modes, the reduction in speed should be accomplished through sustainable means that help support the character and functionality of the corridor. Geometric improvements should be considered along the corridor to provide more buffers and increase user comfort, while transit modes should be supported and encouraged to help shift the automobile usage to sustainable modes such as transit, cycling, and walking. Transit improvements such as dedicated travel lanes and bus priority measures at signalized intersections are expected to significantly improve service reliability and travel times and make transit a more attractive alternative.

Detailed results for segments and intersections, including the directional levels of service and calculation inputs are presented in **Appendix F** for reference.

Table 18 - Segment MMLOS Summary | 2041 Future Baseline AM Peak Hour

Bramalea Road Segment		Transit LOS	Bike LOS	Ped LOS	Truck LOS	Auto LOS
From	To					
Queen St	Knightsbridge Rd	F	F	E	A	D
Knightsbridge Rd	Clark Blvd	F	F	E	A	C
Clark Blvd	Balmoral Dr	F	F	E	A	D
Balmoral Dr	Dearbourne Blvd	E	A	E	A	B
Dearbourne Blvd	East Dr	F	F	E	A	D
East Dr	Orenda Rd	F	F	E	A	D
Orenda Rd	Steeles Ave	F	E	E	A	E
Steeles Ave	Highway 407	F	F	F	A	C
Highway 407	South Limit	F	F	F	A	C
Target		**A**	**A**	**B**	**D**	**E**

Table 19 - Segment MMLOS Summary | 2041 Future Baseline PM Peak Hour

Bramalea Road Segment		Transit LOS	Bike LOS	Ped LOS	Truck LOS	Auto LOS
From	To					
Queen St	Knightsbridge Rd	F	F	E	A	C
Knightsbridge Rd	Clark Blvd	F	F	E	A	D
Clark Blvd	Balmoral Dr	F	F	E	A	E
Balmoral Dr	Dearbourne Blvd	F	A	E	A	F
Dearbourne Blvd	East Dr	F	F	E	A	F
East Dr	Orenda Rd	F	F	E	A	E
Orenda Rd	Steeles Ave	F	F	E	A	E
Steeles Ave	Highway 407	F	F	F	A	E
Highway 407	South Limit	F	F	F	A	E
Target		**A**	**A**	**B**	**D**	**E**

Table 20 - Intersection MMLOS Summary | 2041 Future Baseline AM Peak Hour

Bramalea Rd Intersection	TLOS	BLOS	PLOS	TkLOS	ALOS
Queen Street E	F	F	F	A	F
Fleetwood Crescent	E	F	E	D	F
Clark Boulevard	F	F	F	B	E
Balmoral Road	F	F	F	B	F
Dearbourne Blvd	D	F	D	E	C
East Drive	D	E	E	D	C
Orenda Road	D	E	F	C	E
Steeles Avenue	E	F	F	A	F
Highway 407 North	C	C	C	A	C
Target	**A**	**A**	**B**	**D**	**E**

Table 21 - Intersection MMLOS Summary | 2041 Future Baseline PM Peak Hour

Bramalea Rd Intersection	TLOS	BLOS	PLOS	TkLOS	ALOS
Queen Street E	E	F	F	A	F
Fleetwood Crescent	E	F	E	D	E
Clark Boulevard	F	F	F	B	F
Balmoral Road	F	F	F	B	F
Dearbourne Blvd	E	F	D	E	C
East Drive	E	E	E	D	F
Orenda Road	D	E	F	C	D

Bramalea Rd Intersection	TLOS	BLOS	PLOS	TkLOS	ALOS
Steeles Avenue	E	F	F	A	F
Highway 407 North	B	C	C	A	A
Target	**A**	**A**	**B**	**D**	**E**

4.1.6 Preliminary Conclusions

The following preliminary conclusions have been drawn from the future baseline conditions analysis:

- A corridor capacity deficiency equivalent to one lane in each direction is identified in the AM and PM peak hour screenline capacity analysis.
- Alternative solutions are required such that they:
  - Improve the level of service for vehicles on the corridor;
  - Provide opportunities to promote increased transit use in the corridor while improving the transit level of service;
  - Provide opportunities to accommodate increased pedestrian and cyclist activity while improving safety and efficiency of the active transportation system; and
  - Provide opportunities to mitigate the impact of trucks on the corridor level of service.

The generation of alternative solutions and designs will be assessed in the next steps of the Environmental Assessment undertaking.

A.1 VISSIM MODEL DEVELOPMENT & CALIBRATION REPORT

A.2 MMLOS CRITERION AND OTTAWA MMLOS GUIDELINES EXCERPTS

A.3 TRAFFIC DATA

A.4 MULTI-MODAL VOLUME SUMMARY

A.5 SELECT LINK ANALYSIS | EMME MODEL OUTPUTS

A.6 MMLOS ANALYSIS RESULTS – EXISTING CONDITIONS

A.7 MMLOS ANALYSIS RESULTS – FUTURE DO NOTHING 2041

A.8 SYNCHRO ANALYSIS OUTPUT