Appendix C

- ✓ **Model Development and Results**
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Model Development and Results

York Region Trip-Based Travel Demand Model Calibration

Zone System Revisions

In order to better represent densification efforts proposed by the City on important corridors and in Major Transit Station Areas (MTSAs), a number of zones in the York Region model were further split based on the following criteria:

- ✓ Forecast 2051 population ≥ 5000 people
- ✓ Forecast 2051 employment ≥ 2500 jobs
- ✓ GO Rail: Area overlap to 800m buffer around future GO stations represents between 10 and 60% of the zone area
- ✓ Subway: Area overlap to 800m buffer around future subway stations represents between 10 and 60% of the zone area
- ✓ VIVA BRT: Area overlap to 500m buffer around future BRT lines represents between 10 and 60% of the zone area
- ✓ MTSA: Zone contains a MTSA with at least 150 residents + jobs per hectare, which represents between 5 and 60% of the zone area.

For zones to be split, at least two of the above criteria had to be met. The zones were manually split considering geographic borders, such as rivers, suitable network connections for connectors, and population/employment forecasts. Upon completion of this step, 30 new zones were created from the zone splits. The zone system has been designed as the RH22 system.

Network Revisions

Following the zone splits, the network in their vicinity was reviewed to ensure the following:

- ✓ Sufficient connectors available to serve forecast zone population and employment without causing “choke” points where people enter and leave from a zone.
- ✓ Connectors and local streets modelled with sufficient granularity for travel demand model applications. Because the travel demand model does not generally include all collector and local roads, the approach taken was a road connecting to an arterial at a signalized intersection.
- ✓ Connectors allowed for people to leave and enter the zone to all directions, as feasible by the existing road network.

Outside of a network review in the split zones, the following network changes were also made:

- ✓ Updated the toll costs on Highway 407 to reflect 2016 tolls
- ✓ Slight reduction of HOV lane capacity on Highway 404 to 1600 veh/hr/lane.

The changes discussed in this section reflect the road and transit networks that were available in the 2016 base year. Additional network changes were made to model forecast years, which are described in later sections of this memo.

Land-Use Inputs

The base-year population and employment counts were obtained from the 2016 TTS. Population and employment counts in the GTA06 zone system were proportioned into the revised York Region model using zone population and employment split proportions provided by York Region and were proportioned again into the RH22 zone system using the splits manually developed. The 2016 population and employment values were used for the purposes of model calibration and validation.

Future population and employment counts were updated from the York Region model, proportioned from separate RH22 zone splits which we calculated for future years. Population and employment within York Region were updated using new forecasts obtained from the Region.

Additional inputs used from 2016 include the average household income. This information is from a custom census tabulation provided by the Ministry of Transportation (MTO) and the value is in nominal dollars.

The average number of driving-age adults is also used as an input to the auto ownership model, and was updated using the 2016 TTS, queried by GTA 06 zone. “Driving age adult” was defined as any individual 16 years or older and like the average household income, this was also kept constant for future forecasts.

The inputs referenced in this section are all consistent with the York Region Model.

Auto Ownership Model

The model contains a component which forecasts household auto ownership rates at the zone level to use as an input to the mode choice model. In the recalibration, a new logistic choice model was established. In addition to the original auto ownership predictors, “dummy” variables were added indicating if the zone is within the TTS’ central Toronto planning district (PD1) or the surrounding ones (PD2-6). The intent was to be able to better predict auto ownership rates. For consistency purposes, the new model was fit at the level of GTA 06 zones using updated land use inputs and auto ownership rates from the 2016 TTS and was weighted by the number of TTS responses to control for variance in the TTS rates.

Estimated model coefficients are shown in **Table 1**. All parameters are statistically significant, with significance levels indicated by the number of stars in the “significance” column. All coefficients also have roughly expected effects – increasing household income and size increases predicted ownership rates, while increasing density and being located near rapid transit or in the highlighted planning districts reduces predicted ownership rates.

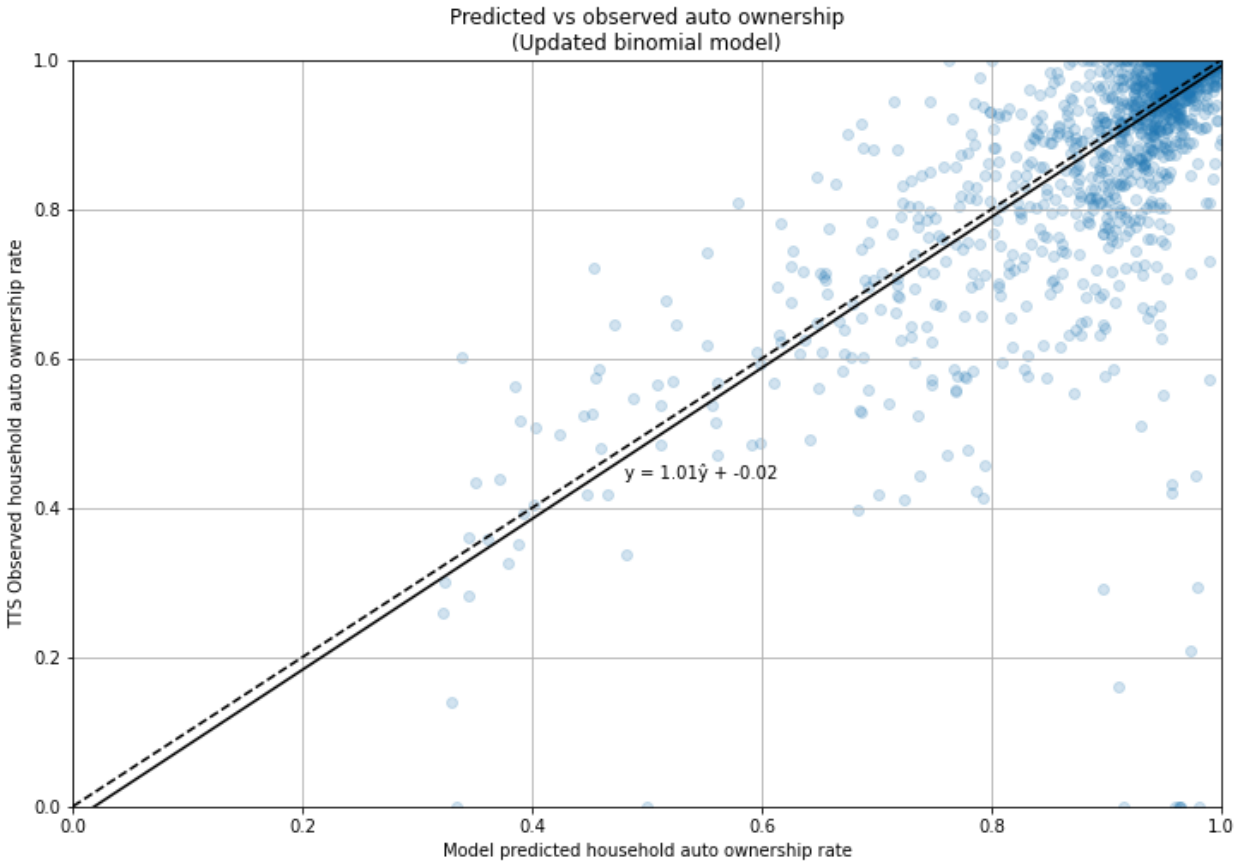
Table 1. Auto Ownership Logistic Model Coefficients

Model Parameter	Model Coefficient	Significance[1]
Intercept	0.9333	-
Household average income (1000s of 2016 dollars)	0.01234	***
log density log 0.01 + (population + 2 employment) / hectare	-0.3234	*
Average number of adults (16+) per household	0.9363	***
Zone within 1.5 km of a rapid transit station	-0.4648	**
Zone in PD1	-1.0266	***
Zone in PD2-6	-1.0182	***

Figure 1 provides a comparison between the household auto ownership rate predicted from the updated model and those observed from the TTS in the 2016 calibration year. As can be seen, outside of a small handful of outliers, the auto ownership from this model matches the TTS observed auto ownership reasonably well, forming a band around the 45° line. An estimated regression between the observed and predicted values shows a small intercept and a slope coefficient of nearly 1.0, indicating low bias.

[1] Model estimation was performed in Python using the statsmodels package. Due to technical limitations of the package, model statistics were not calculated when using observation weightings, so parameter significance was calculated here and in model selection using a separate unweighted estimation.

Figure 1. Updated Auto Ownership Rate Logistic Model Validation to TTS



Trip Generation

Trip generation is defined as trips that originate at or are destined to a zone, segmented by trip purpose. Trip generation is performed in the model at the zone level for 6 different categories of trips:

- ✓ Work trips for general office, sales, and service workers
- ✓ Work trips for manufacturing workers
- ✓ Work trips for professional workers
- ✓ School trips for secondary school students (defined as age 11-18)
- ✓ School trips for postsecondary students (defined as age 19+), and
- ✓ All Other trip purposes.

These categories were kept from the original York Region model and are based on the TTS occupation categories and trip purpose of destination categories (work, school, subsequent school, and all others). Trip generation only models interzonal trips using motorized modes, which are trips whose primary travel mode is the driver or passenger of a private automobile, or transit. For all categories, trip generation is calculated for each zone by applying origin and destination interzonal motorized trip generation rates to the zone's population and employment. Work and school trips origins are calculated from the population, while work trip destinations are generated by employment. Other trips origin and destination generation is calculated from both population and employment.

All rates were re-estimated in our recalibration using trips observed in the 2016 TTS along with the population and employment counts described in Land-Use Inputs. Following the original York Region model, generation rates for work and school trips were calculated at the TTS planning district level, while generation rates for other trips were calculated for 4 broad zone groups and estimated via linear regression.

Tables comparing modelled trip generation rates with trip origins and destinations obtained from the TTS can be found in **Appendix A** within this document. As can be seen in these tables, the trip generation shows excellent agreement with observed TTS trips for work and school trips. The agreement for other trips is still good, more variation between modelled and observed trips is expected in these trips due to the multiple-regression structure of these models.

Trip Distribution

The York Region trip-based model uses two different methods to calculate trip distribution. The distribution of work trips is calculated using a gravity model, which is commonly used for trip-based models. This is performed separately for each of the 3 occupation groupings described in the Trip Generation section. For each O-D pair, a weighting is calculated based on travel times and other costs, and trips are created by combining this weighting with trip generation at origin and destination. The budget and scope of our work did not allow for large scale changes to the trip distribution model, but a light recalibration was performed by

adjusting region-level weighting factors to better match the observed 2016 TTS trips.[2] A comparison of O-D work trips predicted by the recalibrated model and those observed in the 2016 TTS can be found in **Appendix B** within this document.

To calculate the trip distribution for school and other trips, the model starts with a base-year trip distribution for each trip type. This base-year distribution is then reweighted using trip generation for the forecast year to obtain a forecast-year distribution. Recalibration for these trips amounted to updating the base year trip distributions using the 2016 TTS and verifying that the trip distribution calculated by the model reflects observations from the TTS.

Trip distribution is only calculated for the model's internal zones (within the GTHA). Trips to and from external zones are generated from a fixed distribution, which is a unique input for each scenario year. External trips for 2016, 2031, and 2041 were obtained from the York Region model. New external trips were generated for 2031 and 2051 based on the 2041 external trips with a global growth factor based on Ontario Ministry of Finance population projections for Ontario.

Additional Changes

When calculating transit cost matrices for the new Richmond Hill zones, it was discovered that 76 of the York Model zones had missing values for all their origin transit costs, which included 6 zones in Richmond Hill. This was assumed to be an oversight from a previous model iteration and hence all York Region zones with missing costs were identified and updated with costs from the closest non-missing zone within York Region.

Validation to Traffic Counts

With the completion of calibration, the model was validated by comparing simulated 2016 traffic volumes with observed traffic counts from 2016. As is typical for travel demand model validation, traffic counts were validated at the screenline level.

Figure 2 shows the screenlines that were used to validate the model. A range of north-south screenlines span Richmond Hill, including border roads. East-West screenlines were separated into a southern region between Steeles Ave. and Elgin Mills Rd., and a northern region that included roads north of Elgin Mills. These screenlines are divided by direction: 1 – Northbound, 2 – Eastbound, 3 – Southbound, and 4 – Westbound. For example, screenline 404 refers to the westbound direction of screenline 40.

A comparison of simulated and observed screenline volumes is shown in **Table 2.** Traffic count observations took place over the entire 6:00-9:00 AM peak period, so they were converted to a peak hour count multiplied by a peak-hour factor of 0.462. This peak hour

[2] Weighting factors were only changed when predicted trips differed from those observed in the 2016 TTS by over 10% and with an absolute difference greater than: 600 trips for general office and sales workers, 300 trips for manufacturing workers, and 1000 trips for professional workers. Factors for all 3 work trip types were updated iteratively, until all O-D pairs for all work trip types were within the acceptance criteria.

factor was calculated as the average model peak hour factor for trips originating or ending within York Region, weighted by modelled auto demand.

Screenline counts were mainly compared using the volume difference per lane, calculated as the total modelled volume minus the total counts, divided by the number of lanes in the screenline. A target of 200 vehicles per lane was used to identify whether simulated volumes differed from observed volumes. This is half the capacity of a local road, errors below this threshold are anticipated to have minimal effect on widening decisions. Examination of the validation screenlines found the following:

- ✓ Highway 407 volumes are represented reasonably well. Simulated volumes are higher than observed volumes in the eastbound direction and lower in the westbound direction, but within our target for both.
- ✓ Highway 400 volumes match the observed volume well in the southbound direction, but the simulated volumes are approximately 30% lower in the northbound direction. However, as there is only one traffic count for comparison located north of Elgin Mills Road, more counts would be needed to improve the volume estimate.
- ✓ Within Richmond Hill (excluding highways), 7 of 34 screenlines (20%) exceed our target volume difference per lane.
- ✓ In the northbound direction, simulated volumes are close to observed volumes with no screenline volume differences exceeding the target.
- ✓ In the southbound direction, three screenlines (133, 143, and 153) exceed the target with volumes being higher than the observations. Screenline 143 only exceeds the target by a small amount. Screenline 133, which is located just south of Major Mackenzie Drive, exceeds the target by approximately 65%. This area is already congested in the southbound direction in 2016, so the simulated volumes may be overpredicting because peak spreading of traffic to local and collector roads in congested conditions cannot be accurately captured by the model. Screenline 153 overpredicts the observed volumes by approximately 40%; since the count locations for this screenline are north and south of Stouffville Road, this discrepancy may be due to differences in the distribution of traffic between the southbound arterial roads.
- ✓ In the eastbound direction, two screenlines (322 and 324) slightly exceed the target of 200 vehicles per lane, with screenline 322 being higher and screenline 342 being lower than the observed volume.
- ✓ In the westbound direction, two screenlines (304 and 424) exceed the target difference between simulated and observed volumes. Screenline 304 overpredicts the volumes and Screenline 424 underpredicts the volumes. Screenline 424, just west of Highway 404 in north Richmond Hill, only has two count locations across the four arterial roads so the discrepancy may be due to the distribution of traffic across the Highway 404 crossings.

Figure 2. Screenlines used to Validate Traffic Counts from 2016 Base-year Model

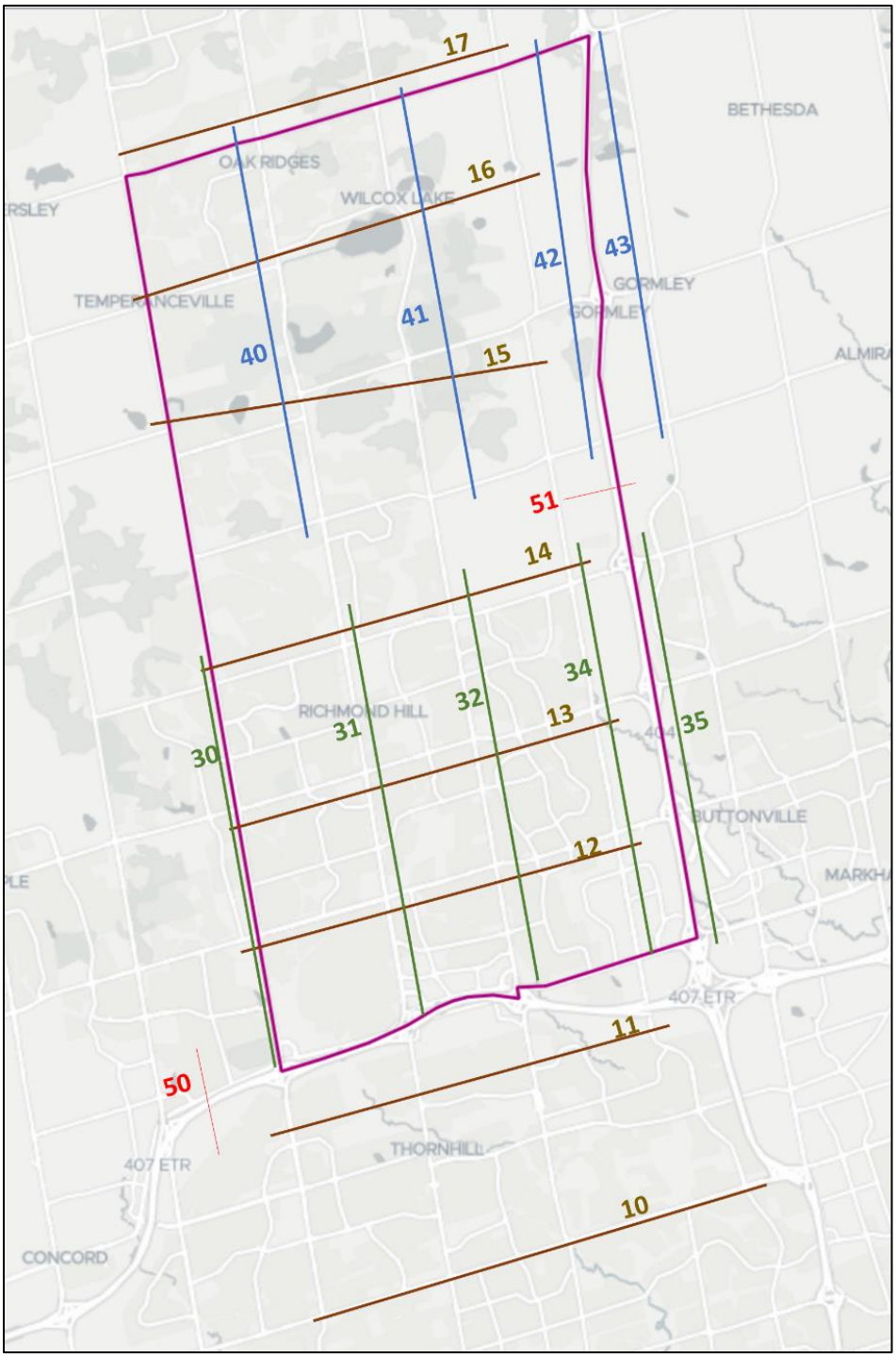


Table 2. Traffic Count Validation by Screenline

Screenline[1]	Number of links	Observed (PHF-adjusted) Total	Simulated volume Total	Simulated / Observed Ratio	Simulated - Observed difference per lane
101	4	4,633	3,381	0.73	-139.10
103	4	7,554	6,407	0.85	-127.40
111	4	4,875	5,306	1.09	43.14
113	4	7,290	6,952	0.95	-33.81
121	3	2,301	2,116	0.92	-30.74
123	3	6,692	5,964	0.89	-121.38
131	3	1,274	1,719	1.35	74.16
133	3	3,245	5,321	1.64	345.94
141	4	2,948	2,090	0.71	-143.00
143	4	5,209	6,480	1.24	211.86
151	4	1,652	1,869	1.13	36.18
153	4	3,449	4,877	1.41	237.97
161	4	1,910	2,193	1.15	47.21
163	4	4,274	4,510	1.06	39.33
171	4	2,233	2,560	1.15	54.60
173	4	4,280	4,351	1.02	11.83
302	4	3,497	4,191	1.20	86.75
304	4	4,445	6,516	1.47	258.93
312	3	4,257	4,954	1.16	99.61
314	3	4,410	4,849	1.10	62.72
322	3	2,900	4,168	1.44	211.40
324	3	2,939	3,363	1.14	70.68
342	4	8,567	6,612	0.77	-217.26
344	4	9,107	8,775	0.96	-36.86
352	4	5,222	5,538	1.06	35.15
354	4	6,635	6,617	1.00	-2.03
402	3	1,983	2,667	1.34	113.98
404	3	2,039	2,499	1.23	76.63
412	3	2,455	3,216	1.31	190.27
414	3	1,575	2,190	1.39	153.88
422	3	2,622	3,122	1.19	125.00
424	3	3,214	2,372	0.74	-210.46
432	2	1,537	1,555	1.01	4.66
434	2	2,109	2,136	1.01	6.64
502	1	3,085	3,536	1.15	112.79
504	1	6,163	5,925	0.96	-59.57
511	1	3,471	2,392	0.69	-359.69
513	1	6,052	6,001	0.99	-17.01
Grand Total	122	152,102	159,291	1.05	30.21
Northbound	31	25,296	23,626	1.07	28.78
Southbound	31	48,046	50,863	0.94	-48.58
Eastbound	30	36,124	39,560	0.91	-56.32
Westbound	30	42,636	45,242	0.94	-42.72

[1] The first two digits of the screenline number indicate the location as shown in **Figure 2.** Screenlines used to Validate Traffic Counts from 2016 Base-year Model

, and the last digit of the screenline number indicates the direction where: 1 – Northbound, 2 – Eastbound, 3 – Southbound, and 4 – Westbound. For example, screenline 404 refers to the westbound direction of screenline 40.

Mode Choice Validation

While a mode choice model recalibration was out of the scope of this project, a quick validation of the mode choice model was performed for Richmond Hill using 2016 TTS data. This considered the mode choice for trips with either origins or destinations in select zones. These were separated into primarily auto (driver and passenger) trips, and transit (GO and local) trips. The results are shown in **Table 3**. As can be seen, the modelled mode choice skews slightly towards auto, but overall it appears to be well-calibrated and sensitive to local conditions.

Table 3. Modelled vs. Observed Auto Mode Share

Area	Modelled Auto Share	Observed Auto Share
Richmond Hill city-wide	89.5%	88.3%
Richmond Hill Yonge Corridor	89.5%	87.4%
Richmond Hill Highway 7 Corridor	93.8%	93.2%
Richmond Hill Leslie Corridor	94.2%	92.8%
Richmond Hill Major Mac Corridor	89.7%	89.0%

Forecast Preparation

Population and Employment Allocation

Population and employment forecasts are two crucial inputs when forecasting travel. The population and employment data for the City of Richmond Hill was obtained from City staff while the population and employment data for the rest of York Region was obtained from the Region of York (Table 4).

Table 4. Population and Employment Data

Horizon Year	2016 (TTS)	2016 (TTS)	2031	2031	2041	2041	2051	2051
Jurisdiction	Population	Employment	Population	Employment	Population	Employment	Population	Employment
Richmond Hill	192,243	65,734	253,067	84,187	286,892	93,790	317,115	103,383
Aurora	54,784	25,288	72,866	33,804	78,609	37,560	85,087	41,017
East Gwillimbury	23,871	7,918	59,893	16,793	85,379	26,476	106,074	37,418
Georgina	45,465	8,392	57,409	13,110	66,072	17,356	72,075	21,902
King	24,367	7,320	35,444	11,714	42,691	13,973	49,650	16,371
Markham	323,646	151,349	417,371	224,156	504,822	262,080	617,621	309,329
Newmarket	81,846	39,310	97,577	51,766	102,835	54,158	110,634	57,570
Vaughan	299,766	170,694	402,198	278,011	491,446	315,399	571,443	352,095
Whitchurch-Stouffville	45,076	11,182	60,524	20,243	68,393	24,554	90,813	31,841
Total	**1,091,064**	**487,187**	**1,456,349**	**733,784**	**1,727,139**	**845,346**	**2,020,512**	**970,926**

Transportation Scenario Analysis – Alternative Strategies

Do Nothing

The Do Nothing scenario is encompassing of the 2016 road network, containing no additional changes from either the Province, York Region, or City. This scenario adds the forecasted population and employment to determine if the existing road network can support the growth. While the Do Nothing scenario is unlikely to provide the adequate infrastructure to support future growth, this scenario provides context to Scenarios 1 and 2, reflecting the impacts on the network should the planned projects not be implemented.

Scenario 1 – Provincial and Regional Improvements

Scenario 1 is reflective of both Provincial and Regional improvements (**Table 5**), including a combination of road widenings, midblock highway crossings, expansion of high-occupancy vehicle (HOV) lanes, and higher order transit improvements (**Table 6**). The phasing is reflective of the horizon year implementation is anticipated. The implementation phase of the projects is indicated in the following tables.

Table 5. Provincial and Regional Road Improvements

Project ID (if applicable)	Type of Improvement	Road	From	To	Phase
-	Highway expansion (HOV lanes)	Highway 400 HOV	Langstaff Road	Aurora Road	2031
-	Highway expansion (HOV lanes)	Highway 404 HOV	Highway 407	Major Mackenzie Drive	2031
R17	Midblock Crossings	Cedar Avenue Extension	Langstaff Road	High Tech Road	2031
R14	Midblock Crossings	Highway 404 north of 16th Avenue	-	-	2031
-	Midblock Crossings	Highway 404 north of Highway 7 (Regional Share)	-	-	2031
-	New 2 lane road	Teston Road	Keele Street	Dufferin Street	2031
-	New 4 lane road	Kirby Road	Dufferin Street	Bathurst Street	2031
-	Widening to 4 lanes	19th Avenue	Bayview Avenue	Leslie Street	2031
-	Widening to 4 lanes	Carrville Road	Bathurst Street	Yonge Street	2031
-	Widening to 4 lanes	Dufferin Street	Sir Benson Drive	Teston Road	2031
-	Widening to 4 lanes	Elgin Mills Road	Bathurst Street	Yonge Street	2031
-	Widening to 4 lanes	Leslie Street	Elgin Mills Road	19th Avenue	2031
-	Widening to 4 lanes	Stouffville Road	Bayview Avenue	Highway 404	2031
-	Widening to 4 lanes	Warden Avenue	Major Mackenzie Drive	Elgin Mills Road	2031
-	Widening to 6 lanes	16th Avenue	Leslie Road	Kennedy Road	2031
-	Widening to 6 lanes	Bathurst Street	Summeridge Drive	Major Mackenzie Drive	2031
-	Widening to 6 lanes	Bayview Avenue	Bantry Ave/Briggs Avenue	16th Avenue	2031

Project ID (if applicable)	Type of Improvement	Road	From	To	Phase
-	Widening to 6 lanes	Keele Street	Steeles Avenue	Highway 407	2031
-	Widening to 6 lanes	Langstaff Road	Keele Street	Dufferin Street	2031
-	Widening to 6 lanes	Rutherford Road	Jane Street	Bathurst Street	2031
-	Jog Elimination	Stouffville Road Jog Elimination			2041
R15	Midblock Crossings	Highway 404 north of Major Mackenzie Drive	-	-	2041
-	Widening to 4 lanes	Bayview Avenue	Stouffville Road	Wellington Street	2041
-	Widening to 4 lanes	Elgin Mills Road	Woodbine Avenue	Kennedy Road	2041
-	Widening to 4 lanes	Jane Street	Teston Road	King-Vaughan Road	2041
-	Widening to 4 lanes	Kirby Road	Jane Street	Dufferin Street	2041
-	Widening to 4 lanes	Leslie Street	19th Avenue	Stouffville Road	2041
-	Widening to 4 lanes	Stouffville Road	Yonge Street	Bayview Avenue	2041
-	Widening to 4 lanes	Teston Road	Dufferin Street	Bathurst Street	2041
-	Widening to 4 lanes	Teston Road	Keele Street	Dufferin Street	2041
-	Widening to 4 lanes	Warden Avenue	Elgin Mills Road	19th Avenue	2041
-	Widening to 4 lanes	Woodbine Avenue	Victoria Square Boulevard	19th Avenue	2041
-	Widening to 6 lanes	16th Avenue	Yonge Street	Leslie Road	2041
-	Widening to 6 lanes	Dufferin Street	Langstaff Road	Rutherford Road	2041
-	Widening to 6 lanes	Keele Street	Highway 7	Rutherford Road	2041
-	Widening to 6 lanes	Major Mackenzie Drive	Leslie Street	Woodbine Avenue	2041
-	Widening to 6 lanes	Warden Avenue	Apple Creek Boulevard	16th Avenue	2041
R16	Midblock Crossings	Highway 404 north of Elgin Mills Road East	-	-	2051
-	New highway construction	Highway 413	Highway 401/407 ETR interchange	Highway 400 (between King Road and Kirby Road)	2051
-	Widening to 4 lanes	19th Avenue	Leslie Street	Warden Avenue	2051
-	Widening to 4 lanes	Jefferson Sideroad	Bathurst Street	Yonge Street	2051
-	Widening to 4 lanes	King-Vaughan Road	Jane Street	Bathurst Street	2051
-	Widening to 6 lanes	Bathurst Street	Major Mackenzie Drive	19th Avenue	2051
-	Widening to 6 lanes	Bayview Avenue	John Street	Hwy 407 south terminal	2051
-	Widening to 6 lanes	Carrville Road	Bathurst Street	Yonge Street	2051

Table 6. Provincial and Regional Transit Projects

Type of Improvement	Road	Phase
Subway Extension	Yonge Line extension with 6 new stops: Downsview Park, Finch West, York University, Pioneer Village, Highway 407, Vaughan Metropolitan Centre	Existing (2022)[1]
Subway Extension	Yonge Line extension with 4 new stops: Steeles Avenue, Clark Avenue, Bridge, High Tech Road	2041
Subway Extension	Yonge Line extension with 6 new stops: Bantry Avenue, 16th Avenue, Weldrick Road, Major Mackenzie Drive, Crosby Avenue, Elgin Mills Road	2051
New GO Station	Gormley GO	Existing (2022)[1]
New GO Station	Bloomington GO	Existing (2022)[1]
New GO Station	Yonge and Carville Road / 16th Avenue	2041
New GO station	Yonge and Elgin Mills Road	2051
GO line service changes	Barrie GO line service updates: 15-minute service south of Aurora, and 30-minute service from Aurora to Barrie	2041
VIVA line improvements	Yonge Street from Highway 7 to 19th Avenue (excluding historic section from Major Mackenzie Drive to Levendale Road)	Existing (2022)[1]
VIVA line improvements	Yonge Street from 19th Avenue to Savage Road North	2051
VIVA line improvements	Major Mackenzie Drive from Highway 427 to Mount Joy GO	2041
VIVA line improvements	Leslie Street from Don Mills subway station to Major Mackenzie Drive (service north of Steeles Avenue only)	2041

1) These projects have already been completed and are in use today. However, these projects were completed after 2016 and before 2031, so 2031 is the first horizon year that they exist in the network.

For this exercise, the boundary area for regional road widenings were projects east of and including Jane Street, west of and including Warden Avenue, and south of and including Bloomington Road.

Scenario 2 – City Improvements+

Scenario 2 is reflective of City road improvements, including a combination of new roads, extensions of existing segments, and new roads needed to support greenfield development. A complete list of City road improvement projects is included in **Table 7**, however some select projects (shown in **Table 8**) were not modelled because the improvements were too fine-grained to capture in a macro-model. This scenario also includes the provincial and regional improvements and transit projects from Scenario 1. The implementation phase of the City projects is indicated in the following table.

Table 7. City of Richmond Hill Modelled Improvements

Project ID	Road	Phasing Prioritization	Proposed Road Features	Improvement Type
1	East Beaver Creek Road from Leslie Street to Highway 7	By 2031	Road Widening	Widening to 4 Lanes
2	Wertheim Court from West Beaver Creek to Leslie Street	By 2051	East-West Multimodal Connection	New 2-Lane Road
3	Wertheim Court from Leslie Street to East Beaver Creek	By 2051	East-West Multimodal Connection	New 2-Lane Road
4	West Beaver Creek Road from Leslie Street to Highway 7	By 2031	Road Widening	Widening to 4 Lanes
5	Far Niente Street Extension from High Tech Road to Highway 7	By 2041	New Major Collector Road Extension	New 2-Lane Road
6	Garden Avenue Extension from Red Maple Road to Bayview Avenue	By 2041	New Major Collector Road Extension	New 2-Lane Road
7	Cedar Avenue Extension from High Tech Road to Langstaff Road	By 2031	New Minor Collector Road Extension	New 2-Lane Road
8	Garden Avenue Extension from Yonge Street to Red Maple Road	By 2051	East-West Multi-Modal Connection	New 2-Lane Road
9	North-South Road from Carville Road to Garden Avenue	By 2041	New Minor Collector Road Construction	New 2-Lane Road
10	Collector Road from Bathurst Street to Highway 7	By 2041	New Major Collector Road Construction	New 2-Lane Road
11	Collector Road in Bathurst and Highway 7 MTSA to Connector Rd	By 2041	New Major Collector Road Construction	New 2-Lane Road
12	Collector Road in Bathurst and Highway 7 MTSA to Bathurst	By 2041	New Major Collector Road Construction	New 2-Lane Road
13	North-South Collector Ring Road in Yonge-Carville/16th MTSA East of Yonge Street	By 2041	New Minor Collector Road Construction	New 2-Lane Road
14	Collector Road in Yonge-Carville/16th MTSA at Hillcrest Mall	By 2041	New Minor Collector Road Construction	New 2-Lane Road
15	Internal Collector Roads in Yonge-Carville/16th MTSA East of Yonge Street and North of 16th Avenue	By 2041	New Minor Collector Road Construction	New 2-Lane Road
16	East-west Collector Ring Road in Yonge-Carville/16th MTSA East of Yonge Street and North of 16th Avenue	By 2041	New Minor Collector Road Construction	New 2-Lane Road
17	Addison Street Extension to Weldrick Road West	By 2031	New Urban Collector Road Construction	New 2-Lane Road
18	Addison Street Extension to Yonge Street	By 2041	New Minor Collector Road Extension	New 2-Lane Road
19	Enford Road Extension to Yonge Street	By 2041	New Major Collector Road Extension	New 2-Lane Road
20	Leyburn Avenue Extension from Canyon Hill Avenue to Bernard Avenue	By 2041	New Minor Collector Road Extension	New 2-Lane Road
21	New Collector Ring Road	By 2051	New Minor Collector Road Extension	New 2-Lane Road
22	North-South Collector Road to Bloomington Road	By 2051	New Minor Collector Road Construction	New 2-Lane Road
23	Bethesda Sideroad from Leslie Street to Highway 404	By 2031	Reconstruction & Paving	Reconstruction and Paving
24	Bethesda Sideroad from Bayview Avenue to Leslie Street	By 2031	Reconstruction & Paving	Reconstruction and Paving
25	Collector Ring Road around 19th Avenue and Leslie Street within North Leslie Secondary Plan Area	By 2031	New Minor Collector Road Construction	New 2-Lane Road
26	Collector Road from 19th Avenue to Terminus within North Leslie Secondary Plan Area	By 2031	New Minor Collector Road Construction	New 2-Lane Road
27	Collector Road from Bawden Drive to future Highway 404 Overpass	By 2051	New Major Collector Road Construction	New 2-Lane Road

Project ID	Road	Phasing Prioritization	Proposed Road Features	Improvement Type
28	Collector Road to Elgin Mills Road East within North Leslie Secondary Plan Area	By 2031	New Minor Collector Road Construction	New 2-Lane Road
29	East-West Major Collector Road from Bayview Avenue within North Leslie Secondary Plan Area	By 2031	New Major Collector Road Construction	New 2-Lane Road
30	North-South Collector Road from 19th Avenue to Elgin Mills Road East within North Leslie Secondary Plan Area	By 2031	New Major Collector Road Construction	New 2-Lane Road
31	Performance Drive Extension to future Highway 404 Overpass	By 2041	New Major Collector Road Extension	New 2-Lane Road
32	Vogell Road from Major Mackenzie Drive to Vogell Bridge	By 2031	New Major Collector Road Extension	New 2-Lane Road
33	Vogell Bridge from Vogell Road to Staples Avenue	By 2041	Bridge	Bridge
34	Brodie Drive Extension	By 2041	New Major Collector Road Extension	New 2-Lane Road
35	Vogell Road Extension to Orlando Avenue	By 2031	New Major Collector Road Extension	New 2-Lane Road
36	Orlando Avenue Extension to Highway 404 Overpass	By 2031	New Major Collector Road Extension	New 2-Lane Road
37	Newkirk Road from Elgin Mills Road E to Major Mackenzie Drive East	By 2031	Road Widening	Widening to 4-Lanes

The projects outlined in Table 8 and Table 9 are improvements that were not modelled in the EMME network because this level of detail is not captured by the model. The projects in Table 7 are more minor roads which are represented in the EMME model by local connectors between the zones and road network. Although not depicted in the model, these roads are essential for local connectivity to help accommodate growth in MTSA and intensification areas.

Table 8. City Road Projects Not Modelled in EMME Network

Project ID	Road	Phasing Prioritization	Proposed Road Features	Improvement Type
2	Wertheim Court from West Beaver Creek to Leslie Street	By 2051	East-West Multimodal Connection	New 2-Lane Road
3	Wertheim Court from Leslie Street to East Beaver Creek	By 2051	East-West Multimodal Connection	New 2-Lane Road
15	Internal Collector Roads in Yonge-Carville/16th MTSA East of Yonge Street and North of 16th Avenue	By 2041	New Minor Collector Road Construction	New 2-Lane Road

Table 9. Intersection Improvements and Rail Crossing Improvements Not Modelled in EMME Network

Project ID	Road	Phasing Prioritization	Proposed Road Features	Improvement Type
S1	Highway 7 and East Beaver Creek Road	By 2031	Intersection Improvement	Signal / Turning Lane Optimization
S2	East Beaver Creek Road and Mural Street	By 2031	Potential to Signalize	Signalize Intersection
S3	West Beaver Creek Road and Granton Drive	By 2031	Potential to Signalize	Signalize Intersection
S4	West Pearce Street and West Beaver Creek Road	By 2031	Potential to Signalize	Signalize Intersection
S5	Highway 7 and Valleymede Drive	By 2031	Intersection Improvement	Signal / Turning Lane Optimization
S6	Briggs Avenue and Bayview Avenue	By 2031	Intersection Improvement	Signal / Turning Lane Optimization
S7	Garden Avenue Extension and Far Niente Street Extension	By 2041	Potential to Signalize	Signalize Intersection
S8	High Tech Road and Far Niente Street Extension	By 2041	Potential to Signalize	Signalize Intersection
S9	Garden Avenue Extension and Cedar Avenue	By 2031	Potential to Signalize	Signalize Intersection
S10	Garden Avenue and North-South Road	By 2051	Potential to Signalize	Signalize Intersection
S11	Highway 7 and Future Collector Spine Road in Bathurst and Highway 7 MTSA	By 2041	Potential to Signalize	Signalize Intersection
S12	Carrville Road and Future North-South Road West of Yonge Street	By 2041	Potential to Signalize	Signalize Intersection
S13	Industrial Road and Enford Road	By 2041	Intersection Improvement	Signalize Intersection
S14	Elgin Mills Road East and Enford Road	By 2031	Intersection Improvement	Signal / Turning Lane Optimization

Project ID	Road	Phasing Prioritization	Proposed Road Features	Improvement Type
S15	Canyon Hill Avenue and Shaftsbury Avenue	By 2031	Potential to Signalize	Signalize Intersection
S16	Canyon Hill Avenue and Future Collector Ring Road in Yonge and Bernard KDA	By 2041	Potential to Signalize	Signalize Intersection
S17	Bernard Avenue and Future Collector Ring Road in Yonge and Bernard KDA	By 2041	Potential to Signalize	Signalize Intersection
S18	North of Bernard Avenue at Yonge Street	By 2041	Potential to Signalize	Signalize Intersection
S19	Coon's Road and Yonge Street	By 2051	Potential to Signalize	Signalize Intersection
S20	Bloomington Road and Future North-South Collector Road	By 2051	Potential to Signalize	Signalize Intersection
S21	10856/10830 Bayview Avenue Access and Bayview Avenue	By 2031	Potential to Signalize	Signalize Intersection
S22	Elgin Mills Road West and Romance Drive	By 2031	Potential to Signalize	Signalize Intersection
S23	Redstone Road and Shirley Drive	By 2031	Potential to Signalize	Signalize Intersection
S24	Performance Drive and Via Renzo Drive	By 2041	Potential to Signalize	Signalize Intersection
S25	Ultimate Drive and Via Renzo Drive	By 2041	Potential to Signalize	Signalize Intersection
C1	Garden Avenue	By 2051	Proposed City Rail Crossing	Rail / road grade separation
C2	Weldrick Road East	By 2051	Proposed City Rail Crossing	Rail / road grade separation
C3	Centre Street East	By 2051	Proposed City Rail Crossing	Rail / road grade separation
C4	Crosby Avenue	By 2051	Proposed City Rail Crossing	Rail / road grade separation
C8	Bethesda Sideroad	By 2051	Proposed City Rail Crossing	Rail / road grade separation
C5	Elgin Mills Road East	By 2031	Proposed Regional Rail Crossing	Rail / road grade separation
C6	19th Avenue	By 2051	Proposed Regional Rail Crossing	Rail / road grade separation
C7	Leslie Street	By 2041	Proposed Regional Rail Crossing	Rail / road grade separation

The intersection improvements and rail crossings in **Table 9** were also not captured in the EMME model because this level of improvement is too fine-grained to be captured in a macro-model. The intersection improvements are recommended due to planned land uses and forecast growth in population and employment in these areas and take into account best practice for intersection spacing for signals and consider the forecast link volumes approaching these intersections. A more detailed analysis of these intersection locations would be expected to justify the needs for signalization.

Although the rail crossings proposed as part of the City improvements are not captured as part of the model, there are several factors that account for their recommendation as part of this exercise. The total traffic volumes in both directions at the City rail crossing locations (C1, C2, C3, C4, and C8 in **Table 9**) range from approximately 600-900 vehicles/hour in the peak

AM hour, and the total traffic volumes at the Regional Rail crossings (C5, C6, and C7) range from approximately 2500-3200 vehicles/hour in the peak AM hour, in the phasing prioritization year specified. At the present time Transport Canada exposure index thresholds combined with planned development growth are contributors to requiring the rail grade separations. New and upgraded City roads necessitated by increased traffic volumes begin to have direct impacts on rail crossings and are considered for grade separations, subject to further studies, in accordance with Transport Canada's Railway Grade Crossing Technical Standards. The rail grade separations are driven by forecasted population and employment growth in the City and are therefore eligible for development charges.

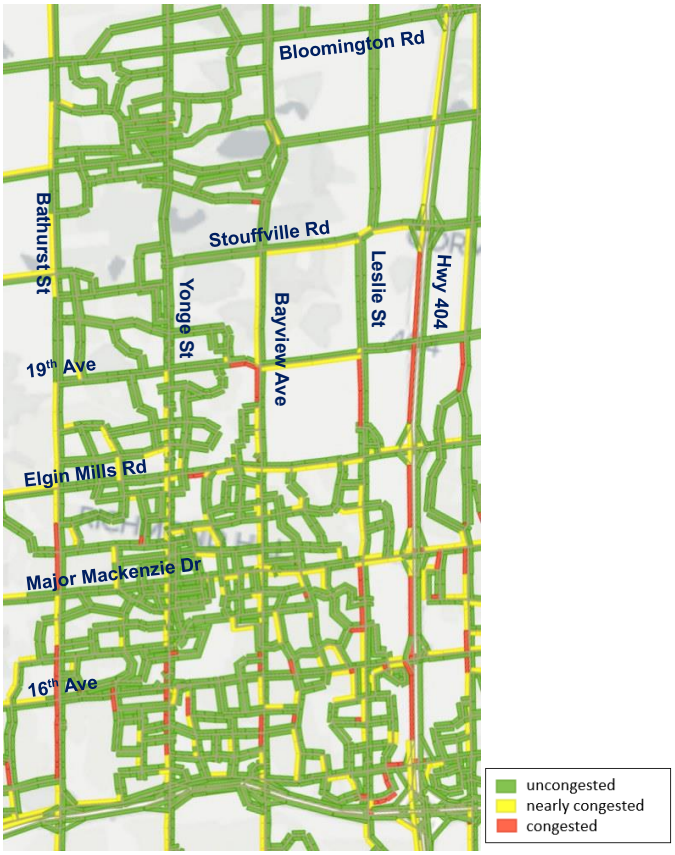
Road Network Assessment

This section presents the modelling results from the updated York Region trip based model. This section is composed of two parts. First, 2016 traffic conditions are shown before moving to the traffic forecasts and scenario comparisons.

2016 Scenario Model Results

To arrive at the preferred alternative, an overview of the 2016 Scenario is necessary to understand the base network conditions. **Figure 3** is an overview of the congestion plots in the City of Richmond Hill from the 2016 travel demand model results.

Figure 3. Richmond Hill Congestion Results Under 2016 Conditions (AM Peak Hour)



In 2016, large pockets of congestion were seen within and next to Richmond Hill, especially in the southbound direction, which is the peak direction in the AM peak period. Stretches of Bathurst Street, Yonge Street, Bayview Avenue, Leslie Street, and Highway 404 are all seen to be congested in the AM peak hour. These examples are all Regional roads. The City-owned and operated roads largely are within capacity, with some exceptions on links accessing Regional roads, such as Red Maple Road (which provides access to the Langstaff GO Train Station) from 16th Avenue.

The modelled 2016 congestion is less prevalent in the east-west directions but stretches of all east-west major arterial roads (Regional roads) between Highway 7 and Stouffville Road are seen to be operating at nearly congested or congested levels. Of particular concern is the congestion on the approach and departure to Highway 404 crossings.

To understand how the alternative scenarios compare against the 2016 model, three focus areas have been selected for further analysis, which are shown in **Figure 3**. This presents the road congestion in the base year, which are supplemented with numerical tags that indicate the number of vehicles that are travelling through a given link during the AM peak hour. The three focus areas are also used in the forecast analysis, and include:

1. Yonge Street from Major Mackenzie Drive to Highway 7
2. Elgin Mills Road and Yonge Street; and
3. East/West Beaver Creek Road and Vogell Road. The numerical tags on the maps are indicative of the number of vehicles that are travelling through a given link in one hour during the AM peak period.

In Focus Area 1, the base year model shows that Yonge Street is experiencing congested traffic conditions in the peak southbound direction from Weldrick Road to Highway 7, with gradually increasing volumes further south on Yonge Street. Yonge Street is nearly congested just south of Highway 7 and north or Weldrick Road. Other parallel streets, such as Red Maple Road are also operating under congested conditions.

Focus Area 2 is centred around the intersection of Yonge Street and Elgin Mills Road. The 2016 model results indicate local congestion in the vicinity of this intersection in the southbound and eastbound directions. A number of east-west links on arterial and collector roads are operating under nearly congested conditions in the eastbound direction in this focus area. The heavy movements southbound toward Toronto and eastbound toward Highway 404 in the AM peak represent the commuter traffic pattern experienced in 2016.

Focus Area 3 is an analysis of Leslie Street and Highway 404 between Elgin Mills Road and Highway 7 and East and West Beaver Creek Road. Similarly to the other focus areas, the 2016 model results show greater congestion on the southbound roads, especially on Highway 404 and parts of Leslie Street, likely as a result of commutes to Toronto or south points for work trips. The model results show that all east-west connections to Highway 404, namely Highway 7, 16th Avenue and Major Mackenzie Drive are operating under congested conditions.

Alternative Scenario Model Results

Richmond Hill Overview

Having established a base understanding of the transportation network based on the 2016 model, the alternative scenarios were assessed for comparing and arriving at the preferred alternative. **Figure 4**, Figure 5, and **Figure 6** show the congestion plots in the City of Richmond Hill for the 2031, 2041, and 2051 forecast years, respectively, for the three different scenarios presented.

In all scenarios, roads within Richmond Hill experience significantly higher congestion compared to the 2016 model as a result of growth, and subsequently increasing travel demands. This congestion is not unexpected given the large forecast growth in the City of Richmond Hill and York Region between 2016 and the 2031, 2041 and 2051 forecast years. As shown previously, areas of Richmond Hill and the surrounding highways were experiencing congested conditions in 2016. These base year congested conditions combined with population and employment growth exacerbate these forecast congested conditions.

In 2031, the Provincial and Regional road and transit improvements do reduce congestion in Richmond Hill as can be seen by comparing Scenario 1 with the Do Nothing scenario; there are reductions in congestion on a number of the east-west roads, including Stouffville Road, 19th Avenue, Elgin Mills Road, and Major Mackenzie Drive. The congestions levels on the north-south roads largely remain the same in the southbound direction, but there are some localized improvements around the intersections of Bayview Avenue with Elgin Mills Road and 16th Avenue.

In 2041, comparing Scenario 1 with the Do Nothing scenario, **Figure 5** shows that the Provincial improvements and Regional improvements listed in the 2022 York Region TMP do help alleviate congestion. This effect can be especially seen on the east-west major arterials in the region, which do drop a level of congestion (from red to yellow) in Scenario 1 compared with the Do Nothing scenario. Some examples of the improvement in the east-west roads are the congestion reduction on Stouffville Road, 19th Avenue and Elgin Mills eastbound. The Highway 404 crossings at 16th Avenue, Major Mackenzie Drive, and Elgin Mills Road are also less congested due to the introduction of the new midblock highway crossings. The congestion reduction is less obvious in the southbound direction due to the higher overall traffic volumes in this direction that increase the congestion but can be seen in certain streets like Yonge Street in the vicinity of Major Mackenzie Drive.

Figure 5 also shows a reduction in traffic congestion in the vicinity of the municipal road improvements when Scenario 2 is compared with Scenario 1. Examples of the changes that can be seen are in the vicinity of 16th Avenue and Yonge Street and on Leslie Street between Highway 7 and 16th Avenue.

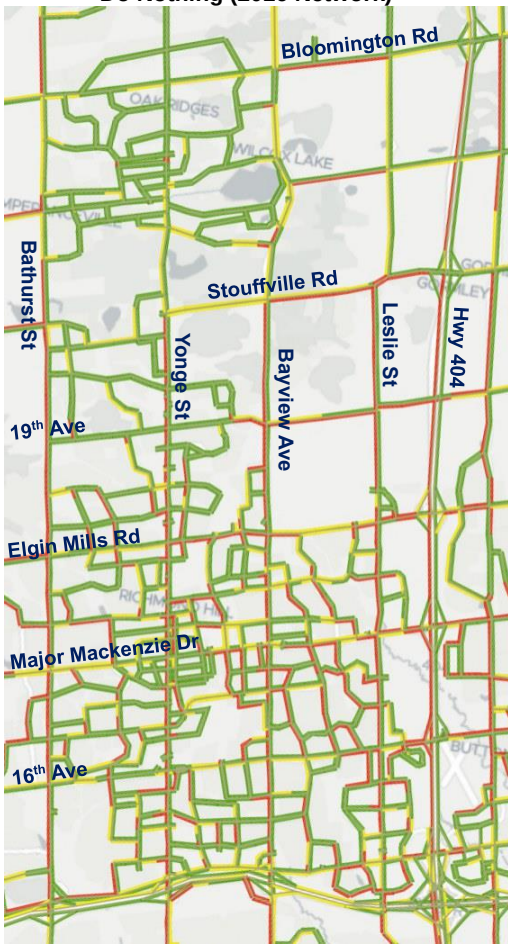
In 2051, the congestion in Scenario 1 is reduced relative to Do Nothing, as shown in **Figure 6**. The congestion on 19th Avenue at the Highway 404 crossing drops substantially to green and

yellow levels with the new midblock crossing just south of 19th Avenue. On Elgin Mills Road and Major Mackenzie Drive, the congestion generally improves in the eastbound direction east of Yonge but gets worse in the westbound direction between Yonge Street and Leslie Street, likely due to increased travel towards the subway extension and GO stations. In the southbound peak travel direction, while the arterials are still mostly congested, there are reductions in congestion from red to yellow along some stretches of Yonge Street south of Elgin Mills and the congestion levels drop significantly on many collector roads. The rest of this section will focus in more detail on the municipal road improvements proposed in this TMP and shows more detailed results in the three focus areas described previously.

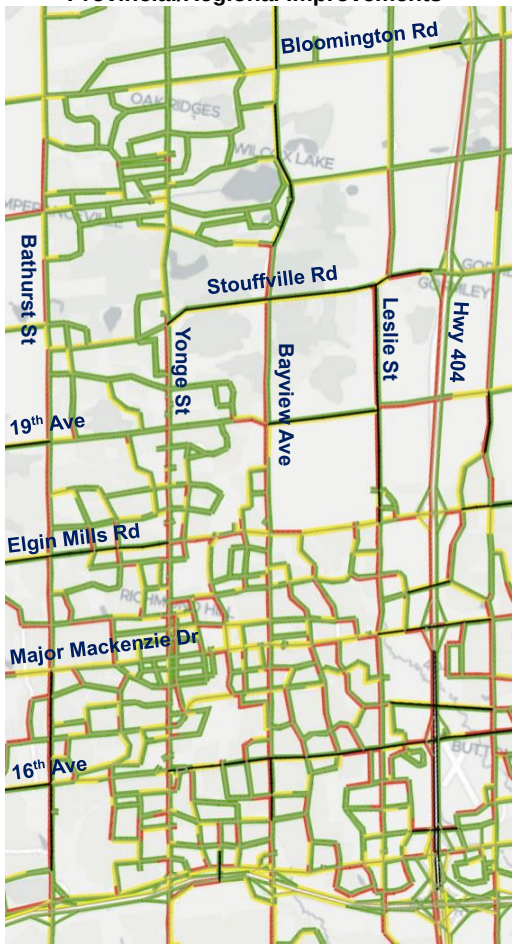
Figure 4. Richmond Hill Congestion Results for 2031 Scenarios

Figure 5. Richmond Hill Congestion Results for 2041 Scenarios

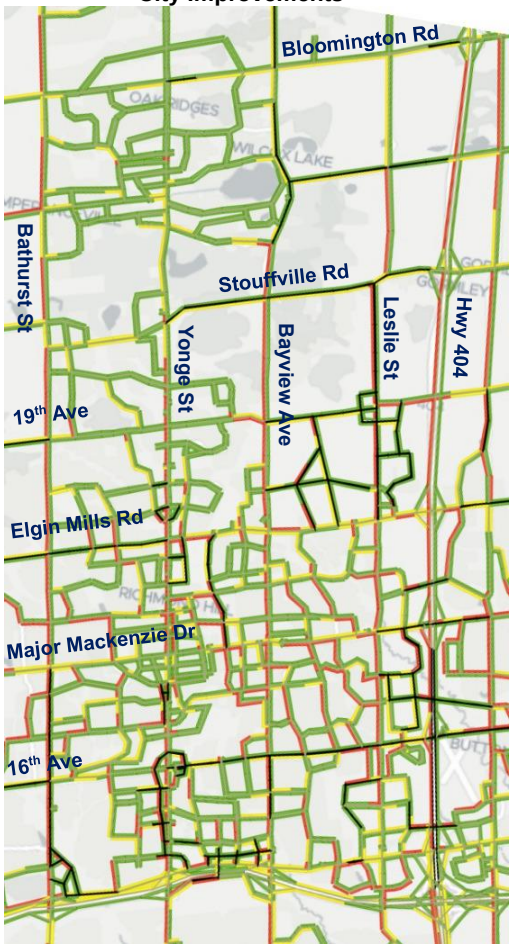
Scenario 0
Do Nothing (2016 Network)



Scenario 1
Provincial/Regional Improvements



Scenario 2
City Improvements+



uncongested
nearly congested
congested

Road Improvements (relative to Existing)
No change
Road improvement

Figure 6. Richmond Hill Congestion Results for 2051 Scenarios

Focus Area 1: Yonge Street from Major Mackenzie Drive to Highway 7

The Focus Area 1 analysis is shown in the congestion plots in **Figure 7**. Yonge Street is already highly congested in the 2016 scenario, especially between Major Mackenzie Drive to Highway 7. In 2051, growth in population and employment increases traffic further, raising all sections of Yonge Street in Focus Area 1 to very congested in the 2051 Do Nothing scenario.

The Addison Street extension included in Scenario 2 extends Addison Street southwards from Harding Boulevard to Weldrick Road. This extension provides an alternative route to the parallel stretch of Yonge Street and can also provide access to proposed developments to reduce the local accesses required from Yonge Street. This extension is forecast to be well used, with simulated volumes of 500 to 800 vehicles in the southern direction in the AM peak.

Figure 8 presents the results from a select link analysis, which shows who is using a particular road, for the Addison Street extension in 2031 to assess usage of the road when it is first implemented. As is seen in this figure, most of the drivers using the Addison Street extension originate from the area west of Yonge between Harding and Major Mackenzie Drive. While it serves as local access to the new developments immediately west of Yonge, it also gets significant use from existing residential areas further to the west. This provides a detour from the section of Yonge between Harding Boulevard and Yongehurst, which is highly congested in all future scenarios due to growth throughout the city.

Also shown in **Figure 7** is the road network in the proposed development at Hillcrest Mall, located at Yonge Street and Carrville Road / 16th Avenue. Large volumes of local traffic are generated on the northwest corner of this intersection, as is seen by the red-level congestion from this development onto Carrville Rd. The proposed collector roads northeast of the Yonge Street and 16th Avenue intersection are also forecast to be congested. A new road parallel to Yonge Street is proposed between Garden Avenue and Carrville Road, which is modeled in Scenario 2. This road gets significant use in this scenario, as shown by the nearly congested and congested segments in the southbound direction. A select link analysis of the new road in 2051 is shown in **Figure 8,** which shows the usage for its northern portion. The new road directly diverts almost 800 drivers from the heavily congested intersection of Yonge Street and Carrville/16th Avenue. Of these, approximately 160 originate from Yonge Street north of the proposed development sites, 120 more are picked up from Hillcrest Mall southbound, 240 originate from and approximately 120 destined to Carrville Road west of the proposed developments. A large number of the trips are originated from/destined to Hillcrest Mall or zones just west of the new road, so the proposed road provides an alternative route to Yonge Street and diverts vehicles from the busy intersection of Yonge Street at Carrville/16th Avenue. While the addition of this road does not solve congestion on Yonge Street, it does alleviate congestion by adding alternate connections for new developments along the corridor.

An additional proposed improvement in this area is the East-West Multi-Modal Connection of Garden Avenue from Yonge Street to Red Cedar, which also modeled in Scenario 2 and shown in **Figure 7**. The extended portion of Garden Avenue does not experience critical congestion in the model, but it is well-used with some segments carrying over 600 vehicles.

The extension carries policy planning significant for its direct link to the Minister's Zoning Order, which focuses on land uses (commercial, residential, and mixed-residential) that supports the development of a Transit-Oriented Community. A select link analysis of this proposed change is also shown in **Figure 8**. As expected, many of the users are local with origins or destinations in the area around the Langstaff transit hub, which has significant growth planned, but also serves other drivers including those from the high-density area north of High Tech Road and those from south of Highway 407 via the new overpass from Langstaff Road – which connects to the Garden Avenue extension in this scenario rather than High Tech Rd. The Garden Avenue extension select link analysis shows volumes of approximately 500 vehicles in either direction. The extension is being used as a connection to Yonge Street and Bayview Avenue, diverts some traffic from Highway 7, and has heavy usage for origins/destinations south of Highway 407 via the overpass. In comparing the volumes from **Figure 7**, the Garden Avenue extension has the overall effect of removing approximately 400 vehicles in each direction from the segment of Highway 7 between the Bayview connection and Silver Linden Drive, with a more modest reduction of approximately 100 and 200 vehicles eastbound and westbound, respectively, further west between Red Maple Road and Connector Road. On High Tech Road west of Silver Linden Drive, the extension reduces traffic volumes by approximately 100 to 200 vehicles eastbound and 200 to 400 vehicles westbound.

Figure 7. Area 1 Yonge Street from Major Mackenzie Drive to Highway 7 for 2051 Scenarios

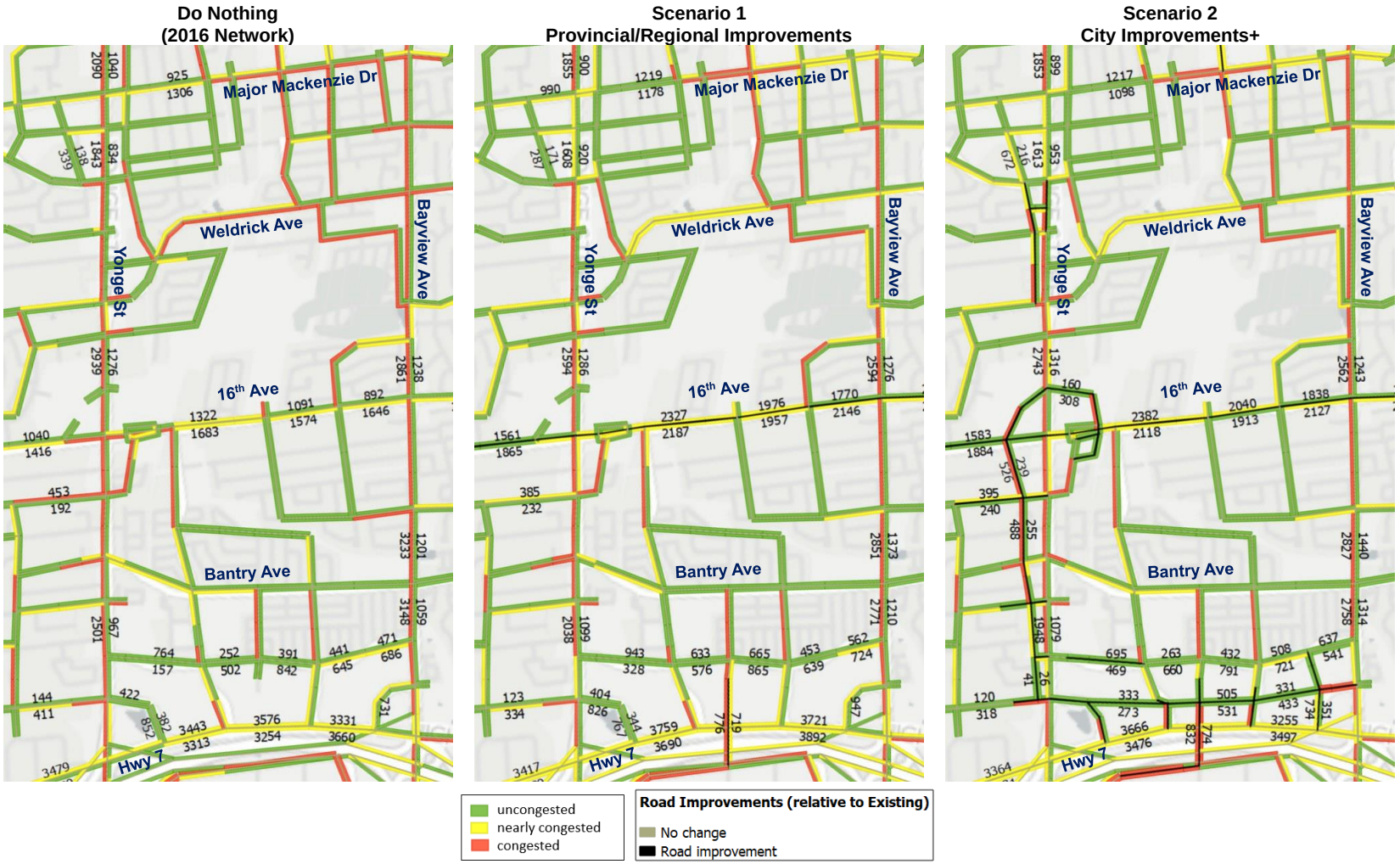
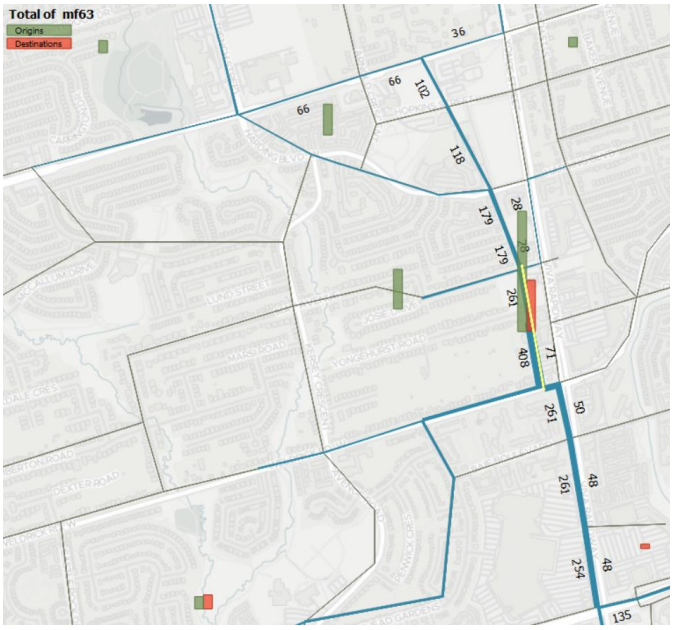
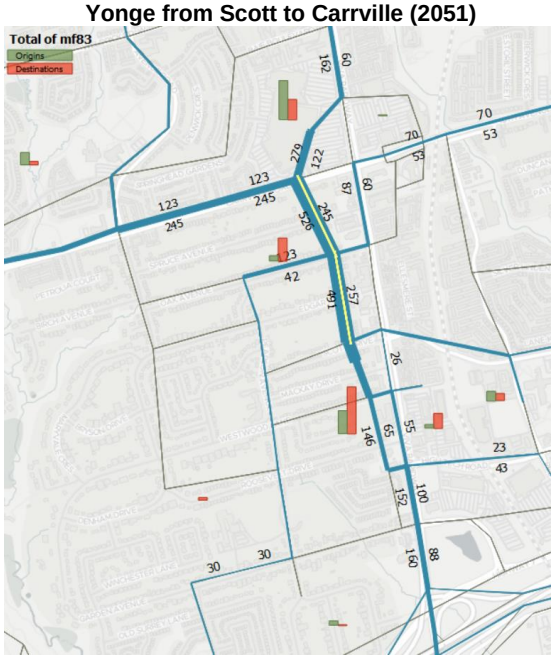


Figure 8. Select Link Analysis for Proposed New Roads in Focus Area 1

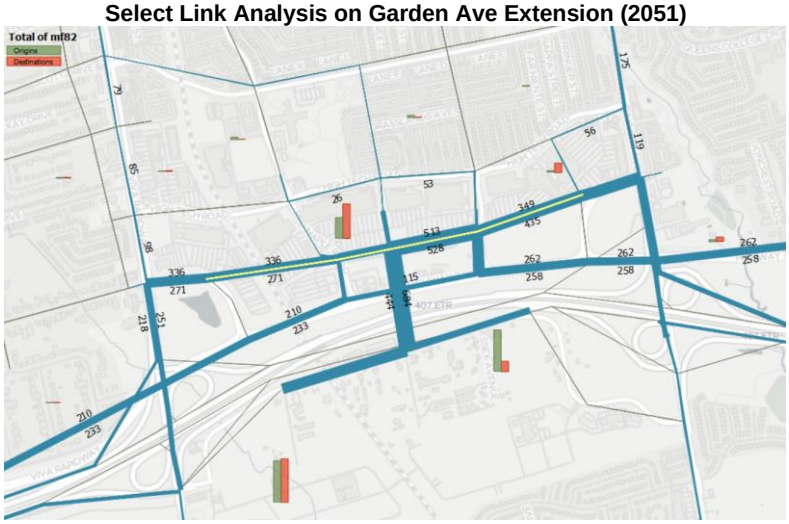
Select Link Analysis on Addison Street Extension (2031)



Select Link Analysis on new road parallel to Yonge from Scott to Carrville (2051)



Select Link Analysis on Garden Ave Extension (2051)



Focus Area 2: Elgin Mills Road and Yonge Street

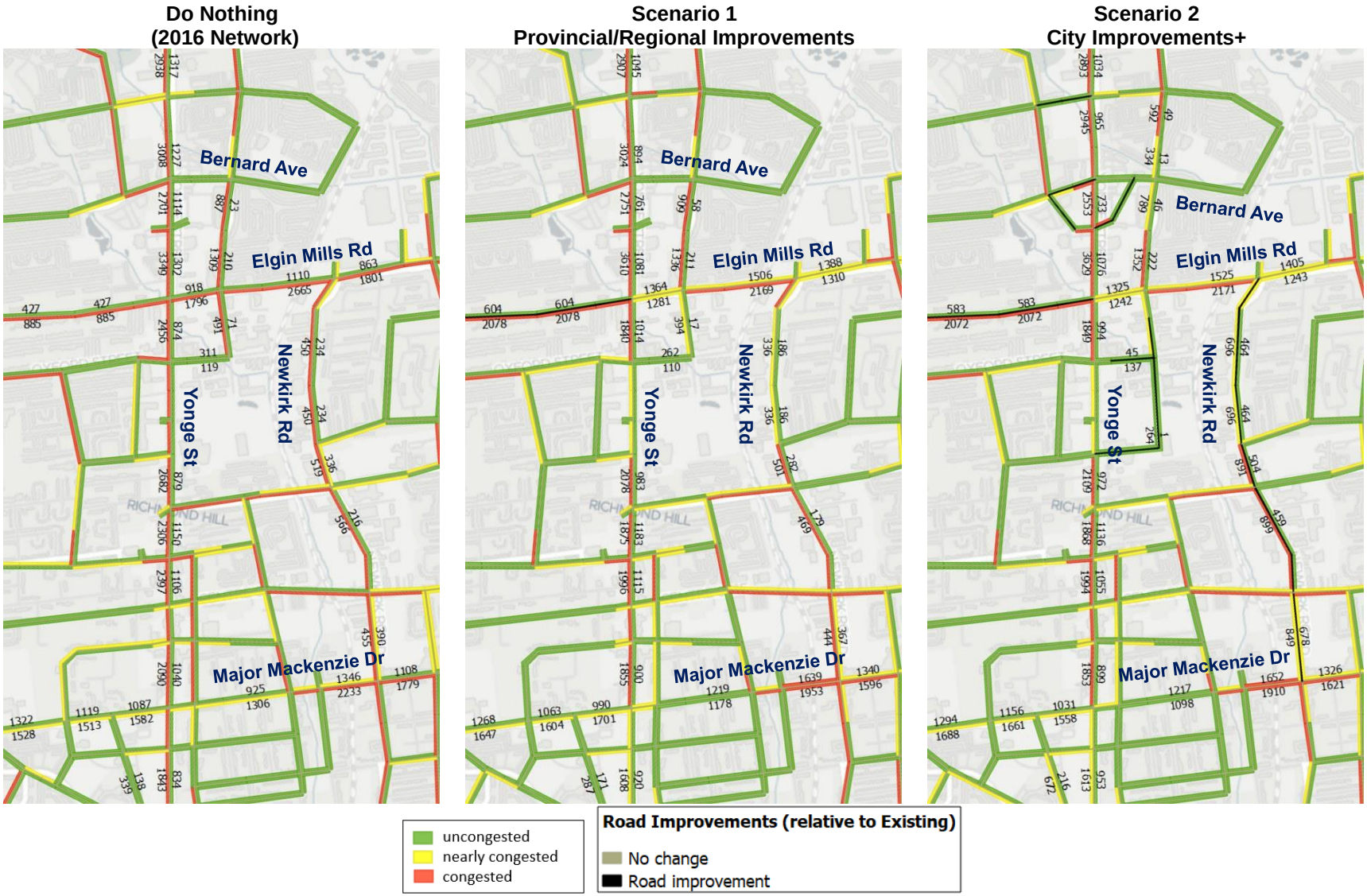
Figure 9 shows forecast congestion plots and selected traffic volumes in the vicinity of the Elgin Mills Road and Yonge Street intersection. The following improvements are proposed in this area:

- ✓ New proposed roads in the Yonge and Canyon Hill Avenue/Bernard Avenue area;
- ✓ New collector roads south-east of Yonge Street and Elgin Mills intersection; and
- ✓ Widening of Newkirk Road between Major Mackenzie Drive and Elgin Mill Road.

The new proposed roads in the Yonge and Canyon Hill Avenue/Bernard Avenue area and southeast of Yonge Street and Elgin Mills Road are not forecast to operate in congested conditions. These roads are still necessary to support local connectivity requirements for developments planned in the area.

With the proposed Newkirk Road widening, traffic volumes southbound on Newkirk Road almost double with an additional 400 vehicles. This road is forecast to run in congested conditions even with the road widening.

Figure 9. Area 2 Elgin Mills Road and Yonge Street Congestion Results for 2051 Scenarios



Focus Area 3: East/West Beaver Creek Road and Vogell Road

The analysis of Area 3 focused on East Beaver Creek Road and West Beaver Creek Road and improvements near Vogell Road (bounded by Leslie Street, Highway 404, 16th Avenue, and Major Mackenzie Drive). The congestion plots for the 2051 scenarios are shown in **Figure 10**.

A major proposed City improvement in this focus area is the Vogell Road extension from Orlando Avenue to Major Mackenzie Drive, which connects with the new Orlando Avenue overpass across Highway 404. These new links see heavy use in the simulated 2051 scenario, with over 700 vehicles travelling southbound on Vogell Road between Major Mackenzie Drive and Staples Avenue. A select link analysis of this traffic in 2041 is shown in **Figure 11** to examine the usage of Vogell Road when it is first implemented. The select link analysis shows the majority of traffic is going to and from zones in the area between 16th Avenue, Leslie Street, Major Mackenzie Drive, and Highway 404. Most of these local users are going to destinations in the southern part of this area and would otherwise have had to travel further along Major Mackenzie Drive, Leslie Street, or 16th Avenue, which are already critically congested in 2051. However, this is not accompanied by a significant reduction in traffic volumes on these roads, likely due to other modelled changes and in-fill by other users who were originally taking different routes. Notably, there appears to be significant pass-through usage with approximately 350 users travelling further south to 16th Avenue in 2041. The Vogell Road extension connects to a new collector road network east of Leslie and north of 16th Avenue that is proposed as part of new developments in the area. Parts of this collector network are seen to be heavily used, especially south of the new proposed overpass over Highway 404.

The remainder of the proposed municipal improvements include widening East Beaver Creek Road and West Beaver Creek Road. These roads are nearly congested in the 2016 scenario, and the 2051 Do Nothing scenario forecasts that multiple stretches of these roads will be congested or nearly congested in both directions. In Scenario 1, without widening any City roads, East and West Beaver Creek Road show similar congestion to the Do Nothing scenario in 2051. In Scenario 2, the widening of East and West Beaver Creek Road does alleviate some of this congestion, although there are a few sections still experiencing significant congestion even with the widenings. This appears to be due to shifts in local access patterns caused by the increased capacity on the widened roads, drawing users away from less convenient paths to local destinations.

The East Beaver Creek area and recommend road networks are subject to Official Plan Amendments in the year 2023 as well as further transportation planning processes that will determine their final alignment and implementation in support of future growth as well as the overall City transportation network.

Figure 10. Area 3 East/West Beaver Creek Road and Vogell Road Congestion Results for 2051 Scenarios

Figure 11. Select Link Analysis of trips along Vogell Road Extension (2041)

Regional Connectivity

Highway Overpasses/Underpasses

Scenarios 1 and 2 include four highway overpass/underpass projects that are listed in **Table 5**, and are again presented in **Table 10**. Given their regional nature and that they are included in the York Region 2022 Transportation Master Plan, these are included in both the *Provincial and Regional*, and the *City Improvements+* scenarios.

Table 10. New Highway Overpass/Underpass Locations

Project ID	Road	Phase
R14	Highway Overpass North of 16th Avenue	2031
R15	Highway Overpass North of Major Mackenzie Drive	2041
R16	Highway Overpass North of Elgin Mills Road	2051
R17	Highway Underpass Red Cedar Avenue	2031

The highway overpasses/underpasses were modelled in the EMME network by adding new highway crossing links at the overpass locations. These roads were connected to appropriate collector roads, as appropriate given the scenario. A select link analysis was conducted to show who would use the four highway overpass/underpass projects proposed to be implemented up to and including the 2041 horizon year, which were run in *Scenario 2 – City Improvements+*. The select link results show the following information:

- ✓ AM peak hour traffic volumes using the corresponding highway crossings, and
- ✓ AM peak hour travel demand for trips using the crossings. Trip origins are shown in green while trip destinations are shown in red. The red and green numbers show trip origins and destinations using the selected facilities to the various zones.

Figure 12 shows the select link analysis results for the Highway 404 Overpass North of 16th Avenue. Trips using this overpass originate from and are destined to a wide region within both Richmond Hill and Markham. Trips origins are primarily concentrated around Major Mackenzie Drive, with about 75% of trips originating from Markham. The trip destinations are also concentrated around Major Mackenzie Drive and specifically employment regions located west of Highway 404. About half the destinations are in Richmond Hill and the other half consists of destinations in Markham and Vaughan mostly.

Selected volumes and demand using the overpass north of Major Mackenzie Drive is shown in **Figure 13**. This overpass is forecast to be used primarily as a connection between northern Markham and Stouffville with regions of Richmond Hill south of Elgin Mills Road. The largest source of trip origins is Markham, with Stouffville as the next largest source of trip origins, followed by Richmond Hill. Most of the trips are destined to zones in Richmond Hill.

Figure 14 shows the select link analysis results for the Highway 404 overpass north of Elgin Mills Road East. This overpass appears to be used mostly to connect origins north of 19th Avenue in Richmond Hill to destinations concentrated between Highway 404 and Warden Avenue around Highway 407 in Markham, as well as some destinations around Major Mackenzie in Richmond Hill and Markham. The majority of trips originate from Richmond Hill and the majority of trips are destined to zones in Markham.

For the underpass below Highway 407 between High Tech Road and Langstaff Road, shown in Figure 15, trip origins and destinations are most highly concentrated near Yonge Street between 16th Avenue and just south of Highway 407. There are also fewer but some other origins coming from Richmond Hill north of 16th Avenue and some other destinations in Thornhill. The majority of trips originate from Richmond Hill and most of the trip destinations are in Markham.

Figure 12. Select Link Analysis Results for Highway 404 Overpass North of 16th Avenue (2031)

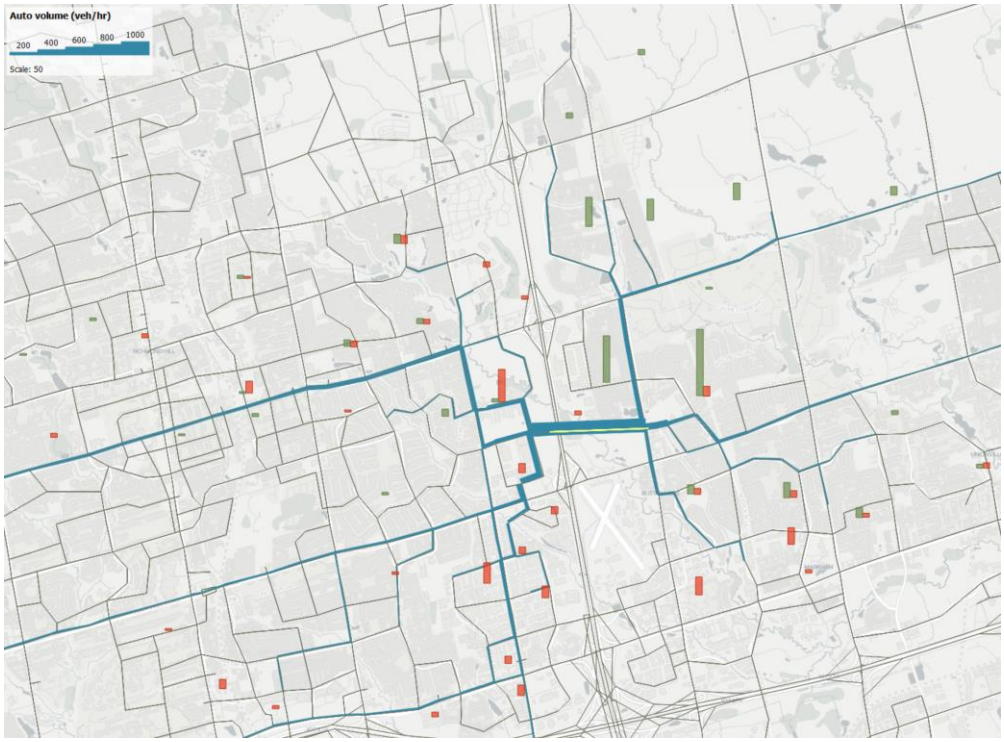


Figure 13. Select Link Analysis Results for Highway 404 Overpass North of Major Mackenzie Drive (2041)

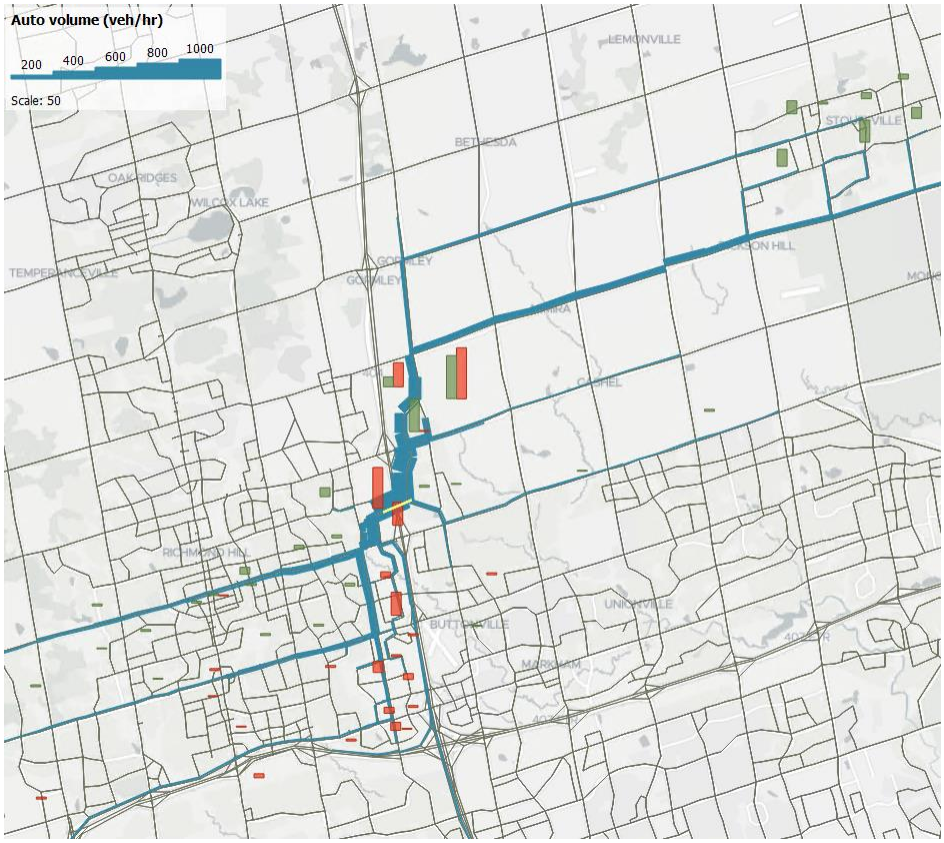


Figure 14. Select Link Analysis Results for Highway 404 Overpass North of Elgin Mills Road East (2051)

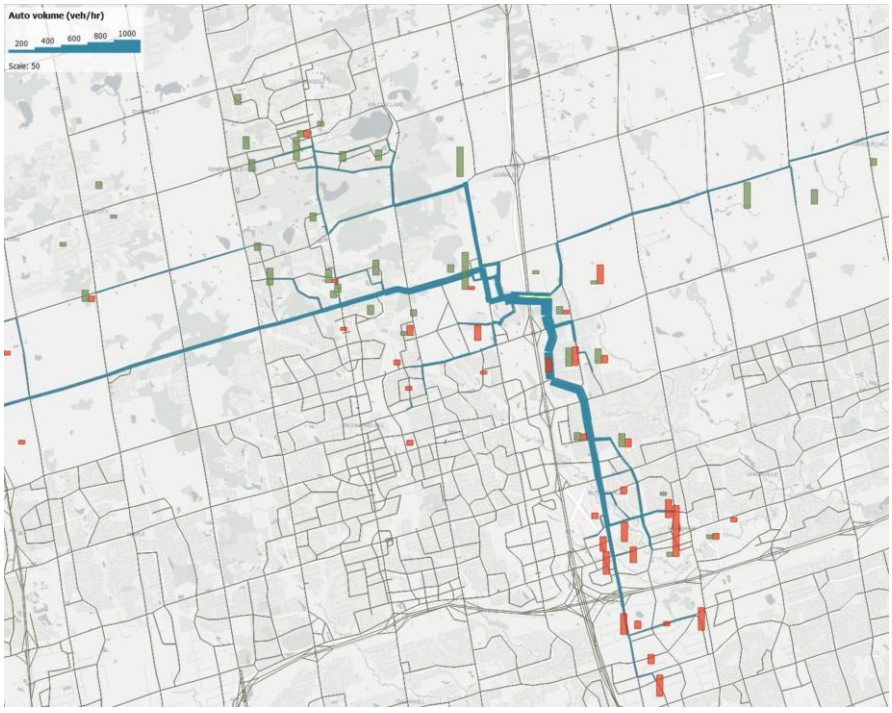
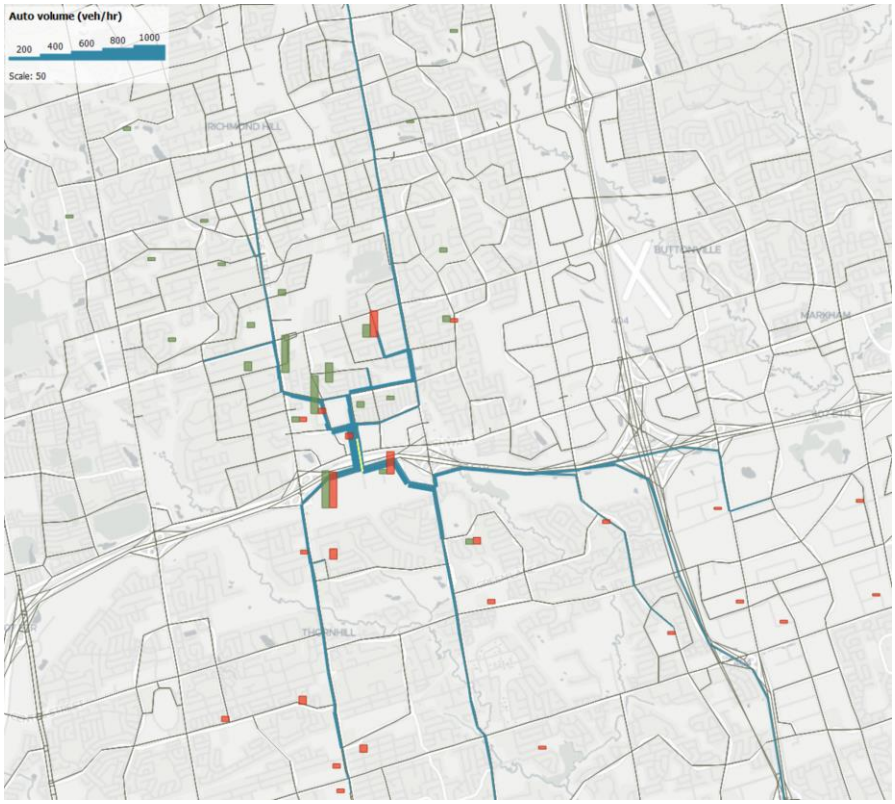


Figure 15. Select Link Analysis Results for Highway 407 Underpass from High Tech Road (2031)



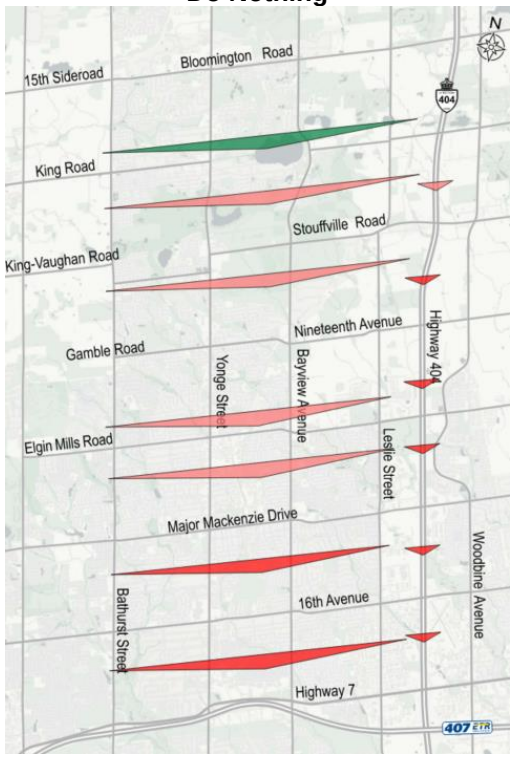
Screenline Analysis

The screenlines that were used to analyze the scenarios in future horizon years include north-south ones that span Richmond Hill and Highway 404 and east-west ones that span across Richmond Hill and Highway 407. The screenlines are intended to show the congestion levels across corridors within the City during the AM peak period.

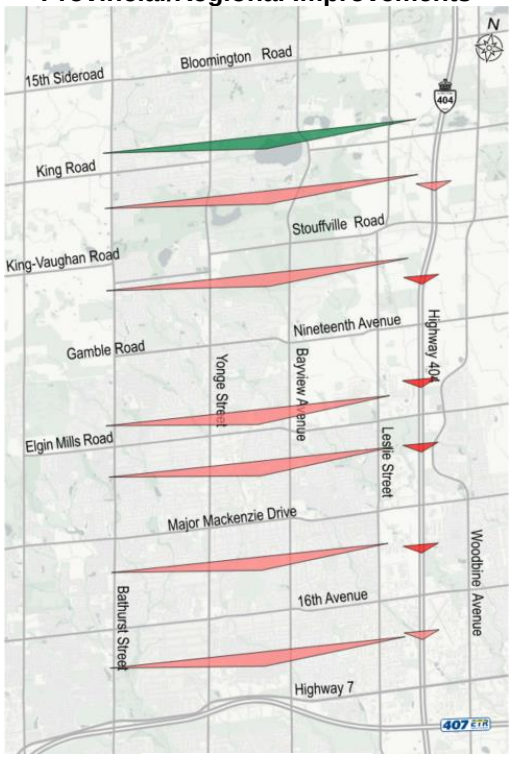
The results of the screenline analysis for the Do Nothing, Scenario 1 (Provincial and Regional Improvements), and Scenario 2 (City Improvements+) for the 2031, 2041, and 2051 horizon years are shown in **Figure 16** to **Figure 21**.

Figure 16. Morning Peak Hour Auto Travel North-South Screenline Results in 2031

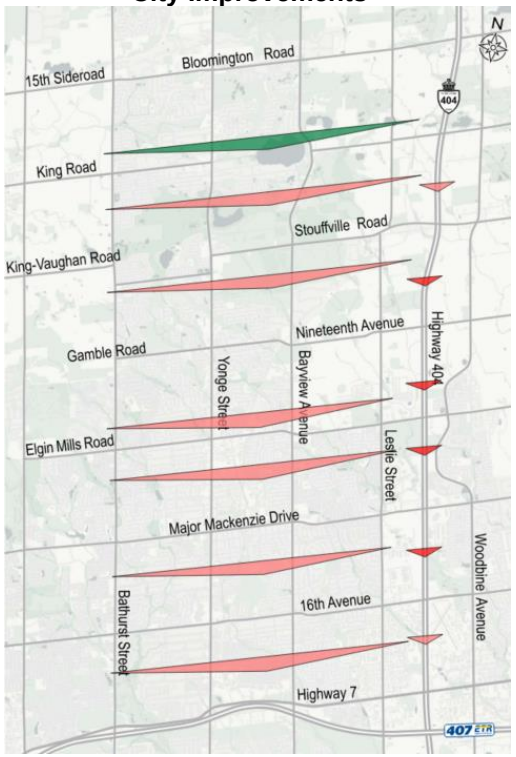
Scenario 0
Do Nothing



Scenario 1
Provincial/Regional Improvements



Scenario 2
City Improvements+



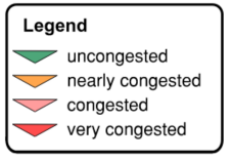
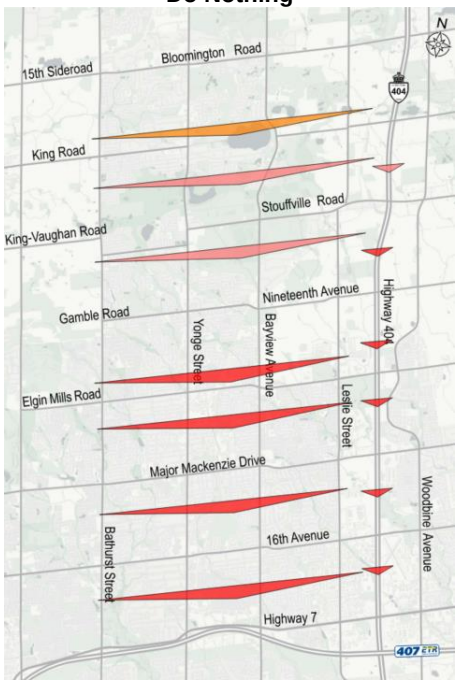
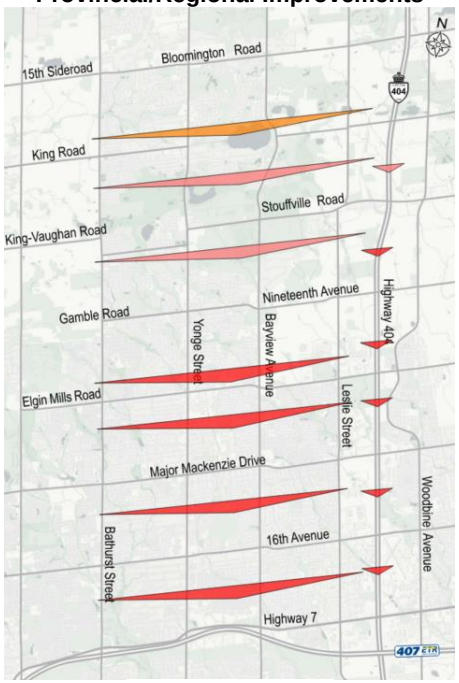


Figure 17. Morning Peak Hour Auto Travel North-South Screenline Results in 2041

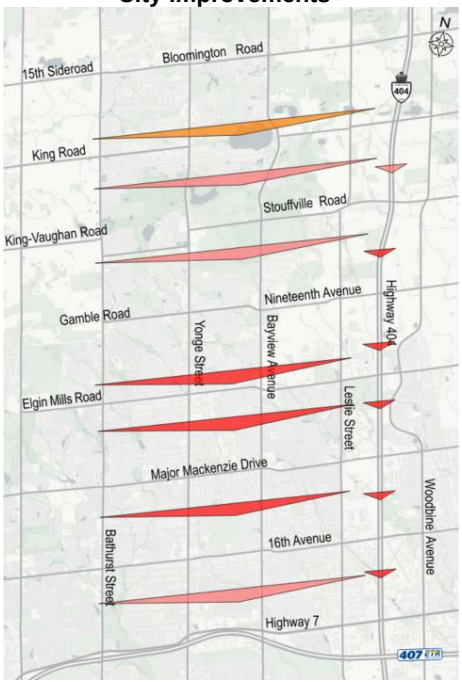
Scenario 0
Do Nothing



Scenario 1
Provincial/Regional Improvements



Scenario 2
City Improvements+



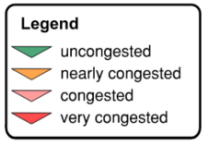
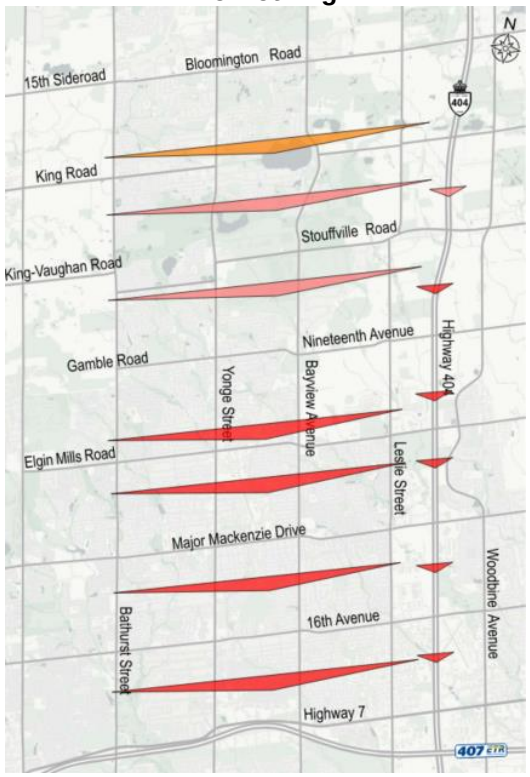
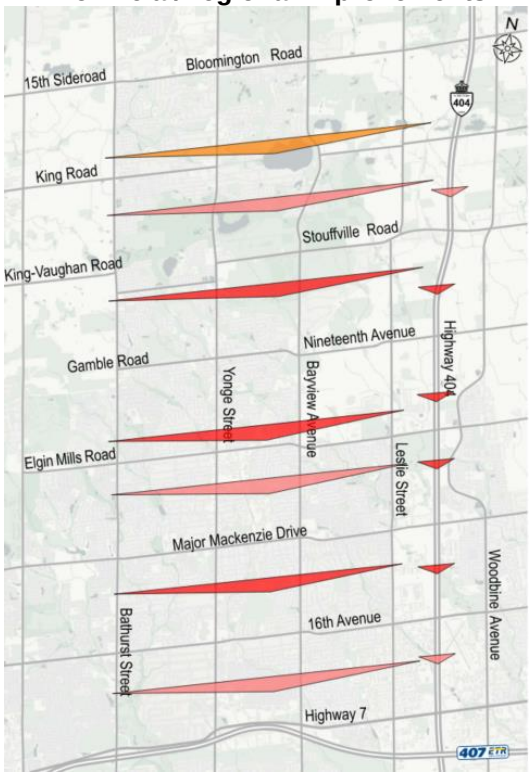


Figure 18. Morning Peak Hour Auto Travel North-South Screenline Results in 2051

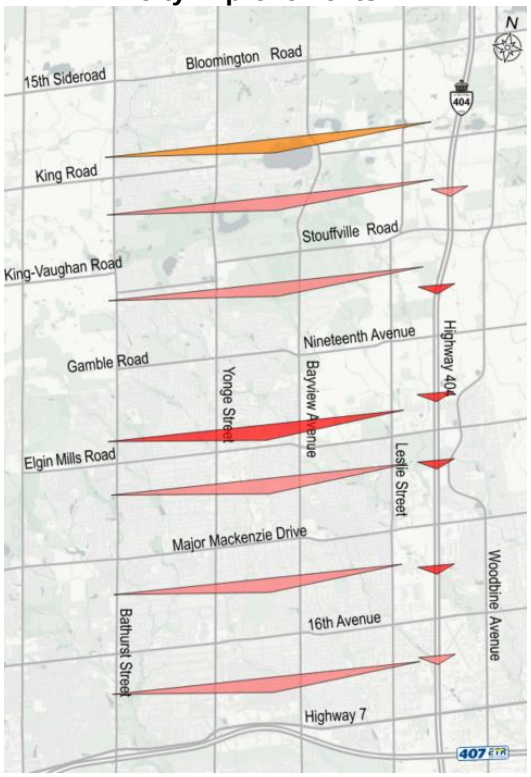
Scenario 0
Do Nothing



Scenario 1
Provincial/Regional Improvements



Scenario 2
City Improvements+



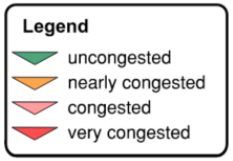
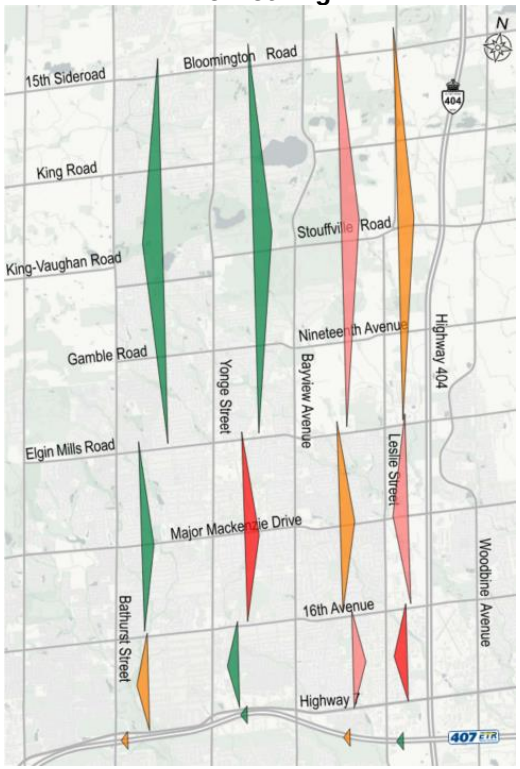
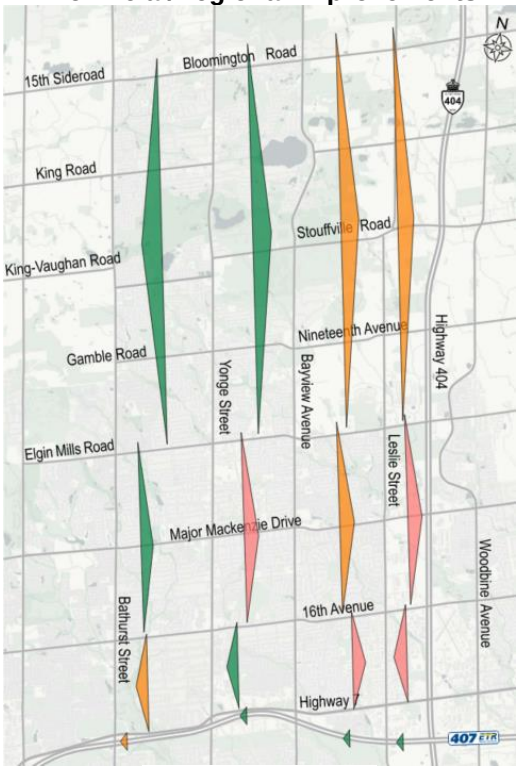


Figure 19. Morning Peak Hour Auto Travel East-West Screenline Results in 2031

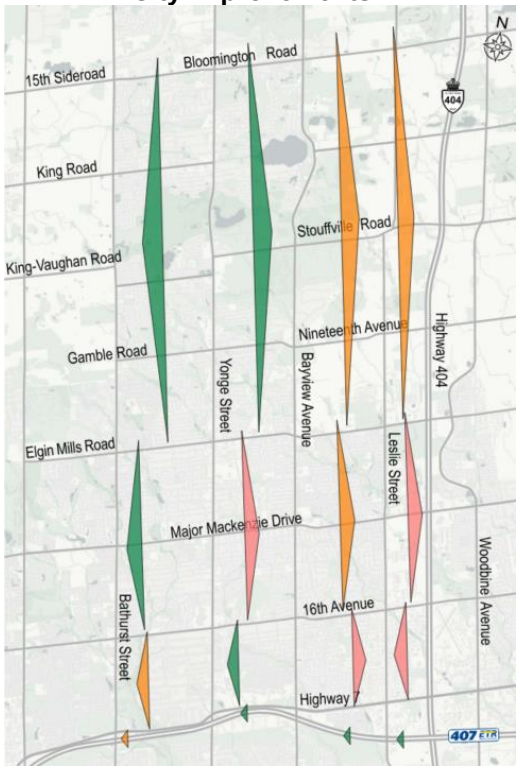
Scenario 0
Do Nothing



Scenario 1
Provincial/Regional Improvements



Scenario 2
City Improvements+



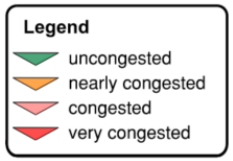
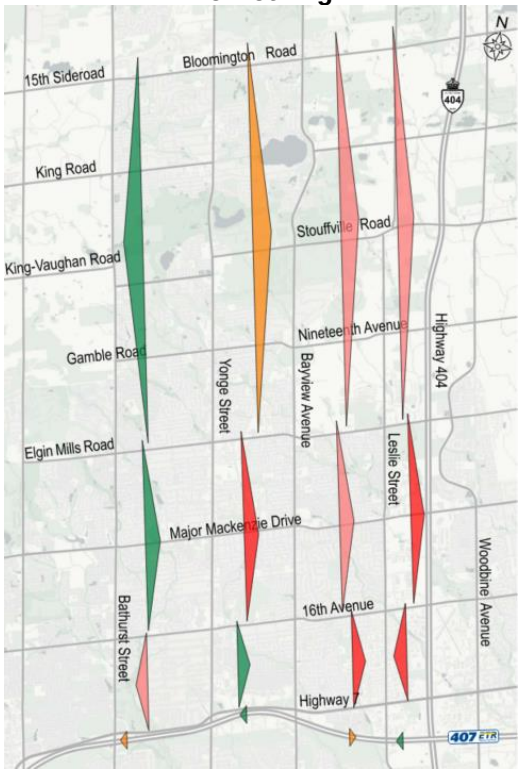
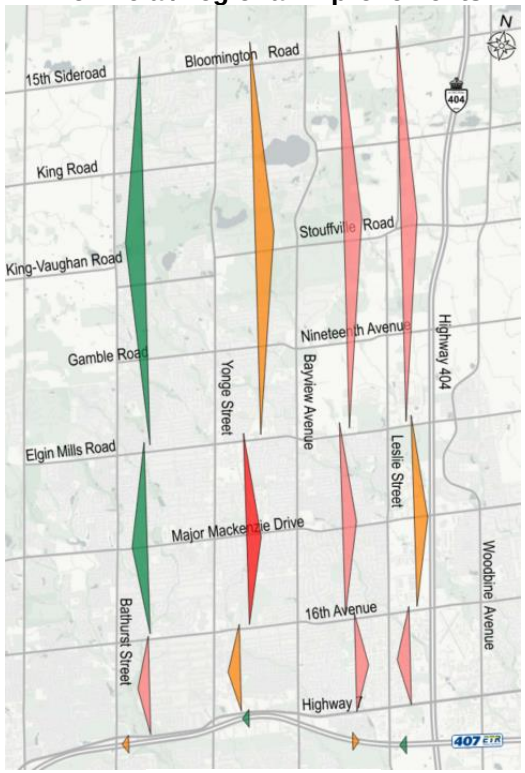


Figure 20. Morning Peak Hour Auto Travel East-West Screenline Results in 2041

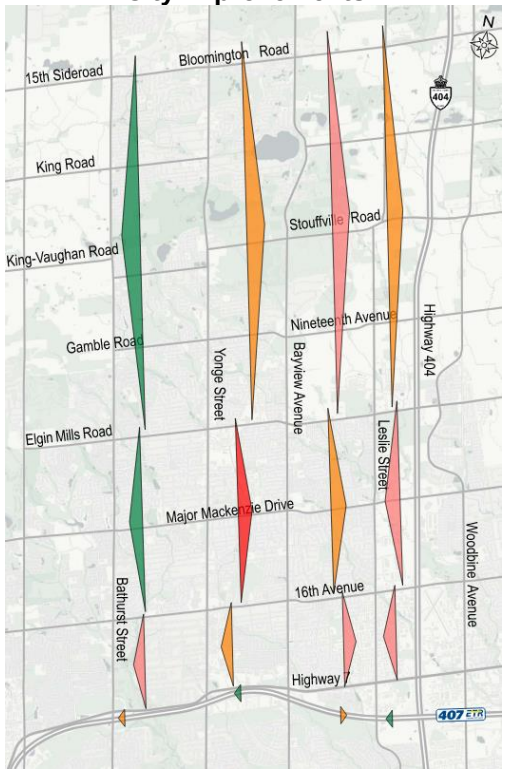
Scenario 0
Do Nothing



Scenario 1
Provincial/Regional Improvements



Scenario 2
City Improvements+



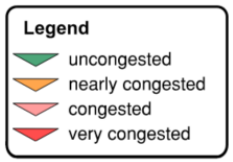
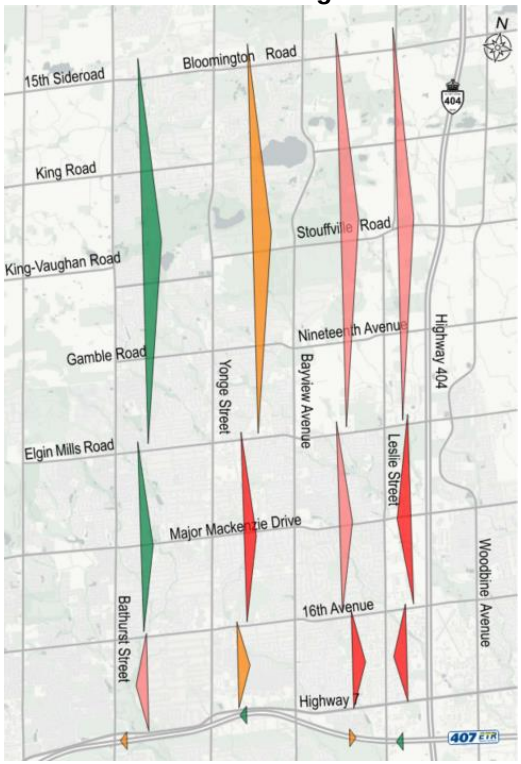
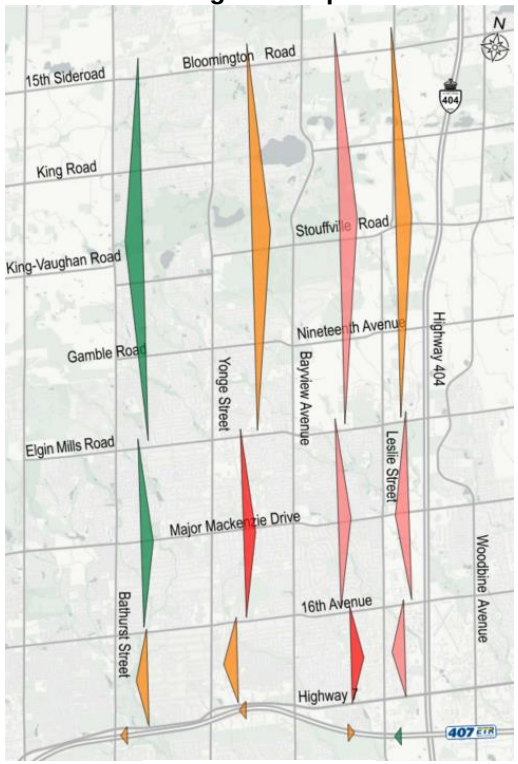


Figure 21. Morning Peak Hour Auto Travel East-West Screenline Results in 2051

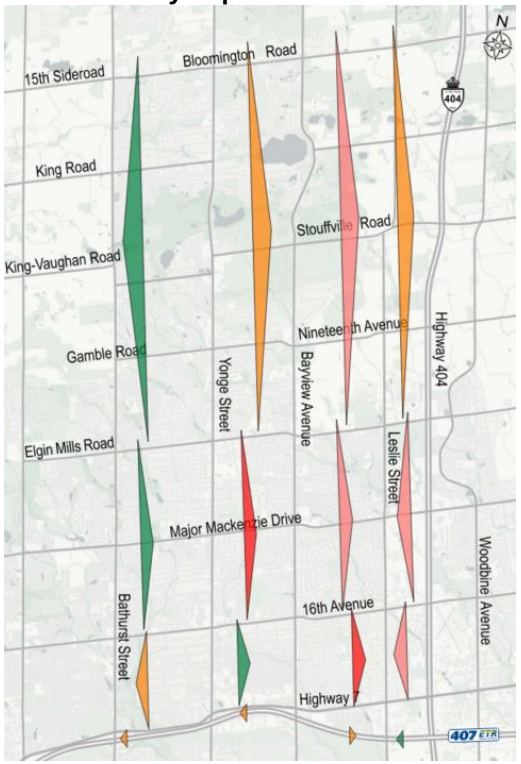
Scenario 0
Do Nothing

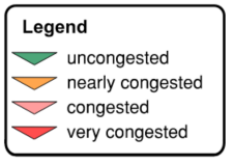


Scenario 1
Provincial/Regional Improvements



Scenario 2
City Improvements+





As can be seen in the north-south screenline plots, the travel demand model is predicting system congestion southbound in the AM peak from north of Stouffville Road down through Highway 7 in all the forecast years and scenarios. This level of congestion is not solely, or likely even principally due to the forecast land-use within the City of Richmond Hill, but is caused by the large, anticipated growth through York Region and the rest of the GTA. Based on **Table 4**, the forecasted population and employment across York Region will impact travel throughout Richmond Hill. As can be seen from comparing Scenario 1 and Scenario 2 to the Do Nothing scenario, the proposed Provincial and Regional road and transit improvements and improvements within Richmond Hill do alleviate some congestion as some of the screenlines south of Elgin Mills within Richmond Hill and south of 16th Avenue on Highway 404 do improve from very congested to congested. In 2031, the very congested corridors are along Highway 404 and south of Major Mackenzie Road, whereas in 2041 the very congested corridors are along Highway 404 and south of 19th Avenue. In 2051, there is some reduction in congestion south of Elgin Mills Road in Scenarios 1 and 2 as compared to 2041. This is likely due to the extension of the Yonge line subway to Elgin Mills in 2051 which has significant ridership in the southbound direction as detailed in this report.

The forecast east-west congestion is less systemic than the southbound congestion, although there are certain screenlines of concern, such as east of Bayview Avenue mostly in the eastbound direction and a handful in the westbound direction, the eastbound approach to Bayview Avenue between 16th Avenue and Elgin Mills Road, and the westbound approach to Bathurst Street between Highway 7 and 16th Avenue. As can be seen from comparing Scenario 1 and Scenario 2 to the Do Nothing scenario, the proposed Provincial and Regional road and transit improvements and improvements within Richmond Hill do alleviate some congestion. This can be seen by the reduction in congestion east of Bayview Avenue in all horizon years and reduced congestion on the westbound approach to Bathurst Street south of 16th Avenue in 2051. The improvement in east-west congestion is likely due to the new Highway 404 overpasses, the arterial road widenings, and transit improvements on east-west corridors such as the Major Mackenzie and Highway 7 BRTs.

The modelled congestion will be partially mitigated by planned active transportation improvements **.** The intent is to address network constraints by creating an interface between roads and active transportation facilities. Active transportation improvements, combined with road improvements, facilitate stronger connections to higher-order transit and the surrounding development, which increases the areas served by a station, as well as first and last mile connections. The macro-model does not include modelling of active transportation facilities, and therefore, cannot capture the effects of AT usage.

Regional and Provincial Transit Improvements

A variety of different transit improvements have been proposed in the vicinity of Richmond Hill as summarized in **Table 6**, including:

1. Additional GO Rail stations on the Richmond Hill line (compared with the 2016 base year);
2. Improved service on the GO Barrie and Stouffville lines;
3. TTC Line 1 Yonge Street subway extension to Elgin Mills Road;
4. TTC Line 1 Spadina subway extension to Vaughan Metropolitan Centre (compared with the 2016 base year); and
5. VIVA BRT service on Yonge Street, Major Mackenzie Drive and Leslie Street.

Items 1 and 4 are projects that have already been completed and are in use today. However, since they were not present for 2016, they were not included in the 2016 baseline scenario and so the first modelled horizon year in which they appear is the 2031 network.

Figure 22 compares the AM peak 3-hour period transit volumes between the 2016 base year and the forecast Scenario 2 for 2031, 2041, and 2051.

In 2031, transit usage is seen to increase as there is more than double the ridership on the Yonge BRT and Highway 7 BRT and almost double the ridership on the GO line between Richmond Hill GO and Langstaff GO.

In 2041, the Yonge subway line extension to High Tech and the Major Mackenzie and Leslie BRTs are added. The subway extension attracts approximately 14,800 southbound riders south of Bridge Station. East of Yonge Street, ridership on the Highway 7 BRT increases in the westbound direction by approximately 15%, as compared to 2031. This is likely caused by the new subway extension as there are more riders travelling westbound towards the subway terminus. The ridership on the Highway 7 BRT is approximately double that of the new Major Mackenzie BRT (east of Yonge) in 2041, likely because of the higher population/employment density around the Highway 7 corridor and the connection of the Highway 7 BRT to the Yonge subway.

In 2051, the Yonge subway line is extended to Elgin Mills Road. The subway extension further increases ridership, with almost 9,000 southbound boardings at Elgin Mills and southbound ridership increasing by approximately 120% (compared to 2041) south of Bridge Station. Ridership on the Yonge BRT north of Elgin Mills increases by approximately 60% southbound and 180% northbound compared to 2041, reflecting the convenient connection for continued travel to/from the subway terminus. Ridership on the Highway 7 BRT continues to increase in 2051. Ridership on the Major Mackenzie BRT increases by approximately 120% and 140% in the eastbound and westbound directions, likely reflecting the improved connection to the subway. The westbound ridership on the Major Mackenzie BRT and Highway 7 BRT are similar in 2051, which is different than the results seen in 2041, reflecting the improved connection to the extended subway from the Major Mackenzie BRT. The Leslie BRT sees a

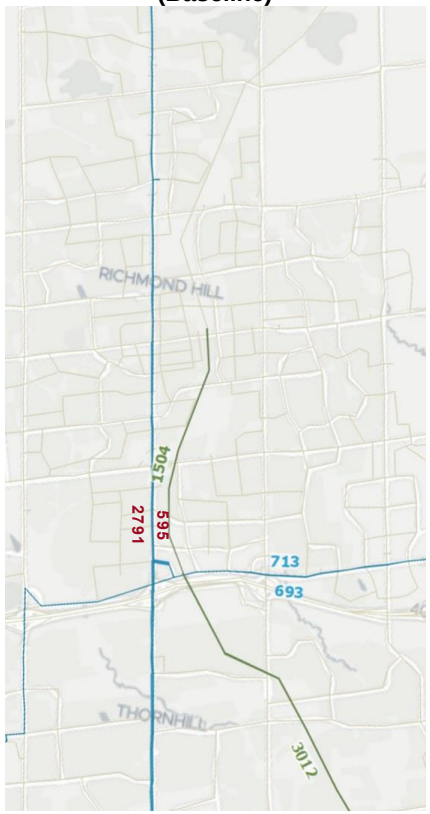
ridership increase of approximately 60% in the southbound direction and 130% in the northbound direction through Richmond Hill.

On the Richmond Hill GO line, peak period ridership drops by approximately 900 riders (20%) between 2031 and 2041, and another 900 riders (25%) between 2041 and 2051. This was mainly attributed to the Line 1 subway extensions in 2041 and 2051, which are not matched by any service improvements on the Richmond Hill GO line past 2031. Unlike most other GO rail lines, current Metrolinx plans for the Richmond Hill line do not include two way service or significant improvements to service frequency or travel time. The extended Line 1 maintains a similar travel time to most locations downtown, while providing two-way service, higher frequency, and many more stops. This presents a strong case for service improvement on the Richmond Hill GO line to mitigate crowding on the Yonge subway.

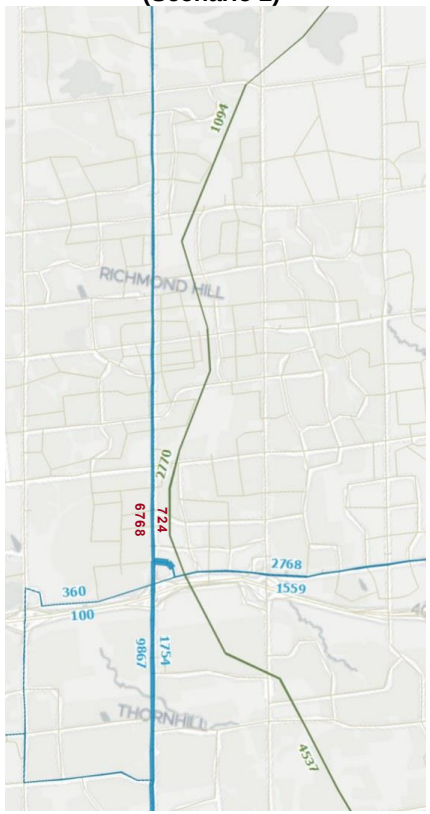
The recommended transit improvements for the City of Richmond Hill are a part of broader advocacy that aligns with the implementation of proposed higher-order transit the Regional and Provincial levels. The proposed projects are intended to expand and extend upon Metrolinx's Existing Yonge-North Subway Extension as well as frequent rapid transit, inclusive of GO train and transit hubs. To continue supporting growth that is forecasted for the City as well as Metrolinx's direction for Transit-Oriented Communities, integrating land use with transportation planning, the City presents a further extension of the Subway to beyond Elgin Mills Road as well as GO Train stations at 16th Avenue as well as Elgin Mills Road.

Figure 22. Simulated AM Peak Hour Regional Transit Ridership

2016 Ridership (Baseline)



2031 Ridership (Scenario 2)



2041 Ridership (Scenario 2)

2051 Ridership (Scenario 2)

Preferred Alternative: Road Network Analysis

Table 11 to Table 14 show the road length and lane kilometres, and rounded VKT (vehicle kilometres travelled), VHT (vehicle hours travelled), and VKT/VHT under congested conditions for the 2016 (base year), 2031, 2041, and 2051 scenarios. Note that the Freeway columns of these tables refer to the stretch of Highway 404 located to the east of Richmond Hill and the stretch of Highway 407 that lies to the south of Richmond Hill.

Table 11. City of Richmond Hill Transportation Network Metrics (2016)

Metric	Freeway	Arterial	Collector / Local	Total
Length	40	238	337	614
Lane-km	142	426	361	929
VKT All	180,600	234,800	39,000	454,500
VKT Critical	60,000	35,300	3,100	98,400
VHT All	3,600	5,900	1,200	10,700
VHT Critical	1,800	1,700	200	3,700

Table 12. City of Richmond Hill Transportation Network Metrics (2031)

Metric	Do Nothing	Do Nothing	Do Nothing	Do Nothing	Scenario 1 – Provincial/Regional Improvements	Scenario 1 – Provincial/Regional Improvements	Scenario 1 – Provincial/Regional Improvements	Scenario 1 – Provincial/Regional Improvements	Scenario 2 – City Improvements+	Scenario 2 – City Improvements+	Scenario 2 – City Improvements+	Scenario 2 – City Improvements+
	Freeway	Arterial	Collector / Local	Total	Freeway	Arterial	Collector / Local	Total	Freeway	Arterial	Collector / Local	Total
Length	40	238	337	614	40	238	343	621	40	238	369	647
Lane-km	142	426	361	929	149	457	373	979	149	457	408	1,013
VKT All	202,700	302,500	65,100	570,400	211,000	313,900	66,500	591,400	211,200	312,000	72,500	595,700
VKT Critical	98,800	124,500	22,300	245,700	105,300	120,300	18,600	244,200	105,300	120,900	19,900	246,100
VHT All	7,300	12,500	3,400	23,200	6,900	11,500	3,000	21,400	6,800	11,300	3,200	21,300
VHT Critical	5,500	8,500	2,100	16,100	5,100	7,200	1,600	13,800	5,000	7,100	1,600	13,700

Table 13. City of Richmond Hill Transportation Network Metrics (2041)

Metric	Do Nothing	Do Nothing	Do Nothing	Do Nothing	Scenario 1 – Provincial/Regional Improvements	Scenario 1 – Provincial/Regional Improvements	Scenario 1 – Provincial/Regional Improvements	Scenario 1 – Provincial/Regional Improvements	Scenario 2 – City Improvements+	Scenario 2 – City Improvements+	Scenario 2 – City Improvements+	Scenario 2 – City Improvements+
	Freeway	Arterial	Collector / Local	Total	Freeway	Arterial	Collector / Local	Total	Freeway	Arterial	Collector / Local	Total
Length	40	238	337	614	40	238	345	623	40	238	385	663
Lane-km	142	426	361	929	149	480	376	1,006	149	480	424	1,053
VKT All	218,800	337,900	78,400	635,100	227,700	359,500	78,800	666,000	227,600	357,400	88,100	673,100
VKT Critical	110,200	177,600	31,500	319,300	110,900	168,600	28,400	307,800	111,100	160,900	32,400	304,300
VHT All	10,100	17,900	4,600	32,600	9,200	15,800	4,000	29,000	9,000	15,300	4,600	28,800
VHT Critical	8,100	14,300	3,200	25,600	6,900	11,400	2,400	20,800	6,700	10,800	2,900	20,400

Table 14. City of Richmond Hill Transportation Network Metrics (2051)

Metric	Do Nothing	Do Nothing	Do Nothing	Do Nothing	Scenario 1 – Provincial/Regional Improvements	Scenario 1 – Provincial/Regional Improvements	Scenario 1 – Provincial/Regional Improvements	Scenario 1 – Provincial/Regional Improvements	Scenario 2 – City Improvements+	Scenario 2 – City Improvements+	Scenario 2 – City Improvements+	Scenario 2 – City Improvements+
	Freeway	Arterial	Collector / Local	Total	Freeway	Arterial	Collector / Local	Total	Freeway	Arterial	Collector / Local	Total
Length	40	238	337	614	40	238	348	626	40	238	390	668
Lane-km	142	426	361	929	149	498	379	1,026	149	498	428	1,075
VKT All	234,600	361,100	85,300	681,000	245,400	382,200	88,700	716,300	245,900	380,900	97,900	724,700
VKT Critical	111,800	196,800	34,800	343,400	116,700	194,400	29,300	340,400	117,200	179,000	32,400	328,500
VHT All	11,700	20,700	5,200	37,600	9,700	16,900	4,300	30,900	9,700	16,600	4,800	31,100
VHT Critical	9,200	16,900	3,600	29,700	7,100	12,500	2,400	22,000	7,100	11,800	2,700	21,600

The large population and employment growth in York Region is reflected in the significant increases in VKT/VHT and VKT Critical/VHT Critical in the Do Nothing scenario. From 2016 to 2031, there is the largest increase with an increase of approximately 116,000 VKT and 12,500 VHT in total. The VKT Critical and VHT Critical increase by approximately 147,300 and 12,400 in total indicating that all of the additional VKT/VHT is congested. From 2031 to 2051, there is a total increase of approximately 111,000 VKT and 14,400 VHT in the 20 year span.

The additional roads proposed as part of Scenario 2 have two different objectives. The first is to improve regional connectivity while the second includes local access.

Table 12 to **Table 14** shows the twin effects of first, building from the Do Nothing scenario to Scenario 1, and then secondly from Scenario 1 to Scenario 2 for the 2031, 2041, and 2051 scenarios. In general, both VKT Critical and VHT Critical are seen to fall markedly from the Do Nothing scenario as Scenario 1 and then Scenario 2 improvements are added, except for the VKT Critical on freeways which increases slightly as compared to Do Nothing. On freeways, the Critical VKT/VHT increases in Scenarios 1 and 2 as compared to Do Nothing; however, All VKT/VHT is also increasing and the proportion of Critical to All VHT is consistently lower in Scenarios 1 and 2. For arterial and local/collector roads, the Critical VKT/VHT falls even as All VKT/VHT increases, meaning that while the total vehicle time/distance travelled increases, less of it is spent in congested conditions. In 2051 Scenario 2, the total VKT Critical and VHT Critical fall by about 5% and 10%, respectively, as compared to the Do Nothing scenario.

In 2031, the VKT/VHT Critical is higher in Scenario 2 than Scenario 1 in some cases, such as on the collector/local roads and in the total. However, this is because the City improvements in Scenario 2 add more lane-km of collector/local roads which increases All VKT/VHT. The proportion of Critical VKT/VHT to All VKT/VHT is actually 1 to 2% lower on local/collector roads in Scenario 2 than Scenario 1, although the proportion is approximately the same for total roads between Scenarios 1 and 2. In 2041, the total VKT Critical and VHT Critical are slightly lower in Scenario 2 than Scenario 1. In 2051, the proportion of Critical VKT/VHT to All VKT/VHT is approximately the same on collector/local roads and freeways between Scenarios 1 and 2 and is 3 to 4% lower on arterial roads in Scenario 2 compared to Scenario 1. This indicates that the City improvements are likely diverting some congestion from the arterial roads and lead to an overall reduction in time and distance travelled. Overall, across all horizon years, Scenario 2 provides some improvement in congested VKT/VHT over Scenario 1.

In Scenario 2, across all the future horizon years, the proportion of VKT in congested conditions is approximately 40 to 45% of total VKT and the proportion of VHT in congested conditions is approximately 65 to 70% of total VHT. This can be compared to proportions of approximately 20% VKT and 35% VHT in congested conditions in the 2016 base scenario. This shows that a significant time and vehicle distance are still spent in congested conditions even in Scenario 2, impacting forecast quality of life for people living in these areas and environmental concerns such as GHG emissions.

Appendix A: 2016 Work Trip Generation Predicted vs Observed

	Origins	Origins	Origins	Origins	Origins	Origins	Destinations	Destinations	Destinations	Destinations	Destinations	Destinations
Planning District	GS Modelled	GS Observed (TTS)	M Modelled	M Observed (TTS)	P Modelled (Model)	P Observed (TTS)	GS Modelled	GS Observed (TTS)	M Modelled	M Observed (TTS)	P Modelled (Model)	P Observed (TTS)
PD 1 of Toronto	12,462	12,126	1,981	1,957	38,981	38,432	94,472	93,537	8,267	8,201	216,757	214,959
PD 2 of Toronto	13,880	14,063	3,305	3,325	33,044	33,467	7,516	8,671	1,916	2,188	12,614	14,510
PD 3 of Toronto	21,429	21,378	8,643	8,643	26,186	26,186	13,974	14,038	6,011	6,060	14,194	14,311
PD 4 of Toronto	15,500	15,463	2,242	2,228	42,110	41,827	20,045	20,152	3,672	3,684	34,073	34,035
PD 5 of Toronto	10,473	10,376	2,356	2,356	17,502	17,356	13,542	13,496	3,013	3,024	21,002	20,935
PD 6 of Toronto	14,777	14,656	3,350	3,342	31,566	31,472	6,299	6,246	2,115	2,130	9,031	9,034
PD 7 of Toronto	5,775	5,732	2,032	2,033	12,195	12,093	3,355	3,242	2,551	2,500	5,139	4,928
PD 8 of Toronto	15,696	15,607	4,757	4,756	33,282	33,157	13,022	13,211	4,579	4,676	18,470	18,741
PD 9 of Toronto	8,019	7,970	5,718	5,631	7,701	7,591	10,595	10,527	7,344	7,244	15,357	15,219
PD 10 of Toronto	12,832	12,725	8,680	8,589	11,102	11,032	15,749	15,469	11,381	11,165	24,450	24,111
PD 11 of Toronto	15,063	15,036	3,651	3,643	35,922	35,850	14,602	14,928	2,107	2,150	26,501	27,071
PD 12 of Toronto	6,671	6,663	1,963	1,963	11,123	10,997	8,562	8,601	783	787	13,142	13,088
PD 13 of Toronto	21,186	20,973	6,422	6,378	22,944	22,705	16,486	16,350	7,133	7,122	23,275	23,145
PD 14 of Toronto	4,572	4,541	1,866	1,866	6,791	6,739	1,259	1,242	611	618	2,847	2,827
PD 15 of Toronto	6,882	6,882	2,772	2,772	8,698	8,688	2,259	2,288	721	730	3,536	3,572
PD 16 of Toronto	20,429	20,314	9,405	9,405	21,630	21,559	14,265	14,296	9,267	9,362	17,045	17,149
Brock	820	691	504	469	725	724	282	155	199	166	238	239
Uxbridge	1,617	1,617	780	780	2,723	2,689	1,017	1,019	937	939	1,375	1,344
Scugog	1,443	1,362	715	715	2,241	2,210	856	785	496	502	867	847
Pickering	8,803	8,660	2,636	2,630	13,187	13,090	4,828	4,728	2,830	2,843	7,968	7,939
Ajax	11,153	11,112	3,482	3,448	14,642	14,600	3,654	3,647	2,090	2,074	6,563	6,580
Whitby	10,157	10,070	3,229	3,196	18,536	18,440	6,384	6,280	3,259	3,215	9,377	9,259
Oshawa	11,663	11,456	5,338	5,337	14,856	14,734	8,853	8,725	3,327	3,356	13,254	13,249
Clarington	6,768	6,562	3,404	3,357	10,307	10,164	2,472	2,320	1,953	1,944	4,396	4,345
Georgina	4,253	4,067	2,640	2,595	4,475	4,234	1,308	1,134	605	565	1,728	1,503
East Gwillimbury	1,849	1,712	990	966	2,484	2,454	753	621	821	803	1,143	1,121
Newmarket	6,612	6,602	3,147	3,074	11,120	11,020	5,480	5,509	2,499	2,444	7,900	7,856
Aurora	4,738	4,671	1,376	1,363	8,527	8,459	3,785	3,743	2,100	2,101	6,264	6,237
Richmond Hill	15,882	15,804	5,038	5,038	29,414	29,324	12,371	12,364	3,515	3,535	18,365	18,381
Whitchurch-Stouffville	3,225	3,214	1,348	1,287	6,644	6,579	1,863	1,870	1,302	1,254	2,218	2,175
Markham	26,284	26,157	8,161	8,128	41,666	41,440	27,636	27,709	10,315	10,357	44,581	44,678
King	2,044	2,019	890	865	3,228	3,200	921	896	723	698	1,295	1,268
Vaughan	28,376	28,015	11,812	11,683	43,348	43,076	29,718	29,456	20,360	20,298	37,861	37,718
Caledon	6,349	6,075	2,903	2,790	8,456	8,341	3,051	2,799	2,894	2,802	4,154	4,069
Brampton	47,438	47,236	27,723	27,625	57,728	57,228	26,000	25,953	16,436	16,435	39,331	39,059
Mississauga	61,187	60,916	23,541	23,256	91,412	90,766	81,436	81,511	29,826	29,668	113,395	113,230
Halton Hills	5,383	5,318	2,537	2,537	8,697	8,599	2,533	2,482	1,789	1,799	2,812	2,730
Milton	8,443	8,231	2,388	2,384	16,287	16,120	4,616	4,439	2,423	2,438	5,547	5,423
Oakville	14,924	14,777	3,781	3,681	28,196	28,043	15,027	14,978	7,137	7,083	23,962	23,966
Burlington	14,519	14,270	5,889	5,781	25,874	25,646	14,208	14,020	6,704	6,625	19,867	19,724
Flamborough	3,166	2,980	1,905	1,898	5,249	5,249	1,566	1,385	1,412	1,409	1,871	1,877
Dundas	1,263	1,237	511	511	2,780	2,724	629	607	423	426	924	875
Ancaster	2,430	2,203	1,405	1,325	5,660	5,170	1,653	1,525	1,609	1,571	2,389	2,164
Glanbrook	1,762	2,175	1,057	1,305	2,568	3,170	807	962	540	644	1,300	1,549
Stoney Creek	5,728	5,678	2,236	2,096	7,459	7,375	3,730	3,691	2,709	2,577	3,361	3,287
Hamilton	25,106	24,393	10,154	9,943	30,553	29,957	22,665	22,178	6,855	6,738	33,974	33,649
Total	**549,030**	**543,785**	**210,663**	**208,950**	**879,819**	**873,976**	**546,102**	**543,785**	**209,560**	**208,950**	**875,718**	**873,976**

2016 School and Other Trip Generation

Note that the model does not model school destinations by land use, so those columns are intentionally omitted.

	Origins	Origins	Origins	Origins	Origins	Origins	Destinations	Destinations
Planning District	Secondary Modelled	Secondary Observed (TTS)	Postsecondary Modelled	Postsecondary Observed (TTS)	Other Modelled	Other Observed (TTS)	Other Modelled	Other Observed (TTS)
PD 1 of Toronto	3,427	3,386	3,094	3,057	14,417	16,259	29,078	31,898
PD 2 of Toronto	5,609	5,700	3,156	3,207	17,058	13,749	15,586	13,829
PD 3 of Toronto	10,826	10,826	4,722	4,722	20,470	19,496	19,061	18,227
PD 4 of Toronto	10,050	10,050	2,954	2,954	21,493	26,931	22,014	27,473
PD 5 of Toronto	6,547	6,547	2,806	2,806	11,551	14,259	12,342	15,606
PD 6 of Toronto	7,533	7,533	2,402	2,402	17,889	17,690	15,739	15,521
PD 7 of Toronto	1,644	1,645	956	956	5,928	6,113	5,766	5,058
PD 8 of Toronto	8,523	8,522	3,781	3,780	17,582	23,502	16,926	22,878
PD 9 of Toronto	3,546	3,546	1,679	1,679	9,139	10,245	10,105	11,283
PD 10 of Toronto	7,899	7,899	3,350	3,350	14,256	14,375	15,832	14,447
PD 11 of Toronto	9,186	9,186	3,853	3,853	18,575	21,630	18,225	21,156
PD 12 of Toronto	3,126	3,126	1,792	1,792	7,527	6,912	7,829	7,806
PD 13 of Toronto	10,445	10,445	5,457	5,457	20,686	25,710	20,357	26,145
PD 14 of Toronto	3,307	3,307	1,106	1,106	5,244	7,543	4,428	7,048
PD 15 of Toronto	4,144	4,144	1,871	1,871	6,986	8,868	5,934	8,069
PD 16 of Toronto	10,802	10,802	4,977	4,977	20,863	22,467	19,565	21,758
Brock	154	154	96	96	1,290	1,178	1,171	861
Uxbridge	686	686	329	329	2,399	2,434	2,200	1,963
Scugog	482	482	110	110	2,415	2,054	2,192	1,918
Pickering	3,279	3,271	1,097	1,094	10,452	10,069	9,628	9,194
Ajax	4,748	4,747	2,370	2,370	12,986	14,801	11,482	13,376
Whitby	5,050	5,045	1,532	1,530	14,400	13,566	13,096	13,446
Oshawa	4,545	4,544	1,913	1,913	18,071	16,547	16,593	17,113
Clarington	2,517	2,512	1,024	1,022	10,139	8,037	8,948	7,017
Georgina	1,013	1,013	220	220	4,969	3,826	4,311	3,229
East Gwillimbury	726	726	279	279	2,738	2,319	2,504	1,678
Newmarket	3,318	3,318	959	959	9,836	9,879	9,417	10,515
Aurora	2,862	2,862	655	655	6,546	7,093	6,233	6,521
Richmond Hill	9,940	9,940	3,170	3,170	22,124	22,156	20,299	20,754
Whitchurch-Stouffville	1,230	1,230	282	282	5,032	4,286	4,470	3,359
Markham	14,752	14,752	4,385	4,385	38,743	37,348	36,956	37,094
King	671	671	230	230	2,767	1,921	2,504	1,796
Vaughan	13,924	13,921	4,539	4,538	37,008	39,290	36,316	36,973
Caledon	1,822	1,822	661	661	7,572	5,793	6,967	4,893
Brampton	26,297	26,287	9,998	9,994	65,752	60,344	59,436	57,108
Mississauga	31,049	31,049	11,717	11,717	88,255	91,719	87,439	93,089
Halton Hills	2,310	2,310	723	723	6,852	6,422	6,236	5,729
Milton	3,937	3,937	1,468	1,468	12,256	13,548	11,057	12,291
Oakville	8,941	8,939	1,961	1,961	22,956	27,221	21,979	26,704
Burlington	5,587	5,587	2,034	2,034	21,682	21,302	20,801	20,849
Flamborough	964	964	524	524	4,024	3,080	3,577	2,129
Dundas	617	617	389	389	2,131	2,183	1,790	1,894
Ancaster	1,739	1,640	422	398	4,105	4,046	3,761	3,899
Glanbrook	733	905	39	48	2,186	3,673	1,868	2,647
Stoney Creek	1,903	1,903	882	882	6,614	7,012	6,100	5,625
Hamilton	9,816	9,720	5,517	5,463	32,935	33,270	31,932	36,074
Sum	**272,227**	**272,218**	**107,481**	**107,413**	**708,897**	**732,166**	**690,049**	**727,940**

Appendix B: 2016 Predicted and Observed Work Trip Flows

The following tables contain trip counts aggregated by PD and regional groupings of the origin and destinations. Due to their outsized impact on Richmond Hill, Toronto's PD1 and the individual York Region municipalities are presented independently. The remaining zones are grouped by city/region. This is the aggregation level at which shadow factor recalibration of the work trip gravity model was performed. Georgina and East Gwillimbury are omitted because of their very low counts of both predicted and observed trips in 2016.

2016 Predicted Work Trips[3,4]

	PD1	Rest of Toronto	Durham	Newmarket	Aurora	Richmond Hill	Stouffville	Markham	King	Vaughan	Peel	Halton	Hamilton	Sum
PD1	26,785	21,386	342	15	14	485	6	1,420	3	1,007	5,269	438	239	57,413
Rest of Toronto	185,392	260,431	7,345	1,390	1,424	8,538	499	26,997	353	27,868	47,393	5,296	678	573,993
Durham	19,341	34,194	73,021	863	1,033	2,270	1,073	10,177	120	1,901	2,986	238	120	148,023
Newmarket	1,956	3,488	440	4,608	2,055	1,636	483	2,363	413	1,744	595	44	3	20,666
Aurora	1,627	2,622	265	1,688	2,143	1,688	223	1,805	255	1,224	632	34	2	14,470
Richmond Hill	8,114	14,120	468	1,038	1,249	6,765	425	7,482	320	6,733	2,900	222	9	50,090
Stouffville	970	2,357	911	463	418	1,124	1,159	2,387	49	762	319	9	1	11,064
Markham	13,477	26,693	1,292	600	706	5,088	686	19,026	100	4,033	3,516	199	8	75,619
King	727	1,294	56	387	310	472	48	384	234	1,230	810	47	3	6,077
Vaughan	11,722	27,263	457	565	637	2,809	178	4,374	326	23,074	10,637	474	34	82,666
Peel	32,930	54,015	731	468	481	1,808	92	3,560	474	15,723	193,609	17,983	1,487	323,447
Halton	15,421	9,593	102	34	36	312	6	600	29	1,083	40,223	58,250	8,911	134,607
Hamilton	2,809	1,805	13	2	2	10	0	28	1	133	5,679	22,163	75,568	108,213
Sum	322,036	460,912	86,262	15,741	12,037	34,179	5,266	82,398	2,867	87,447	315,018	105,416	87,063	1,622,361

[3] Cells for total work trips are coloured red if they do not meet the target criteria of a difference of less than 200 work trips (all professions) and are more than 10% higher or lower than the observed TTS trips.
[4] Note the due to their smaller size and since they are not next to Richmond Hill, Georgina and East Gwillimbury are not calculated in these tables. The target criteria were not exceeded for any planning-district-level totals either to or from these regions.

2016 Observed Work Trips

	PD1	Rest of Toronto	Durham	Newmarket	Aurora	Richmond Hill	Stouffville	Markham	King	Vaughan	Peel	Halton	Hamilton	Sum
PD1	24,977	21,551	831	181	56	547	0	2,006	0	884	4,898	679	201	56,834
Rest of Toronto	187,984	257,394	8,240	1,084	1,491	8,927	578	26,095	199	27,608	49,091	5,979	761	575,709
Durham	18,466	35,760	71,892	751	901	2,432	1,102	10,538	41	2,198	3,177	299	67	148,113
Newmarket	1,867	3,469	395	4,377	2,277	1,618	382	2,308	347	1,777	861	80	0	20,696
Aurora	1,525	2,330	209	1,965	1,875	1,442	343	1,955	301	1,599	776	13	0	14,493
Richmond Hill	8,197	14,452	636	883	1,367	6,588	259	7,451	203	6,162	3,471	270	0	50,166
Stouffville	1,379	2,969	434	485	342	829	1,169	2,535	68	441	358	25	0	11,080
Markham	13,490	27,147	1,699	756	687	5,220	533	18,202	92	4,143	3,122	345	201	75,725
King	489	1,453	0	386	283	400	0	362	566	1,214	793	71	62	6,084
Vaughan	11,728	26,252	598	806	777	2,994	192	4,702	378	22,282	10,961	897	146	82,774
Peel	34,043	55,952	794	503	409	1,732	147	3,971	536	15,705	189,326	18,708	2,297	324,233
Halton	15,233	10,336	160	89	13	363	46	716	10	2,036	41,612	55,493	9,280	135,387
Hamilton	3,032	2,100	0	0	102	143	0	84	0	547	6,517	22,727	74,099	109,389
Sum	322,923	462,647	86,500	15,809	12,081	34,280	5,299	82,744	2,862	87,472	315,526	105,707	87,114	1,626,711

2016 Ratio of Predicted to Observed Trips

	PD1	Rest of Toronto	Durham	Newmarket	Aurora	Richmond Hill	Stouffville	Markham	King	Vaughan	Peel	Halton	Hamilton	Sum
PD1	1.07	0.99	0.41	0.08	0.25	0.89	1.00	0.71	1.00	1.14	1.08	0.64	1.19	1.01
Rest of Toronto	0.99	1.01	0.89	1.28	0.95	0.96	0.86	1.03	1.77	1.01	0.97	0.89	0.89	1.00
Durham	1.05	0.96	1.02	1.15	1.15	0.93	0.97	0.97	2.94	0.86	0.94	0.79	1.79	1.00
Newmarket	1.05	1.01	1.11	1.05	0.90	1.01	1.26	1.02	1.19	0.98	0.69	0.55	1.00	1.00
Aurora	1.07	1.13	1.27	0.86	1.14	1.17	0.65	0.92	0.85	0.77	0.81	2.65	1.00	1.00
Richmond Hill	0.99	0.98	0.74	1.18	0.91	1.03	1.64	1.00	1.57	1.09	0.84	0.82	1.00	1.00
Stouffville	0.70	0.79	2.10	0.95	1.22	1.36	0.99	0.94	0.72	1.73	0.89	0.37	1.00	1.00
Markham	1.00	0.98	0.76	0.79	1.03	0.97	1.29	1.05	1.08	0.97	1.13	0.58	0.04	1.00
King	1.49	0.89	1.00	1.00	1.09	1.18	1.00	1.06	0.41	1.01	1.02	0.67	0.04	1.00
Vaughan	1.00	1.04	0.76	0.70	0.82	0.94	0.93	0.93	0.86	1.04	0.97	0.53	0.23	1.00
Peel	0.97	0.97	0.92	0.93	1.18	1.04	0.62	0.90	0.88	1.00	1.02	0.96	0.65	1.00
Halton	1.01	0.93	0.64	0.38	2.80	0.86	0.14	0.84	2.88	0.53	0.97	1.05	0.96	0.99
Hamilton	0.93	0.86	1.00	1.00	0.02	0.07	1.00	0.33	1.00	0.24	0.87	0.98	1.02	0.99
Sum	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Active Transportation Network Prioritization

Active Transportation Network Prioritization

The phasing of the active transportation network as part of the RHTMP applied the route prioritization criteria, key assumptions based on best practices, as well as input from the public and City staff. A scoring criteria methodology was also developed that could be used by the City as part of their future capital planning and budgeting processes to review, confirm or modify the network priorities recommended in this master plan. This is provided in **Table 1.**

Table 1. Overview of Scoring and Assumptions for Prioritization Criteria

Key assumptions to consider when using this criterion to score a route	Score
Criteria 1: Rapid build-out of a connected "primary" spine network that links to major mobility / transit hubs, supports intensification areas, and connects to key destinations	
The route forms part of the spine network	High (30)
The route does not form part of the spine network	Low (10)
The spine connects to mobility / transit hubs	High (30)
The spine supports intensification	High (30)
The spine connects to schools, community centres and recreation areas	High (30)
The spine connects to the Yonge Street corridor	High (30)
Total	**/ 30**
Criteria 2: Connect neighbourhood destinations and link neighbourhoods to the spine network	
The route connects to local neighbourhood destinations such as schools and parks	High (25)
The route does not connect to local neighbourhood destinations such as schools and parks	Low (8)
The route is not on the spine network but connects to / intersects a spine route	High (25)
The route is not on the spine network and does not connect to or intersect a spine route	Low (8)
Total	**/ 25**
Criteria 3: Alignment with the TMP: road and transit projects and timing	
The route is part of a proposed infrastructure / road project in the TMP	High (15)
The route is not part of a proposed infrastructure / road project in the TMP	Low (5)
The active transportation / trail route connects to a project (road or transit) identified in the TMP	High (15)
Total	**/ 15**
Criteria 4: Ability to integrate with current planned / schedule of capital works projects (includes roads and trails)	

Key assumptions to consider when using this criterion to score a route	Score
The route has been previously identified in a Council-approved planning document	High (15)
The route can be implemented as part of a scheduled capital works project	High (15)
The route is not associated with the City's current schedule of capital works projects	Low (5)
Total	**/ 15**
Criteria 5: Ease of implementation and constructability	
Projects that can be easily implemented with pavement markings and signage (no road reconstruction or widening required)	High (15)
New projects that can be implemented / constructed as part of a capital project	High (15)
Projects that require a feasibility study prior to implementation (implementation of missing sidewalk links or cycle tracks behind the curb)	Moderate (10)
New road or AT / trail projects that require an environmental assessment prior to implementation (typically, timing for EA is dependent upon when road is required and not driven by the AT / trail facility)	Low (5)
Projects that have significant utility, environmental and / or structural features or additional property requirements	Low (5)
Total	**/ 15**
Total Score of all Criteria	**/ 100**

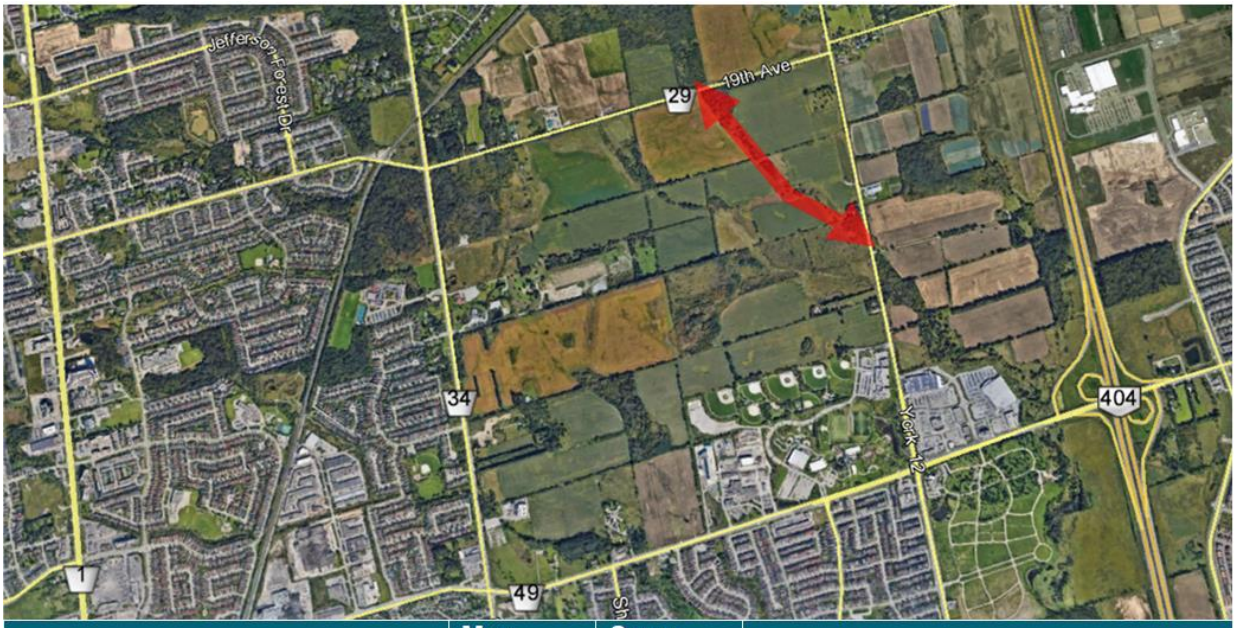
The local trails network was similarly prioritized with a set of criteria. **Table 2** summarizes the scoring and ranking methodology for the trail priorities, which was developed independently by the City and provided for incorporation into this TMP.

Table 2. Overview of Scoring and Assumptions for Prioritization Criteria

Trail Prioritization Criteria	Point Allocation
Ownership: Mandatory criteria for any project in the top 5 priorities	
Land is in public ownership	3 points
Development is assumed, or likely to be assumed within planning horizon	3 points
A registered agreement with private landowner if the land is not in public ownership	3 points
Project Identification: Mandatory criteria for projects in the top 3 priorities	
Trail was identified in DC Study or another plan (municipal, Regional or other jurisdiction)	2 points
Public support for the trail	2 points
Council direction	2 points
Level of Service: Subjective criteria based on perceived benefit to the surrounding community and trail network	
Provides a needed connection to a park, trail, or other destination	Up to 3 points
Improves access to parkland or trails in areas currently under served	Up to 3 points
Serving infill and intensifying areas	Up to 3 points
Funding and Logistics: Tangible criteria based on available information	
Secondary funding (grants and partnerships)	Up to 3 points
Trail is proposed/approved and developer built through a development application	Up to 3 points
Is there room in the funding window	Up to 3 points
Ability to coordinate with another capital project	Up to 3 points
Project achievability and complexity	Up to 3 points

Examples on how the scoring methodology can be used to inform the phasing and prioritization of proposed active transportation routes and trails are provided in **Figure 1** and **Figure 2.** This is intended to be applied in the capital planning and implementation phase.

Figure 1. Example #1: Lake to Lake extension in the North Leslie Development area (Leslie Street to 19th Avenue)



Criteria	Max. Score	Score Provided	Rationale
Rapid build-out of a connected "primary" spine network that links to major mobility / transit hubs, supports intensification areas, and connects to key destinations	30	30	Completes a gap in the spine network, forms part of a regional trail system, connects to Richmond Green Sports Centre and Park, public library and secondary school and will provide access to new residential area.
Connect neighbourhood destinations and link neighbourhoods to spine network	25	25	Part of the spine network but will provide local connectivity in future residential area.
Alignment with the TMP; road and transit projects and timing	15	7.5	Off-road route not identified as part of road improvement or transit project in the TMP but connects to other road projects.
Ability to integrate with previously planned/ schedule of capital works projects	15	15	Available budget to complete the detailed design study in the short term and construction in the short- to medium-term.
Ease of implementation and constructability	15	7.5	Requires a detailed design study prior to implementation. Anticipated complexities due to site location.
Total	100	85	

Figure 2. Example #2: Spadina Road / Valleymede (Major Mackenzie Drive to Highway 7)

Criteria	Max. Score	Score Provided	Rationale
Rapid build-out of a connected "primary" spine network that links to major mobility / transit hubs, supports intensification areas, and connects to key destinations	30	30	Completes a gap in the spine network, located along a transit route, connects to Viva Next rapidway along Highway 7, YRT bus route along Major Mackenzie and schools.
Connect neighbourhood destinations and link neighbourhoods to spine network	25	25	Part of the spine network but will provide neighbourhood connectivity.
Alignment with the TMP; road and transit projects and timing	15	0	Route not identified as part of road improvement or transit project in the TMP.
Ability to integrate with previously planned/ schedule of capital works projects	15	15	Improvements identified in the 2010 PCMP.
Ease of implementation and constructability	15	15	Can be implemented relatively easily (investigate opportunity to enhance existing signed bike route to bike lanes by removing on-street parking).
Total	100	85	

Summary of Priority Routes

Cumulatively, a route can have a maximum score of 100 points. The higher the score, the higher the priority. It should be noted that this evaluation process for identifying priority routes is not meant to be prescriptive, but rather as best practice. A priority is not just about the timing of construction for a project. A priority could also indicate the need to initiate a study (Class EA, on or off-road cycling / multi-use trail feasibility study) in the short-term, as part of the planning / confirmation process, prior to detailed design and implementation. Examples on how to use the prioritization criteria to help inform the phasing for a proposed active transportation route are provided on the following pages. A total of nine priority active transportation projects have been identified for the City's active transportation and trails network to 2031. These priority projects were reviewed and confirmed with City staff and are intended to help achieve the overall goals and improvements identified as part of the TMP process. A detailed summary of the active transportation priorities is provided in **Table 3**.

Table 3. Active Transportation Network Prioritization List

Type of Proposed Facility	Length (KM)
Priority 1: North-South Route and CN Rail Corridor	
Off-Road Trail	3.64
In-Boulevard Multi-Use Path	0.05
Bike Lane	0.17
Signed Bike Route with Edgeline	0.11
Signed Bike Route	1.23
Total for Priority	**5.20**
Priority 2: Lake to Lake	
Off-Road Trail	4.18
In-Boulevard Multi-Use Path	0.09
Total for Priority	**4.27**
Priority 3: Spadina-Valleymede	
Bike Lane	6.83
Priority 4: Weldrick	
In-Boulevard Multi-Use Path	2.83
Bike Lane	3.14
Signed Bike Route with Edgeline	0.14
Total for Priority	**6.11**
Priority 5: East-West Route and Trans Canada Pipeline Route	
Bike Lane	0.96
Off-Road Trail	2.42
Total for Priority	**3.38**
Priority 6: East Don River Trail (Oxford- Direzze Trail)	
Off-Road Trail	0.47

Type of Proposed Facility	Length (KM)
Priority 7: MacLeod Trail	
Off-Road Trail	0.54
Priority 8: Garden Avenue Multi-Modal Connection	
Off-Road Trail	0.21
Bike Lane	0.82
Cycle Track	1.55
Signed Bike Route with Edgeline	2.07
Total for Priority	**4.65**
Priority 9: East Beaver Creek-Headford	
In-Boulevard Multi-Use Path	1.72
Cycle Track	1.05
Buffered Bike Lane	1.44
Bike Lane	2.31
Total for Priority	**6.52**
Total	**37.97**

Trail Network Prioritization

In addition to the nine priority active transportation routes, the City identified ten local trail priorities for the short and medium term. A detailed summary of the trail priorities is provided in **Table 4**.

Table 4. Trail Prioritization List

Priority Number	Name	Phase	Length (KM)
1	Jefferson Forest Trail from Port Arthur Crescent to Bayview Avenue	Short-Term	1.76
2	Beaver Woodland Trail South to Highway 7	Short-Term	1.37
3	Elgin East Channel Lands Trail from Jefferson Forest Drive to 19th Avenue	Short-Term	0.65
4	Rouge River Headwaters Valley & Trails	Medium-Term	1.61
5	TRCA Elgin West Channel Lands Trails to Townwood Drive	Medium-Term	0.97
6	Humberview Pond Trails to Humberland Drive	Medium-Term	0.74
7	TRCA Lands Riotrin Valleylands Trails from John Birchall Road to Elgin Mills Road East	Medium-Term	0.88
8	Oak Ridges East Trails from Pennyroyal Court to Worthington Avenue	Medium-Term	1.00
9	Webster Park Trail North to Udine Court	Short-Term	0.48
10	Oak Ridges Corridor Conservation Reserve Trails to Sweet Gale Crescent	Medium-Term	0.37
Total			**9.83**

Active Transportation Network Maintenance

Active Transportation Network Maintenance

A key TMP implementation consideration is the operations and maintenance of active transportation routes and infrastructure asset management. Regular and appropriate active transportation facilities' maintenance protects the City's capital investment by extending the lifespan of infrastructure. The information in this section is intended to be used as a reference to supplement existing City maintenance practices.

As the City of Richmond Hill's active transportation network continues to expand, maintenance practices should be reviewed and adapted to reflect new routes, equipment and expectations for safe, comfortable facilities.

Roles and Responsibilities

Active transportation network maintenance and operations in Richmond Hill will require ongoing coordination between City Staff, York Region and other agencies. Roles and responsibilities' comprehension and buy-in are important to ensure facilities are maintained in an appropriate state of repair throughout the network.

In Ontario, liability and maintenance responsibility typically lies with the jurisdiction that owns a corridor or who has assumed responsibility of a facility through legal agreement with the property owner. Local municipalities or conservation authorities usually assume responsibility for trail maintenance. On-road facilities (bike lanes) are typically under the jurisdiction responsible for the provision and maintenance of the road in question.

It is recommended that maintenance and operation agreements be formalized between the City and the Region as part of the detailed design and implementation phase in order to formally establish a maintenance level of service strategy. Segments in the network in the boulevard for Regional roads, such as multi-use pathways and potentially cycle tracks depending on their location in the boulevard, should follow the existing approach used with segments of the Lake-to-Lake route maintained by the City.

General Maintenance Considerations

Maintenance considerations should follow guidelines set in the **City's Asset Management Plan (2021).** The **Provincial Minimum Maintenance Standards (O. Reg. 239/02)** and **York Region's Pedestrian and Cycling Planning and Design Guidelines (2018)** provide additional elements that should be considered when reviewing the City's active transportation network maintenance requirements. **OTM Book 18 (2021)** also includes asset management assumptions and typical service life for various elements of an active transportation network. A detail summary of the considerations for each of these plans is provided in **Appendix A** within this document.

Cost Considerations

Typical high-level annual maintenance costs for components of the active transportation network ranges for on and off-road facilities, therefore an absolute dollar value for maintenance costs has not been calculated. These costs are considerations for annual capital budgeting purposes. Annual maintenance costs for on and off-road active transportation routes will vary depending on several factors including:

- ✓ Level of service standard adopted and whether the maintenance of a facility can be incorporated into the City's or Region's (depending on route jurisdiction) maintenance budget / program for roads or trails;
- ✓ Type of facility (the cost to maintain an on-road facility is expected to be incorporated into the overall road maintenance budget except for additional sweeping that may occur 1-2 times per year);
- ✓ Equipment available and currently owned by the City; and
- ✓ Context and location of the route.

It is recommended that the budget for maintenance grow incrementally along with the incremental growth and expansion of the active transportation network. As each new segment is added, the impact to operations and respective budgets should be reviewed and updated as necessary by the City.

Maintenance Recommendations

Following the review of existing maintenance guidance and considerations, **Table 1** presents the maintenance recommendations proposed for the RHTMP.

Table 1: Maintenance Recommendations

Recommendation	Status	Phase
Include Operations Staff as key stakeholders during the design and approval process for any new active transportation facilities including sidewalks, cycling facilities and recreational trails as part of development-driven and capital programming projects.	New	Short-Term
Work with others to develop a formal maintenance program and Standard Operation Procedures (SOPs) for the pedestrian, cycling, shared use and multi-use recreational trail networks and incorporate into operating budgets, equipment needs and resources.	New	Short-Term
Working with Operations Staff, review existing maintenance strategies and update as necessary with consideration to the Minimum Maintenance Standards, winter maintenance service levels for snow clearance on sidewalks, cycling facilities, and trails, and winter maintenance where technically, operationally, environmentally, and fiscally feasible.	New	Short-Term

Recommendation	Status	Phase
Continue to engage with York Region to discuss maintenance responsibilities and level of service associated with pedestrian and cycling infrastructure within Regional ROW.	Existing, Continued	Short-Term
Implement the recommendations of the future Trails Level of Service Study by working with Asset Management to update the existing Asset Management Plan to include active transportation routes outside of the road right-of-way to provide an understanding of the off-road trail maintenance and lifecycle considerations for the City.	New	Short-Term
Consider adoption of a pilot project to identify priority winter cycling routes to understand what types of additional staffing resources and additional snow clearing equipment may be required and to provide the community the opportunity to experience winter maintained cycling routes.	New	Short-Term

Appendix A

2021 Asset Management Plan

The City's 2021 Asset Management Plan includes active transportation assets within the City's road right-of-way. Active transportation infrastructure outside of the right-of-way will be covered in a future iteration of the Plan. The Plan's established service levels provide alignment between i) corporate objectives, ii) the public's understanding of services provided by the City's infrastructure system, and iii) technical considerations and performance measures for managing the infrastructure. The following table summarizes the asset management strategy regarding the maintenance and lifecycle of active transportation facilities.

Table 2. Lifecycle Strategies for Active Transportation (Source: City of Richmond Hill 2021 Asset Management Plan)

Lifecycle Activity	Description of Activities Practiced by the City
Non-Infrastructure	The City makes continuous improvements in operations as well as initiatives related to employee capabilities, communications, and training.
Maintenance	The City performs routine maintenance such as grinding, patching, single and multi-bay replacement, utility cut repairs, and sidewalk/trail levelling. Winter maintenance is practiced for all sidewalks and multi-use paths within the road right-of-way.
Rehabilitation	AT assets generally do not undergo rehabilitation activities and are replaced at end of life.
Replacement	Replacement activities includes replacement of sidewalks and resurfacing of pathways. These activities are based on condition and forecasted based on age and expected service lives.
Disposal	Pathway disposals are infrequent and generally related to rerouting.
Growth/Service Improvement	Improvement activities may include technologies such as pavement material alternatives and new and improved materials and design processes. Expansions to the primary spine pathway network and connections to neighbourhood destinations are considered as part of the City's Transportation Master Plan to improve the active transportation network.

Provincial Minimum Maintenance Standards – Road Operation Maintenance Practices and Level of Service Standards

Ontario Regulation 239/02, a regulation under the Municipal Act, 2001, identifies Minimum Maintenance Standards (MMS) for Municipal Highways, which sets out a suggested minimum standard for repairs and seasonal maintenance, including winter, of roadways under municipal jurisdiction. The Provincial Minimum Maintenance Standards are guidelines only, and the level of service standards established in the City's 2021 Asset Management Plan should be the primary source to inform maintenance activities.

The MMS outlines standards for various elements of road maintenance and operations including the frequency of road inspections, weather monitoring, ice formation on roadways, snow accumulation, and sidewalk trip edges.

In 2018, the MMS were amended and introduced provisions for the maintenance of walking and cycling facilities **(Figure 1)**, specifically:

- ✓ Winter maintenance standards for **bicycle lanes**;
- ✓ Winter maintenance standards including patrol obligations for **sidewalks**;
- ✓ The ability for municipalities to declare a significant weather event with implications for winter maintenance on roadways, bicycle lanes and sidewalks during the duration of the event; and
- ✓ Inspection standards for areas adjacent to sidewalks.

Figure 1. MMS Definitions

The MMS defines "Bicycle lanes" as:

- A portion of the roadway that has been designated by pavement markings or signage for the preferential or exclusive use of cyclists; or
- A portion of a roadway that has been designated for the exclusive use of cyclists by signage and a physical or marked buffer.

This does not include in-boulevard multi-use pathways. If a multi-use pathway commonly functions as a pedestrian facility, then it is recommended that a municipality's sidewalk maintenance level of service standard should apply.

The MMS defines "sidewalks" as:

- The part of the highway specifically set aside or commonly understood to be for pedestrian use, typically consisting of a paved surface but does not include crosswalks, medians, boulevards, shoulders, or any part of the sidewalk where cleared snow has been deposited.

In locations where an in-boulevard multi-use pathway is existing and functions as a pedestrian connection, typically local municipalities apply the sidewalk maintenance standards for in-boulevard multi-use pathway.

A summary of the new service levels identified in the updated standards for active transportation facilities for each mode is included in this section.

Bicycle Lanes/Separated Bicycle Lanes

The MMS now addresses winter maintenance of bicycle lanes and separated bicycle lanes. The specific requirements are noted below from Section 4.2:

1. Subject to section 4.3, the standard for addressing snow accumulation on bicycle lanes is,

    a. after becoming aware of the fact that the snow accumulation on a bicycle lane is greater than the depth set out in the Table to this section, to deploy resources as soon as practicable to address the snow accumulation; and

    b. after the snow accumulation has ended, to address the snow accumulation so as to reduce the snow to a depth less than or equal to the depth set out in the Table to this section to provide a minimum bicycle lane width of the lesser of 1 metre or the actual bicycle lane width. O. Reg. 366/18, s. 7.

2. If the depth of snow accumulation on a bicycle lane is less than or equal to the depth set out in the Table to this section, the bicycle lane is deemed to be in a state of repair in respect of snow accumulation. O. Reg. 366/18, s. 7.

Source: O. Reg 239/02, Section 4.2

Sidewalks

The revised standards incorporate guidance on winter maintenance of sidewalks. The specific requirements are noted below from Section 16.3:

1. Subject to section 16.4, the standard for addressing snow accumulation on a sidewalk after the snow accumulation has ended is,

    a. to reduce the snow to a depth less than or equal to 8 centimetres within 48 hours; and

    b. to provide a minimum sidewalk width of 1 metre. O. Reg. 366/18, s. 15.

2. If the depth of snow accumulation on a sidewalk is less than or equal to 8 centimetres, the sidewalk is deemed to be in a state of repair in respect of snow accumulation. O. Reg. 366/18, s. 15.

3. If the depth of snow accumulation on a sidewalk exceeds 8 centimetres while the snow continues to accumulate, the sidewalk is deemed to be in a state of repair with respect to snow accumulation, until 48 hours after the snow accumulation ends. O. Reg. 366/18, s. 15.

Source: O. Reg 239/02, Section 16.3

York Region Pedestrian and Cycling Planning & Design Guidelines

Activities recommended by the Region for regular maintenance is summarized in **Table 3**, which is adapted from the Region's Pedestrian and Cycling Planning and Design Guidelines.

Table 3. Summary of Maintenance Activities for Active Transportation Facilities

Maintenance Activity	Type	Description
Inspection and Patrol	Year-Round	Routing inspection and patrolling to ensure that facilities are in a state of good repair.
Pothole and Surface Discontinuity Repair:	Year-Round	Ensuring a smooth walkable/rideable surface free of major cracks and/or discontinuities.
Pavement Markings and Signage	Year-Round	Ensuring visibility of signage and pavement markings and refreshing pavement markings following winter months.
Sweeping	Year-Round	Clean-up of leaves, debris and dirt that accumulate along active transportation facilities.
Snow Clearing and Snow Removal, Prevention of Ice Formation	Winter	All of the winter maintenance activities that help create a navigable active transportation facility year-round where applicable.
Vegetation Trimming	Others – As Needed	Ensuring grass and other plantings do not impact the surface through regularly cutting and trimming.
Litter Collection	Others – As Needed	Removing/collecting garbage accumulated in boulevards and through open spaces.

(Source: York Region Pedestrian and Cycling Planning and Design Guidelines, 2018)

Maintenance Costs and Asset Management Strategies

Table 4 outlines the typical unit prices and assumptions for maintenance based on WSP's experience in active transportation planning and design across Ontario. **Table 5** outlines asset management assumptions and typical service life for various elements of an active transportation network based on best practices outlined in OTM Book 18; however, it is recommended that City review this information and consider the various strategies to manage their active transportation network. Additional details on non-winter and winter maintenance practices can be found in OTM Book 18. Maintenance practices for active transportation facilities can include:

- ✓ Sweeping;
- ✓ Surface repairs;
- ✓ Pavement markings and signage;
- ✓ Vegetation management;
- ✓ Snow clearance / ice control; and
- ✓ Drainage improvements and drainage grates.

Table 4. Maintenance Typical Unit Prices and Assumptions

Item	Unit Price	Assumptions
Painted Line Markings	$2.5 / m	Unit price is for a single 100 mm wide painted line marking, therefore assume - $5 / m for both sides of the road. Maintenance cost assumes that painted line markings are fully replaced / renewed on an annual basis.
Cold Plastic Line Markings	$5 / m	Unit price is for a single 100 mm wide cold plastic line marking, therefore $10 / m for both sides of the road. Maintenance cost assumes that plastic line markings are replaced every 5 years (or 20% annually). See calculations below: $5 / m x 20% = $1 / m
Painted Stencils	$50 / m	Assumes stencils are placed every 75m as per OTM Book 18, therefore 26 stencils / kilometre on both sides of the road (13 signs on each side of the road). Maintenance cost assumes 30% of painted stencils will need to be replaced / renewed on an annual basis. This equates to $400 per year. See calculations below: $50 x 26 = $1,300 $1,300 x 30% = $400
Cold Plastic Stencils	$275 each	Assumes stencils are placed every 75m as per OTM Book 18. 26 signs in 1 kilometre on both sides of the road (13 signs on each side of the road). Maintenance cost assumes 30% of painted stencils will need to be placed / renewed on an annual basis.

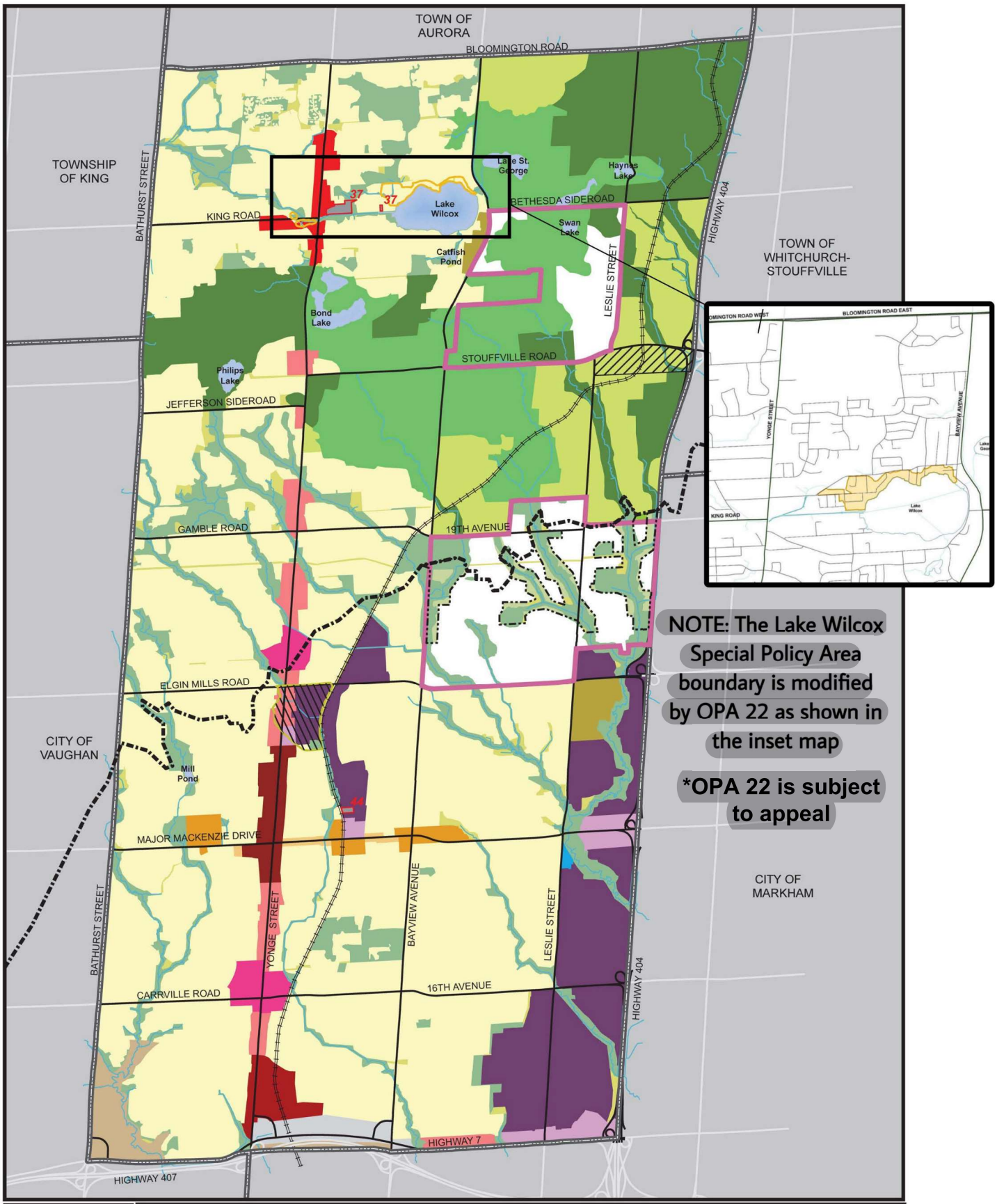
Item	Unit Price	Assumptions
		This equates to $2,200 per year. See calculations below: $275 x 26 = $7,150 $7,150 x 30% = $2,200
Route Signs	$200 each	Assumes 26 signs per kilometre (13 on both sides of the road / route). Maintenance cost assumes 5% of all signs will need to be replaced annually. This equates to $260 annually. See calculations below: $200 x 26 = $5,200 $5,200 x 5% = $260
Sweeping Costs	$2,400 to $4,000 / km	Assumes sweeping frequency of 6 times a year per road km (uni-directional, one side of the road).

Table 5. Asset Management Strategies

Type	Useful Life	Asset Management Strategies
Asphalt bikeway	25 years	Minor repairs Resurfacing Rehabilitation Full-depth replacement
Concrete bikeway	50 years	Minor repairs Replace deteriorating segments Full replacement
Bridge (AT or motor vehicle)	25–75 years	Bridge repairs Minor rehabilitation Full replacement
Culvert	25–50 years	Culvert repair Minor rehabilitation Full replacement
Painted Line Markings and Symbols	1–2 years	Refresh annually or depending on wear
Durable Line Markings, Symbols and Green Surface Treatments	3–7 years	Depends on type, weather conditions, amount of wear, preparation of surface during application
Signage	20 years	Replace damaged or faded signs
Physical separation (bollards, curbs, planters)	Until damaged	Repair or replace damaged or missing bollards and other separators

(Source: OTM Book 18 Update)

Official Plan Excerpts



RICHMOND HILL OFFICIAL PLAN

Land Use

SCHEDULE A2

Legend

- ORM Natural Core
- ORM Natural Linkage
- ORM Countryside
- Greenbelt Plan Protected Countryside
- Natural Core
- Natural Linkage
- Countryside
- Parkway Belt West
- Major Urban Open Space
- Employment Area
- Employment Corridor
- Richmond Hill Centre
- Downtown Local Centre
- Oak Ridges Local Centre
- Key Development Area
- Regional Mixed Use Corridor
- Local Development Area
- Local Mixed Use Corridor
- Neighbourhood
- Utility Corridor
- Special Policy Area
- Flood Vulnerable Area
- Leslie Street Institutional Area (LIA)
- Lands subject only to the policies and schedules of Part II of this Plan.
- Oak Ridges Moraine Conservation Plan Area
- Greenbelt Plan Area
- Waterbodies
- Watercourses
- C.N.R.

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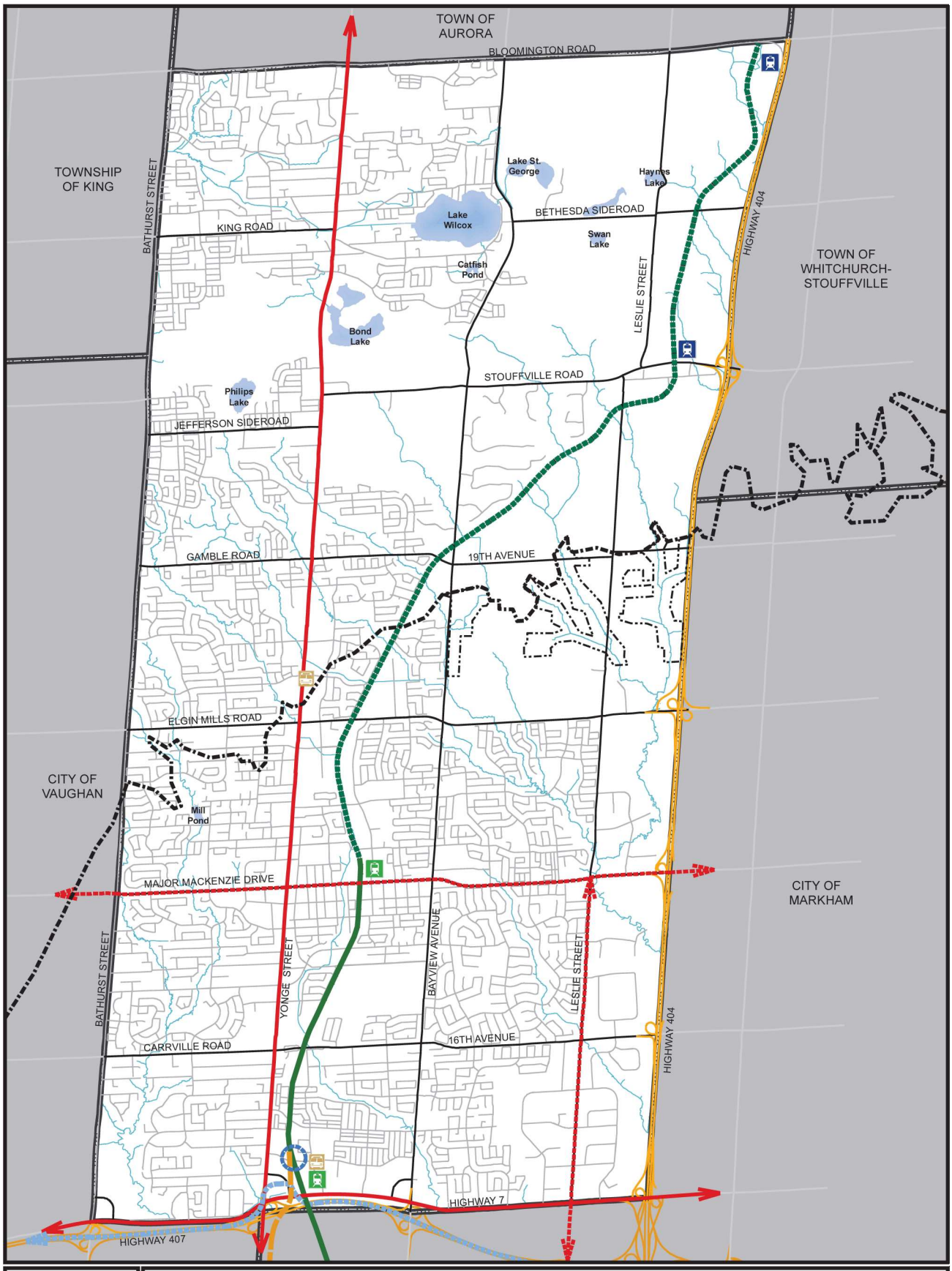
Richmond Hill

PLANNING & REGULATORY SERVICES DEPARTMENT



RICHMOND HILL OFFICIAL PLAN

Public Rapid Transit

APPENDIX 5

Legend

- Future Rapid Transit Corridor
- Proposed Subway Extension
- Proposed 407 Transitway
- Regional Rapid Transit Corridor
- Future Commuter Rail (GO)
- Existing Commuter Rail (GO)
- Provincial Highways
- Arterial Streets
- Terminal
- Proposed GO Station
- Existing GO Station
- Proposed Integrated Transit Hub
- Oak Ridges Moraine Conservation Plan Area
- Greenbelt Plan Area
- Waterbodies
- Watercourses
- C.N.R.

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Scale 1:45,000

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Richmond Hill

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