Memo

Date:	Monday, October 28, 2019
Project:	Promenade Centre Secondary Plan
To:	City of Vaughan
From:	HDR
Subject:	Subarea Model Development and Calibration Memorandum

The City of Vaughan has initiated the Promenade Centre Secondary Plan (PCSP) study. As part of the comprehensive transportation analysis work, a subarea model was developed for the study area using the EMME platform and the York Region EMME model as a base. The purpose of this model is to provide detailed traffic and turning movement forecasts for roads that would otherwise not be included in the Regional EMME model, including minor collector and local streets. Volumes produced from this model are used as inputs to the future year Synchro model intersection analysis.

A subarea was extracted from the York Region EMME model and further refined with a disaggregated zone system and detailed road network. The model was developed for the weekday AM, PM, and Saturday peak hour.

Recognizing that York Region's EMME model is based on the weekday AM peak hour, the AM travel demand matrix was transposed to develop the PM model to provide background traffic flows to the subarea model. In addition, Streetlight Origin-Destination data was obtained to provide additional OD data as well as the seed to the Saturday peak model.

Subarea Model Zone System and Existing Network

The model uses a refined zone system, covering a broader study area bounded by New Westminster Drive to the West, Atkinson Avenue to the East and Clark Avenue West to the South. The subarea zone boundary is shown in **Figure 1**.

The road network in the existing subarea model includes all arterials and collectors, as well as key local roads and is shown in **Figure 2**. Centroid connectors were specifically modified in order to reflect access to local and arterial roads accurately. Network assumptions such as free-flow speed and lane capacity were consistent with the York Region Model standards.

Figure 1: Subarea Model Zone Boundary

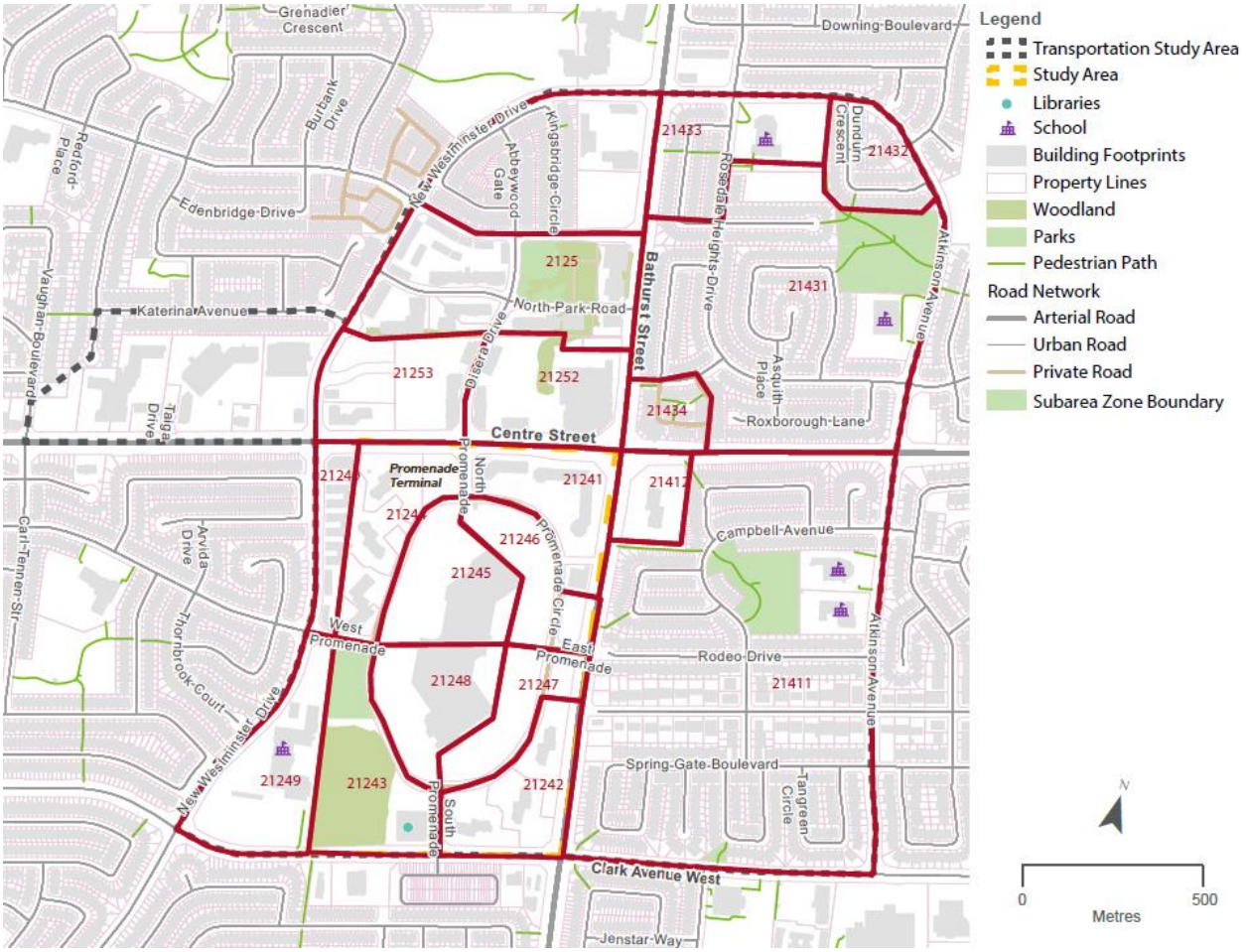
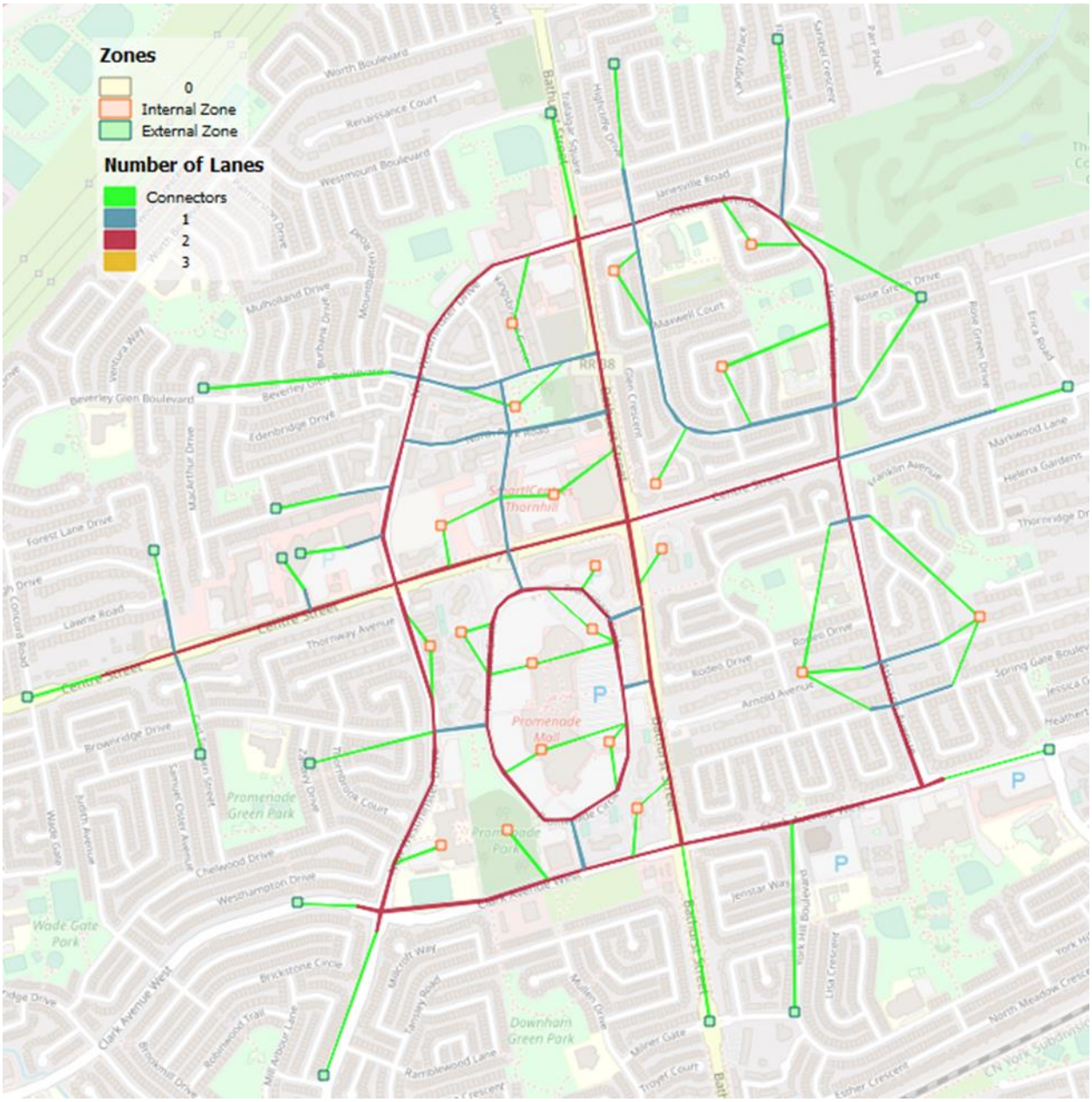


Figure 2: Subarea Model Network (Existing)



Trip Generation and Calibration Methodology

This section documents the methodology used to conduct trip generation and calibrate the existing EMME subarea model. Results of the subarea model are presented at the end. Detailed trip generation data can be found in **Attachment A**.

TRIP GENERATION

The model estimates the number of trips generated in the study area (both trip origin and destination) using trip rates in the Institute for Transportation Engineers (ITE) Trip Generation Manual (10th Edition) and detailed, property-based land use information, with any gaps in data filled in by the 2016 TTS.

The ITE Trip Generation Manual provides the average vehicle trip generation rate at a site in the AM and PM peak hour, and for the peak hour of the site during the weekend. Land use information in the Secondary Plan was provided by the City, including information such as the number of residential units and Gross Floor Area (GFA) for retail areas.

External traffic outside of the study area is generated by the extraction of the OD matrix from the York Region model. In cases where the traffic extracted from the model was unreasonably low or non-existent, the origin and destination totals were replaced with traffic counts on the corresponding street to better match existing conditions. The seed values for that zone are also replaced with a similar street, as there need to be a base number of trips in order to balance. For the weekend model, external traffic is determined exclusively using counts as origin and destination totals, as the York Region model does not provide any data. In cases where counts were not available for a street, the PM model trips were used instead.

This trip generation process provides updated trip origin and destination matrices for zones in the subarea. It was then used as control matrices to update the origin-destination (OD) matrix in the model. This updated OD matrix was then calibrated to the traffic counts.

STREETLIGHT ORIGIN-DESTINATION DATA

Streetlight data was used to generate the O-D seed for the weekend period, as the York Region Model is intended to be used for the AM peak of a typical work day. Streetlight data, when not calibrated, should only be used to determine relative travel patterns between areas, rather than being relied on for actual traffic volumes.

Streetlight OD analysis was performed in order to determine the level of traffic for internal zones, as well as to and from the external zones on a Saturday. The time period used for the Streetlight seed was 3 to 7 PM. It was not possible to perfectly re-create the Promenade sub-area zone system within Streetlight due to a limitation on the number of zones that could be used, and so larger zones were used instead. The resulting OD matrix was disaggregated to the level of the sub-area by splitting the zone to zone demand based on the proportion of trips generated to each component zone. In cases of externals that were not able to have a pass through zone included, demand from a nearby parallel street was used instead, with scaling applied if necessary.

CALIBRATION TARGET

The GEH statistic was used to determine how well the modelled volumes match the observed volumes. The GEH statistic is able to address both absolute and relative difference between the modelled and observed volume. It avoids some pitfalls that occur when using only the relative difference, primarily by allowing for greater variance between modelled and observed data at lower values, but requiring lesser variance at higher values.

The GEH statistic is calculated as:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

Where M is the hourly modelled volume and C is the observed volume (count).

A GEH value less than 5 is considered a good match between the modelled and observed volume; A value between 5 and 10 is acceptable; and a value higher than 10 usually requires further attention for model calibration. Typically 80% to 85% GEH values that are less than 5 is considered as very close match between the modelled and observed volume.

CALIBRATION PROCESS

The OD trip matrix is calibrated to traffic counts using the Demand Adjustment tool in EMME. It is noted that the adjustments made to the OD trip matrix are capped based on a blend of the relative (ratio) and absolute difference compared to the unadjusted demand matrix in order to ensure that single zones do not generate unreasonable amount of trips. After the blend of relative and absolute volume adjustment, a further cap is applied to ensure that no trips are being increased or decreased by a factor greater than 4.

The calibrated OD trip matrix is then imported back to EMME to perform a standard traffic assignment, where the resulting modelled link volumes are compared with the counts to validate the model.

Subarea Model Calibration Results

The GEH statistic reflecting the calibration results is shown in **Table 1**. After applying caps on the adjustments, 70% and 79% of the links have a GEH value less than 5 in the AM and PM peak hour, respectively, indicating a good match between the modelled and observed volume. More than 95% of links have a GEH value that is less than 10 in both AM and PM peak hour. The results show that the modelled volumes are able to match closely with the observed volumes. It is noted that the PM subarea model is not as accurate as the AM model, likely due to the background traffic volumes used in the PM model being based on the transpose of the AM demand matrix taken from the York Region model.

Traffic volumes generated in the subarea model (existing AM, PM, and Saturday Peak Hour) are shown in **Figure 3**, **Figure 4**, and **Figure 5** respectively.

Table 1: GEH Statistic

GEH	Adjusted Demand, Capped, AM Peak Hour		Adjusted Demand, Capped, PM Peak Hour		Adjusted Demand, Capped, WK Peak Hour	
	# of Links	%	# of Links	%	# of Links	%
<=5	104	70%	118	79%	123	79%
5-10	35	24%	25	17%	24	15%
>10	9	6%	7	5%	8	5%
Total	**148**	**100%**	**150**	**100%**	**155**	**100%**

Figure 3. Subarea Area Model Traffic Volumes, Existing AM Peak Hour

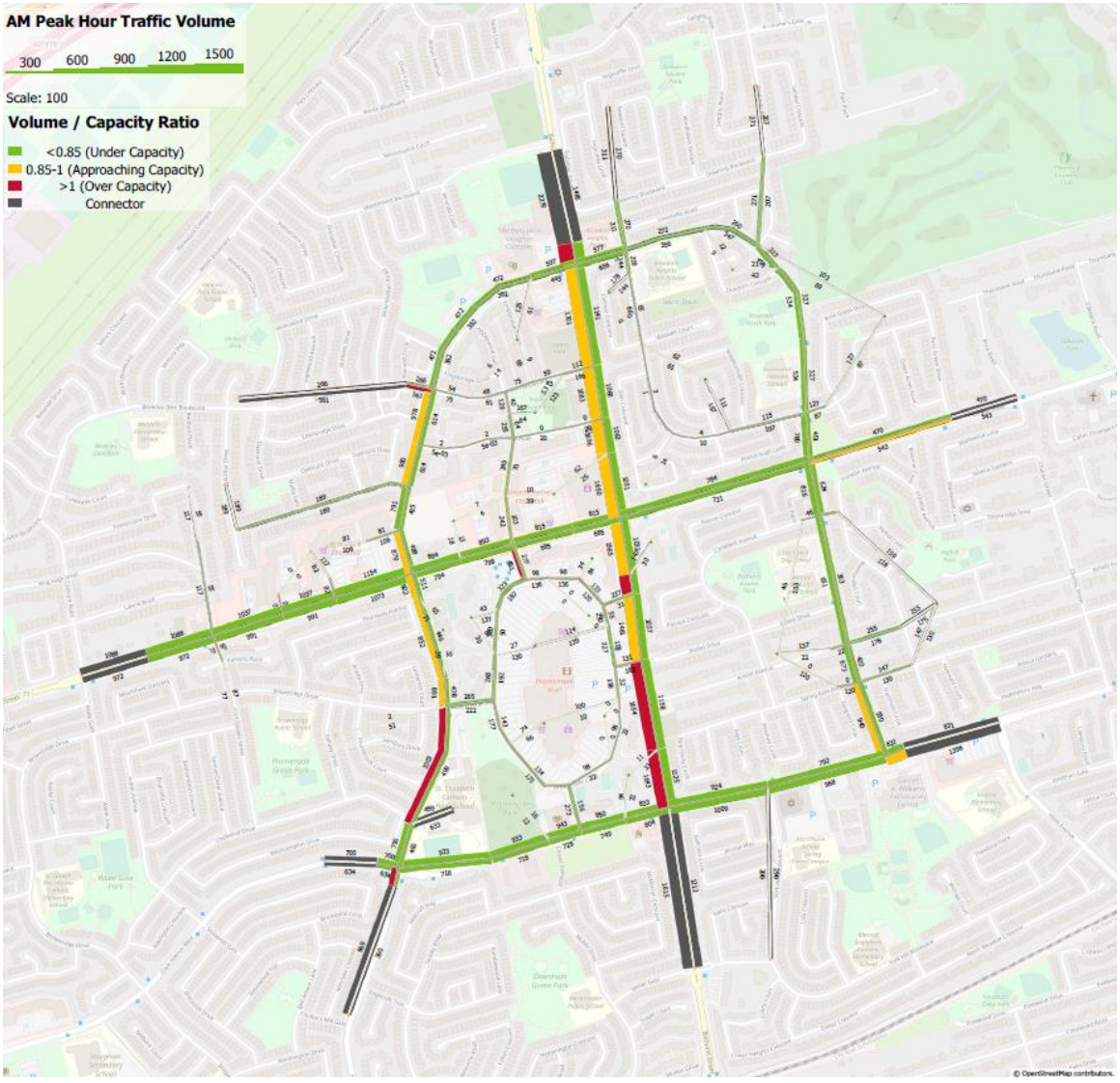


Figure 4. Subarea Area Model Traffic Volumes, Existing PM Peak Hour

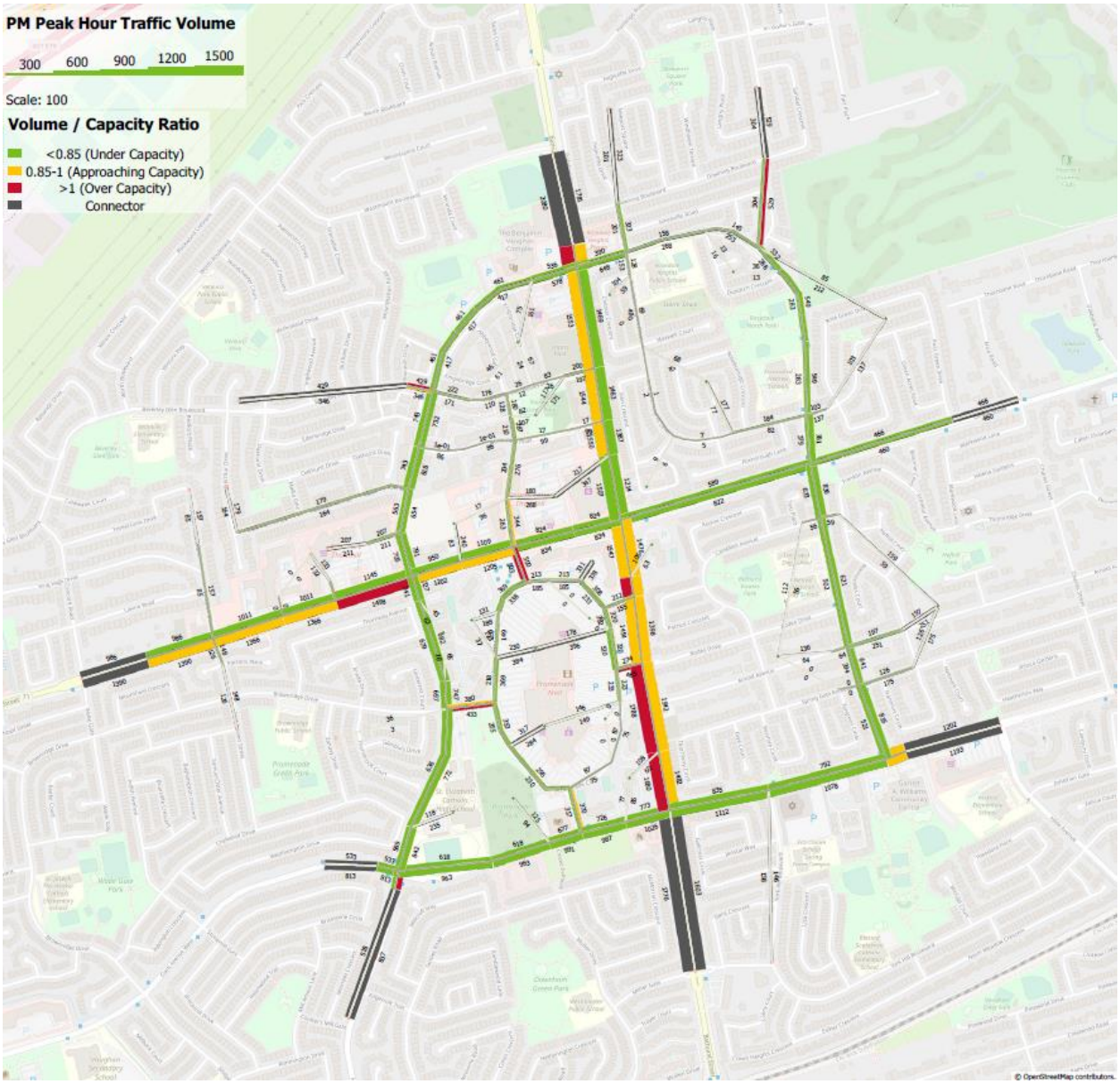
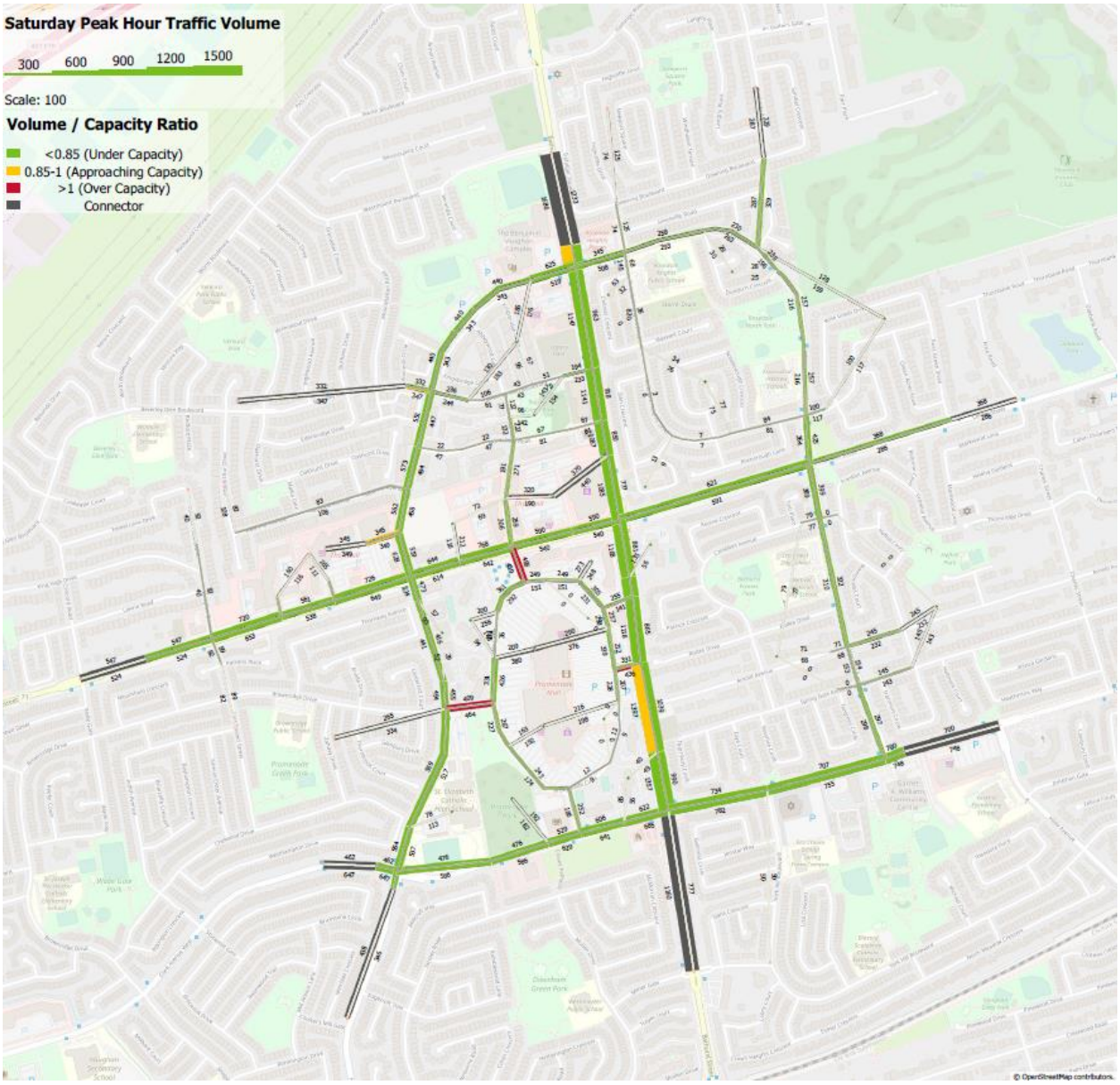


Figure 5. Subarea Area Model Traffic Volumes, Existing Saturday Peak Hour



2041 Base Case Model Development

This section documents the land use and network assumptions and the forecasted traffic volumes for the 2041 Base Case scenario.

2041 Base Case Land Use

The 2041 base case land use assumes York Region's 45% intensification scenario for background transversal demand. In addition, a list of developments that are either under construction, completed, or approved in **Table 2** was assumed and their associated demand was generated using the ITE Trip Generation Manual and added to the demand.

Table 2: Developments added to base land use in 2041

Zone	Address	Development Description	GFA [ft²]	Units	Development Source	Status
21253	777 New Westminster Dr	D'or Condos	421,787	468	Z.0.032/Da.13.014	Under Construction
2125	7890/7990 Bathurst St	Legacy Park[1]	376,202	474	OP.11.007/z.11.032/DA.12.057	Completed
21248	1 Promenade Circle	Promenade Phase 1 Development	-	790	Z.18.020	Approved
21248	1 Promenade Circle	Promenade Phase 1 Development	376,202	-	Z.18.020	Approved

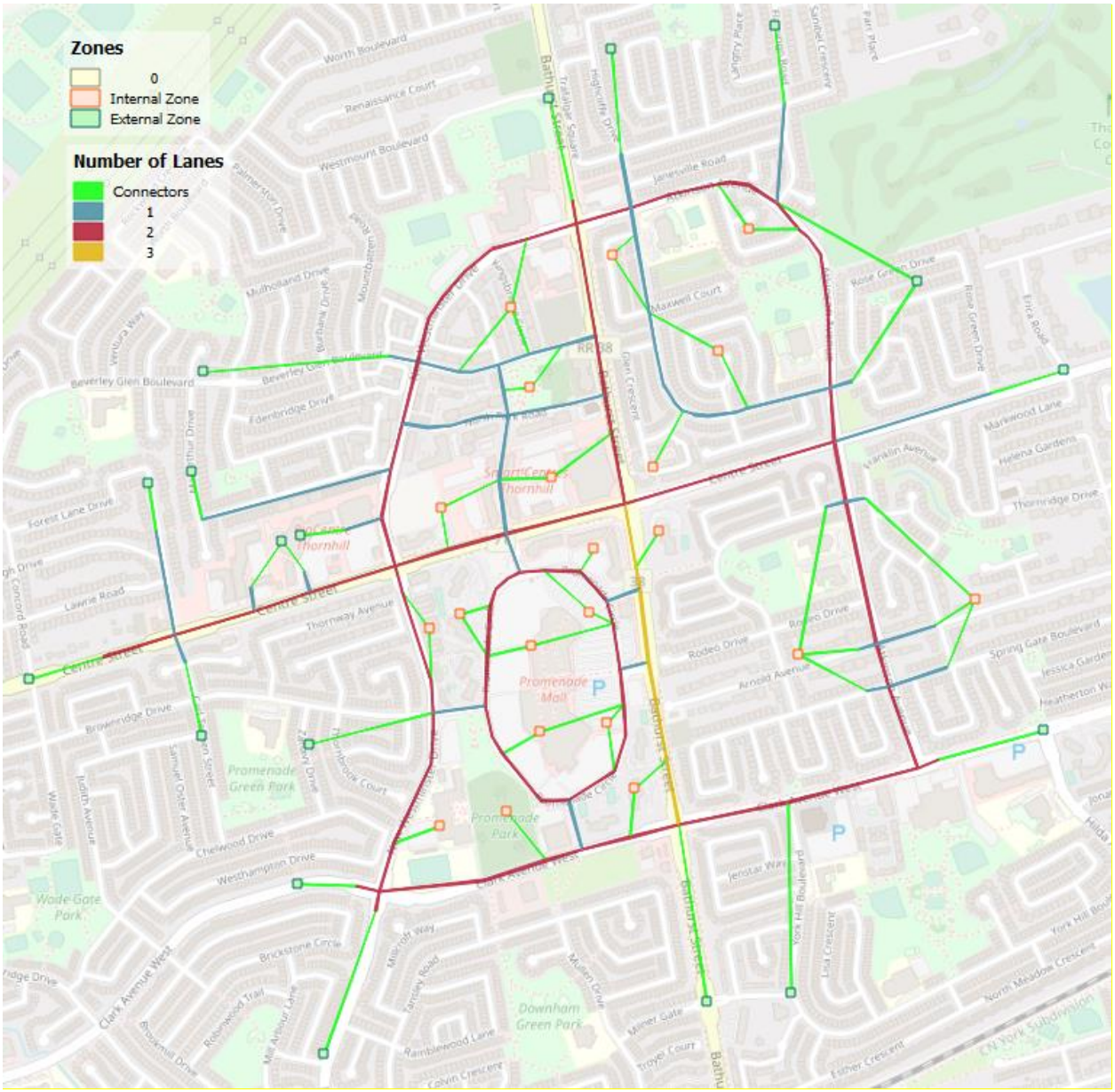
[1] While Legacy Park finished construction in late 2016, it was not included in the base year land as it was likely not reflected in 2016 TTS data

[2] This development is outside of the Promenade study area. In order to capture the effects of the relatively large development, trip generation was performed for the units, and 25% of this traffic generated was assumed to enter the Promenade area. This was added to the origin or destination totals of the corresponding external zone. It was verified that these developments were not included in the York Region model 2041 land use.

2041 Base Case Network

The 2041 Base Case scenario assumes planned improvements identified in the York Region TMP, where Bathurst Avenue will be widened from 4 lanes to 6 lanes. (4 lanes plus 2 transit lanes). The 2041 Base Case road network is shown in **Figure 6**.

Figure 6: 2041 Base Case Network



2041 Base Case Mode Share

The 2041 base case model assumes the same mode share as the York Region model. With these network assumptions, the 2041 Base Case transit modal split for the study area is approximately 29%, as shown in **Table 3**. Different mode share scenarios will be tested in the next phases of this study.

Table 3: Modelled Modal Split for 2041 Base Case

Mode	% of Trips		% of Trips	
	2011 Modelled	2041 Base Case Modelled	2011 Modelled	2041 Base Case Modelled
Auto driver	5,800	9,550	68%	56%
Auto passenger	1,270	2,550	15%	15%
Transit	1,440	4,900	17%	29%
Total	8,510	17,000	100%	100%

Source: York Region Model, extracted for TTS 06 zone 2204, 2205, 2246-2250

2041 Base Case Traffic Volumes

A demand matrix was extracted for the subarea from the York Region model. The matrix was further disaggregated into the finer zone system, as discussed earlier. Ratios for the demand disaggregation were based on the number of trips generated in the existing conditions. The demand adjustment factors from base year adjustments are applied to the demand generated for 2041.

The 2041 AM, PM and weekend peak hour traffic volumes are shown in **Figure 7**, **Figure 8** and **Figure 9** respectively. With the projected population and employment growth, the area is expected to be heavily congested in 2041. These volumes were used in the 2041 Base Case Synchro traffic analysis to conduct detailed analysis for traffic operations.

Figure 7. 2041 Base Case AM Peak Hour Traffic Volume

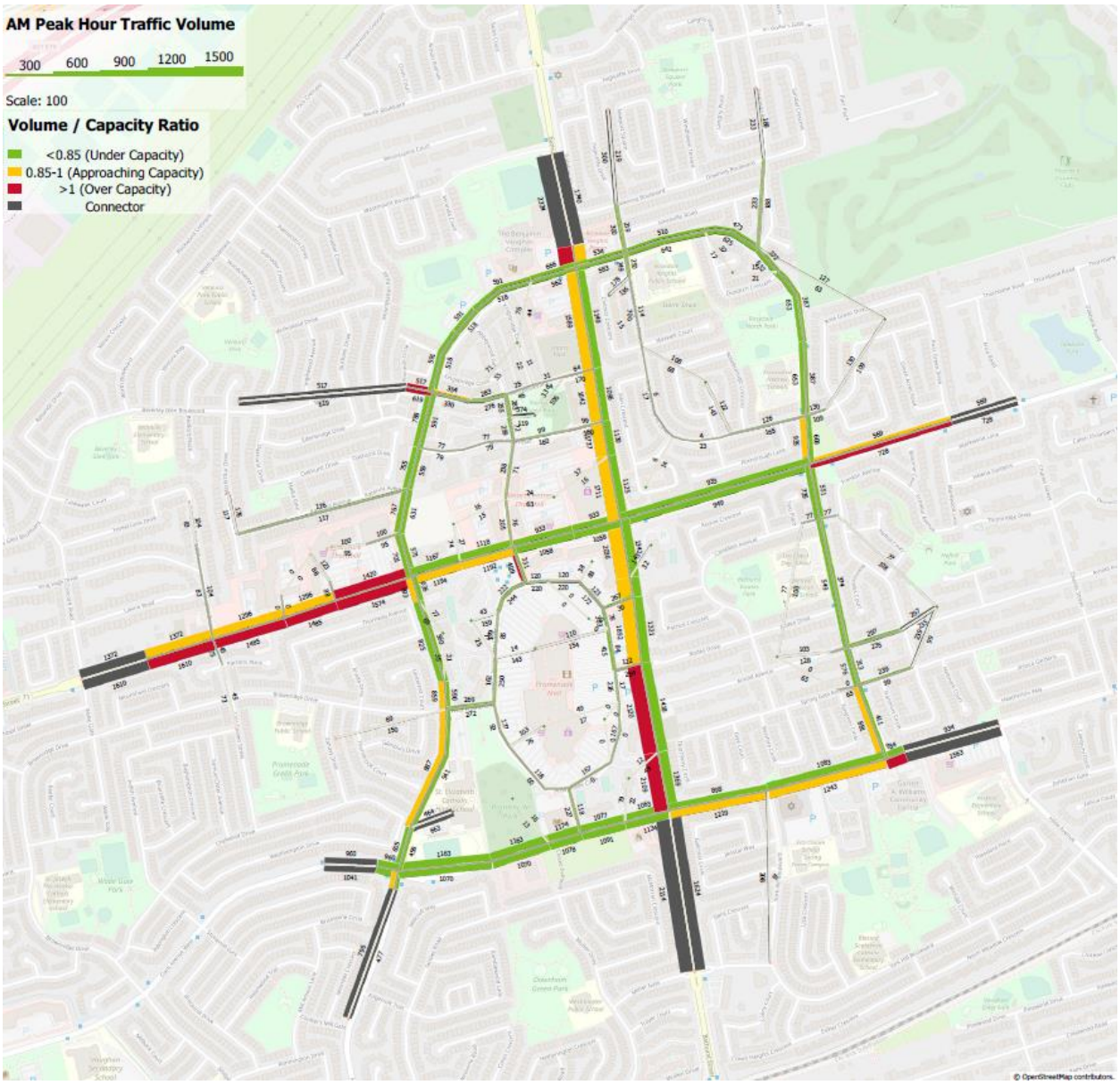


Figure 8. 2041 Base Case PM Peak Hour Traffic Volume

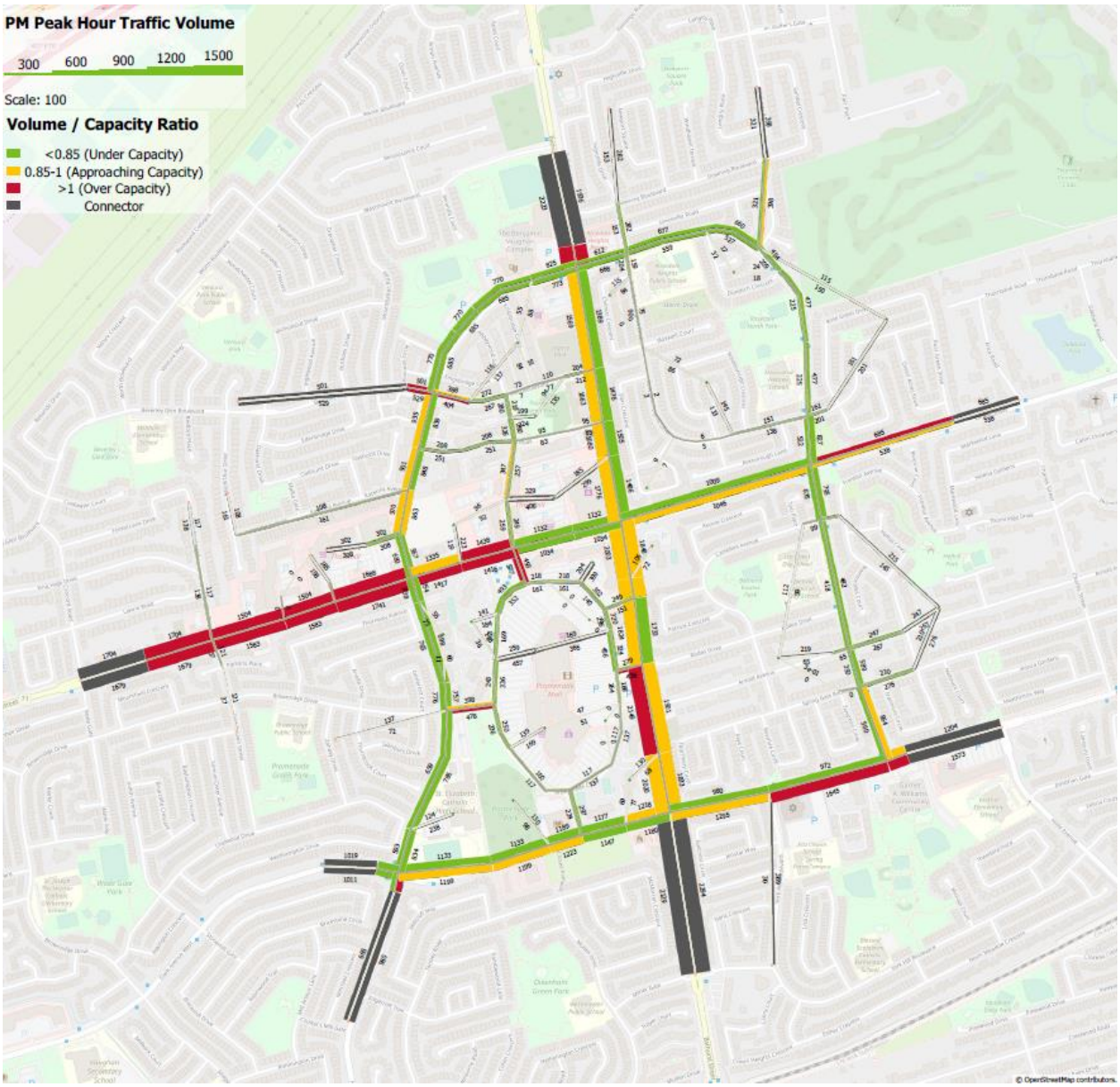


Figure 9. 2041 Base Case Saturday Peak Hour Traffic Volume