



Appendix D

Discussion Papers

- D1. Existing Transportation Conditions, Trends and Future Plans
- D2. Transportation Demand Management
- D3. Role of Transit
- D4. Safety and Traffic Calming



D1. Existing Transportation Conditions, Trends and Future Plans

City of Vaughan

Transportation Master Plan Existing Transportation Conditions, Trends and Future Plans

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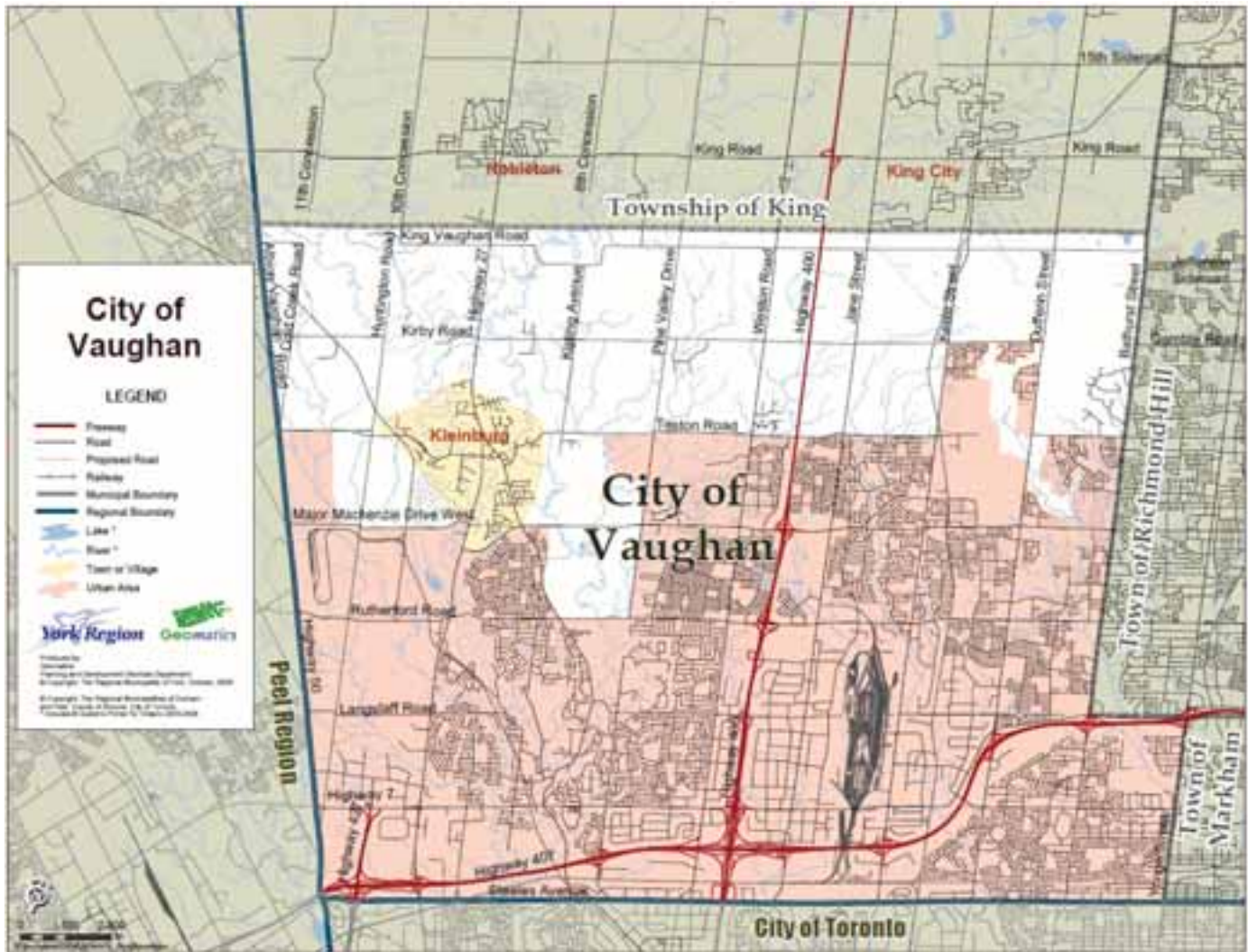
1. Introduction

As part of the Transportation Master Plan for the City of Vaughan, this discussion paper aims at describing the existing transportation conditions and recent trends in the context of Vaughan’s continuous rapid urban growth. Attempts have been made to expose existing transportation deficiencies through overview analyses of available data.

2. Study Area

The City of Vaughan is centred on Highway 400 immediately north of Toronto and occupies the southwestern portion of York Region. The City is approximately 274 square kilometres with 4 main communities including Kleinburg, Maple, Woodbridge and Thornhill. As depicted in **Figure 1**, Vaughan is bounded by King Township on the north, City of Toronto on the south, Towns of Markham and Richmond Hill on the east and Peel Region (City of Brampton and Town of Caledon) on the west.

Figure 1. Vaughan TMP Study Area

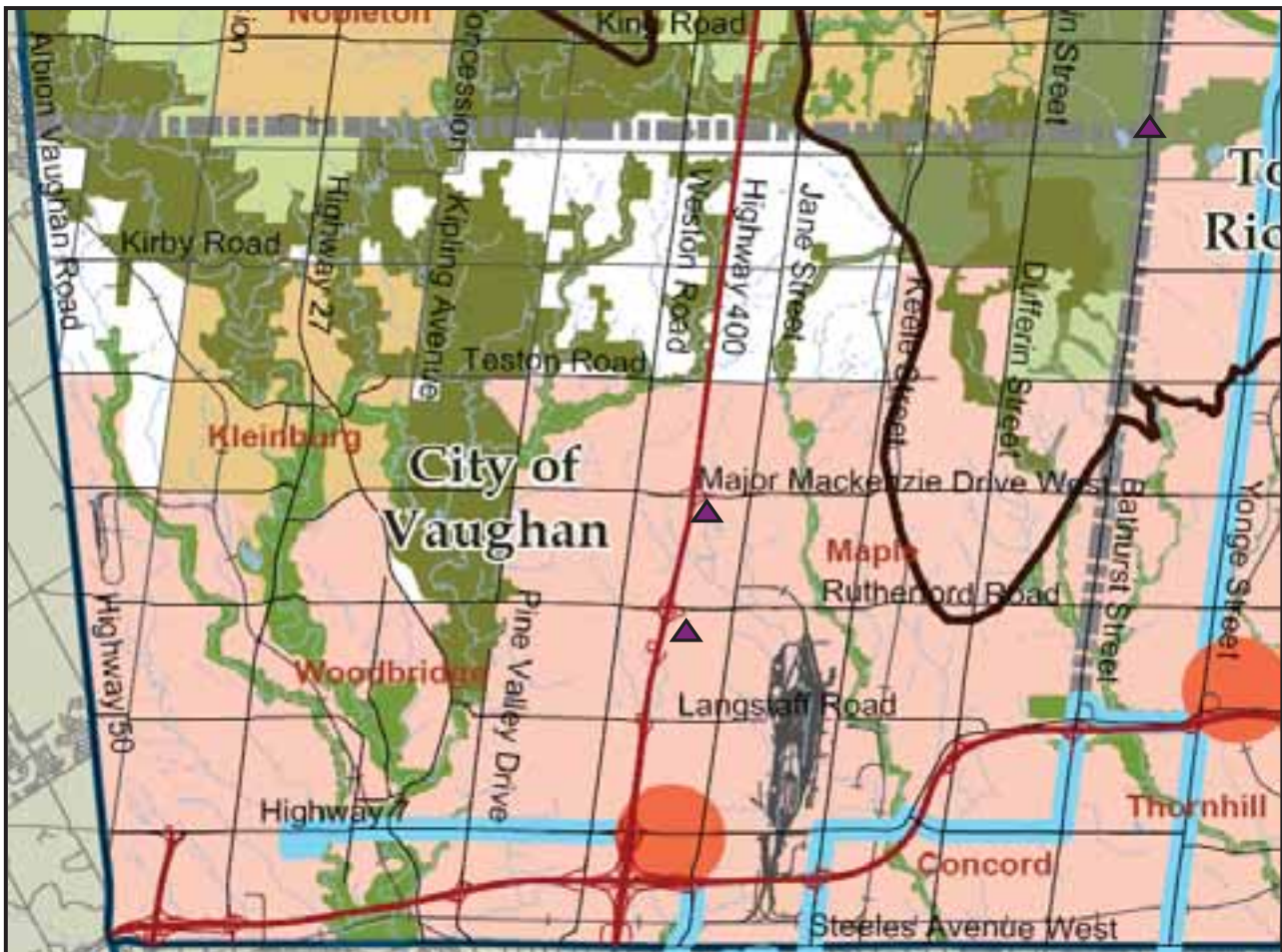


2.1 General Land Uses and Urban Boundary

The City is categorized into various land shown in **Figure 2**, adopted from the Regional Official Plan. The single largest land designation within the City is urban which covers the entire southern portion with interrupted designations consisting mainly of the natural heritage system and the protected countryside. The natural heritage system and the protected countryside also make up the main designations for the northern portions of the City beginning from Teston Road. A significant portion of the Kleinburg area is designated as settlement, town or village.

The existing land uses consist of residential, commercial, industrial, agricultural, open space and parks. Residential land uses are comprised of single family and multifamily dwellings distributed through the City around the urban communities of Woodbridge, Maple and Thornhill. The Woodbridge area residential land use is concentrated within a jurisdiction roughly bounded by Weston Road, Highway 27, Major Mackenzie Drive, and Highway 7. Residential land use around the Maple area roughly occupies the quadrant east of Jane Street and north of Rutherford Road, while that of the Thornhill area generally occupies the quadrant east of Dufferin Street and north of Steeles Avenue. Commercial land use such as retail is typically mixed with the residential land uses with more concentration around interchanges and major intersections. A notable exception is the Vaughan Mills Mall between Highway 400 and Jane Street south of Rutherford Road. Beginning from the western boundary of Vaughan with Brampton, industrial land uses stretch eastward along Highway 407 and continues northward along Highway 400. The area north of Teston Road is primarily rural and dominated by land uses such as agricultural and open space.

Figure 2. Regional Land Use Designations



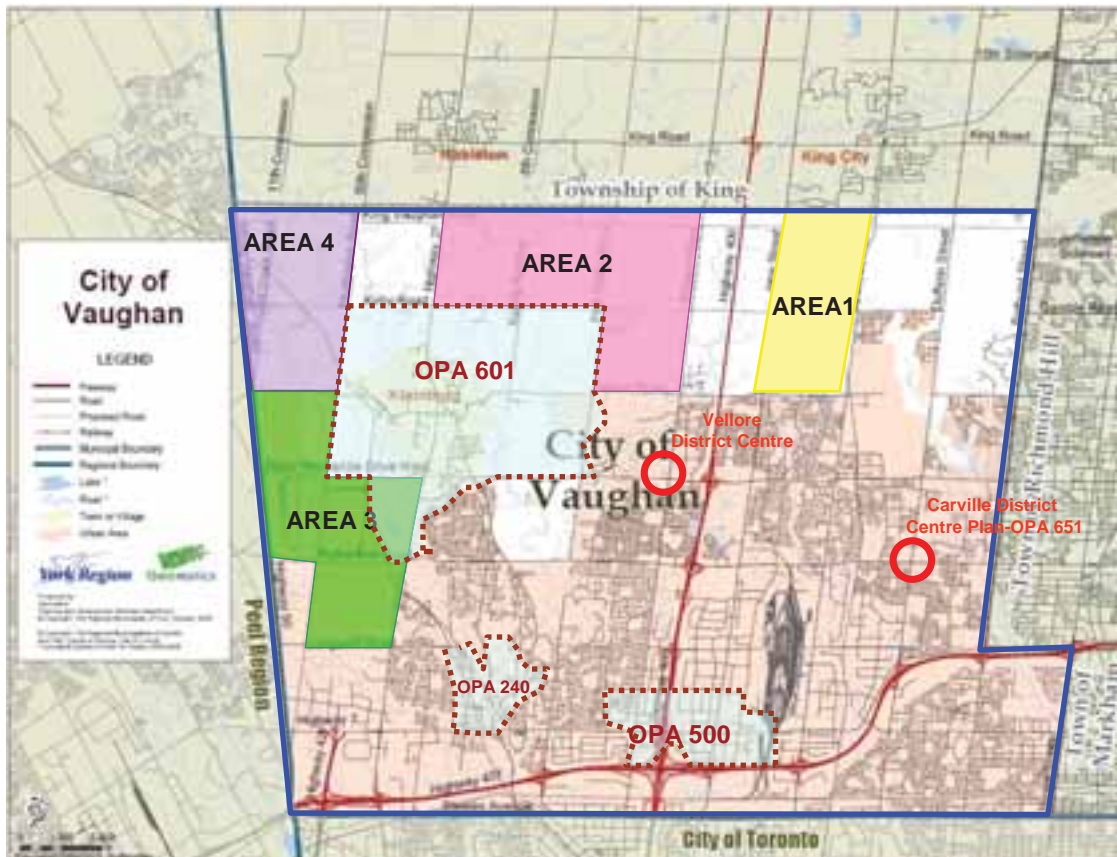
2.2 Areas for Accommodating Growth

Two district centres are planned for the City of Vaughan. They include the Carrville Village District and the Vellore Village District. As depicted in **Figure 3**, Carrville is located at the intersection of Rutherford Road and Dufferin Street while Vellore occupies the four quadrants of the intersection of Major Mackenzie Drive and Weston Road. Both district centre plans establish a development concept that provides a mix of residential unit types and accommodates the commercial needs of the local residents, while encouraging the evolution of a pedestrian-friendly and transit supportive development pattern over time.

Added to the aforementioned district centre developments are three Official Plan Amendments (OPA) to the City of Vaughan Master Plan that complement its urban development. These proposed planned developments including OPA 500, OPA 240, and OPA 601 are presented in **Figure 3**. OPA 500 refers to the proposed Vaughan Corporate Centre which will be the focus of business, government, entertainment and culture with a complementary higher density of development. OPA 240 refers to the proposed Woodbridge Community Plan, while OPA 601 refers to the Kleinburg Nashville Community Plan. Both of these plans call for high density residential and commercial developments with transit and pedestrian facilities. These three areas are focus areas being reviewed in detail as part of Vaughan’s Official Plan Review program and, as such, they will also be subject to more detailed transportation analysis.

To accommodate the growth expected for Vaughan, an expansion to the city’s urbanized development boundary will likely be needed. Four areas have been identified as candidates for urban development as shown in **Figure 3**. Some or all of these will also be subjected to more detailed transportation analysis.

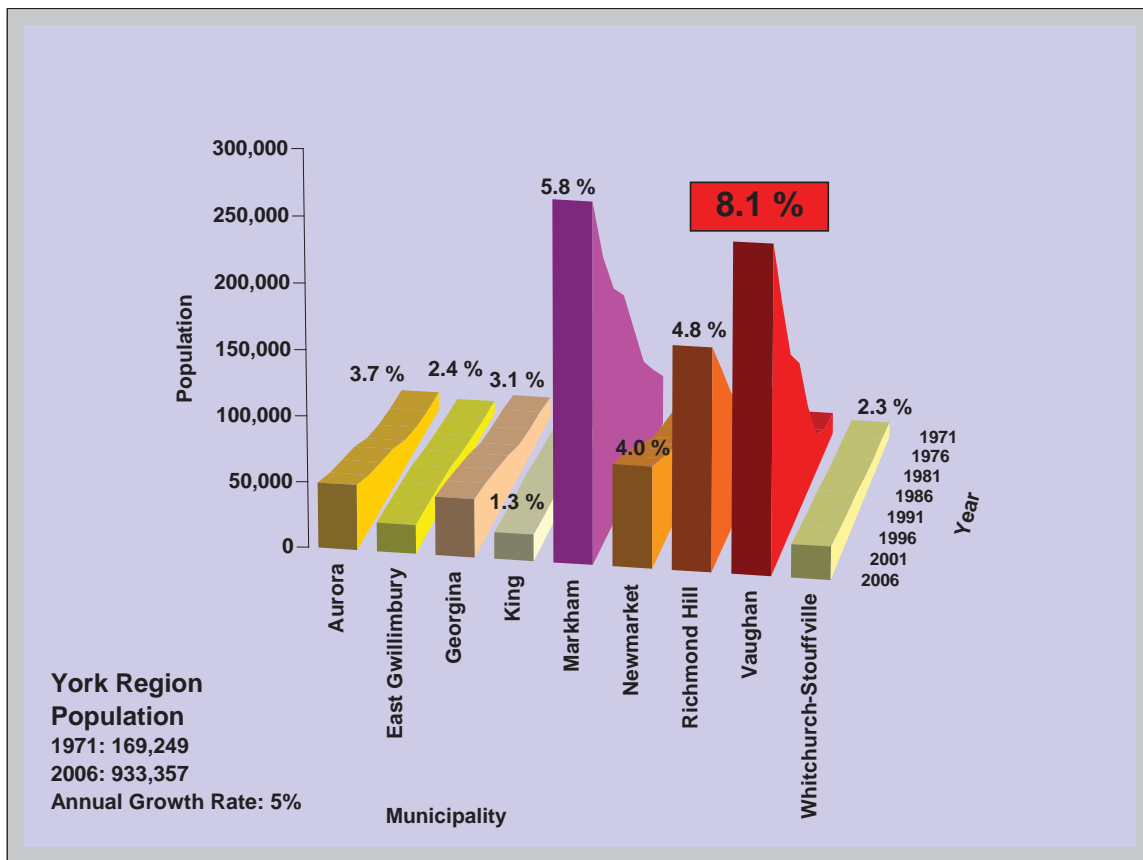
Figure 3. Planning Areas and Development Blocks within the City of Vaughan



3. Population, Employment and Other Socio-economic Demographic Characteristics

The City of Vaughan is the fastest growing municipality in York Region. Having grown by 181,000 people over the years 1986 to 2006, and over 15-fold since 1971, with an annual growth rate of over 8%, Vaughan has the highest growth rates among the municipalities across Canada. **Figure 4** shows percentages of population growth for York Region municipalities between 1971 and 2006. This rapid growth in population stemmed from the migration of people into the Region and the City following the development of the York-Durham Servicing Scheme, which opened up large areas of newly available serviceable land for development.

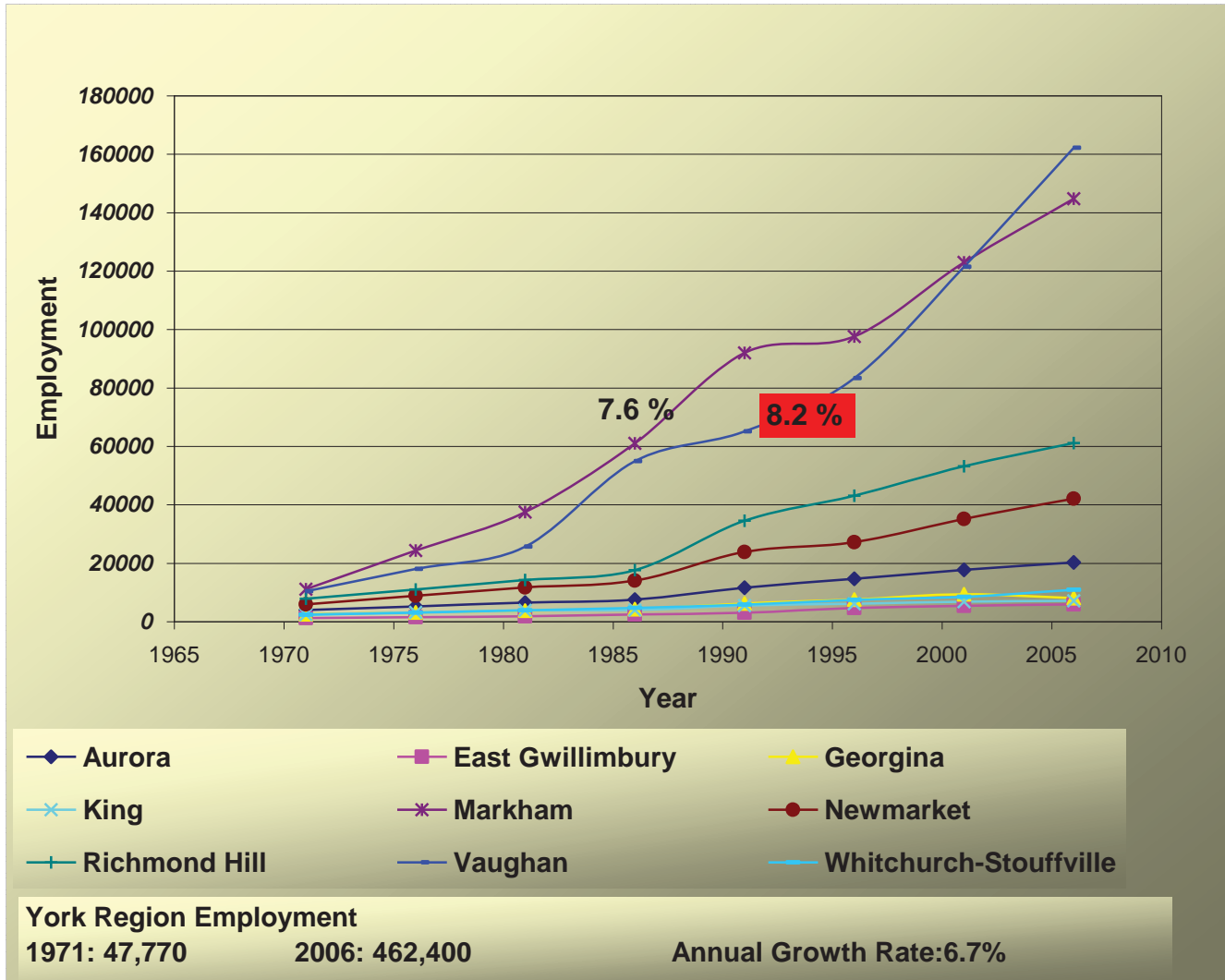
Figure 4. York Region Municipalities Population Growth since 1971



Source: York Region Website
1971 to 2001 based on Statistics Canada Census Data
All figures, excluded 2006, are as of mid-year.
2006 based on York Region Planning and Development Services forecasts

The annual employment growth rate of York Region, almost 7%, is higher than the annual population growth rate of 5%. In 2006, it was estimated that approximately 460,000 people were working in the Region. Among the municipalities of the Region, Vaughan has the highest employment growth rate (8%) as depicted by **Figure 5**. The City's total employment has increased steadily from 10,500 jobs in 1971 to more than 162,000 in 2006. Employment growth has increased at a higher rate than population growth, indicating the relative strength of the Region's economy.

Figure 5. York Region Municipalities Employment Growth Since 1971

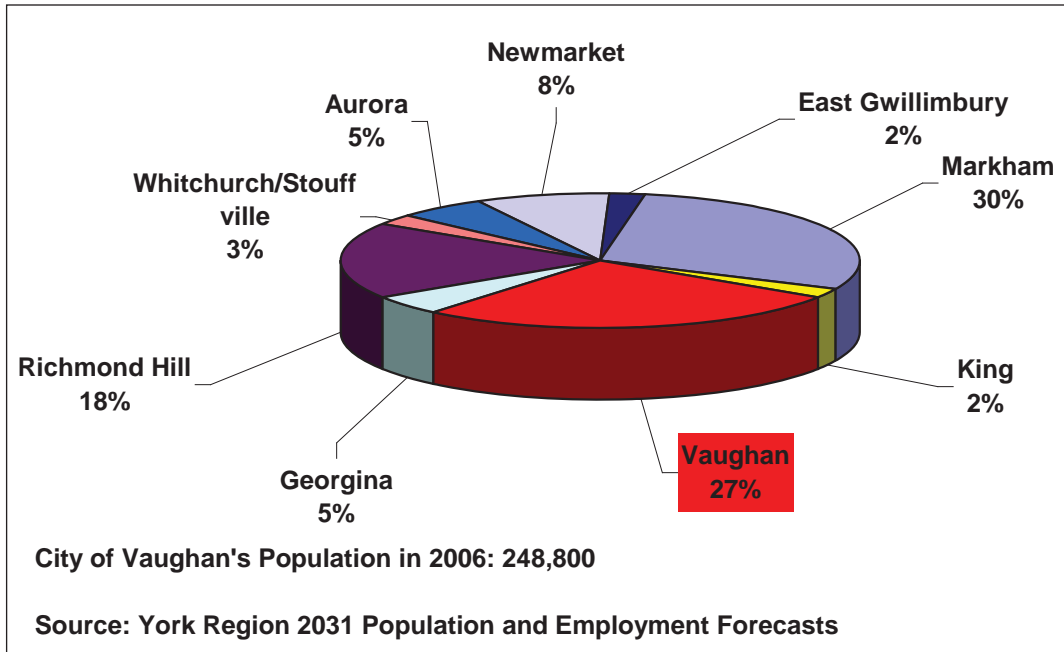


Source: York Region Website
1971 to 2001 based on Statistics Canada Census Data except 1976 which is as interpolated figure
All figures, excluded 2006, are as of mid-year.
2006 based on York Region Planning and Development Services forecasts

3.1 Existing Population and Employment

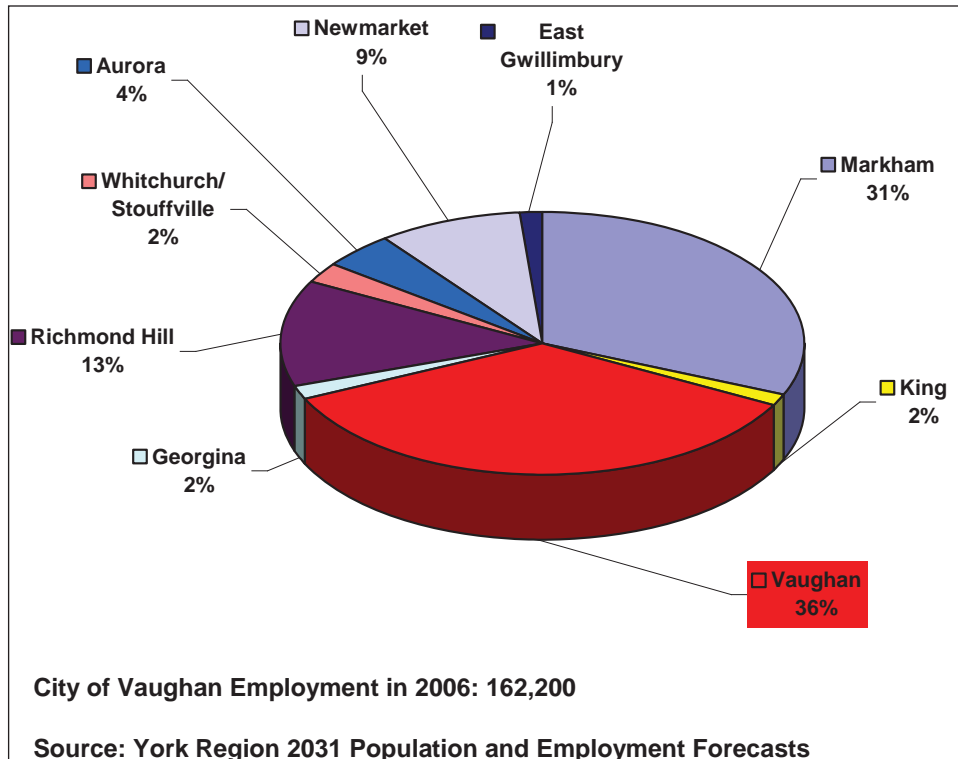
The City of Vaughan is the second highest populated City within York Region, after Markham, with about 249,000 residents in 2006. **Figure 6** shows 2006 population distribution by constituent municipalities across the Region. The City of Vaughan's population makes up more than 27% of York Region's population (930,000).

Figure 6. Distribution of 2006 Population within York Region Cities



According to the 2006 employment data, there are more than 162,000 jobs within the City of Vaughan. **Figure 7** illustrates 2006 employment distribution by constituent municipalities across the Region. With 36% of York Region's 462,000 employment, the City of Vaughan has the highest employment share within the Region.

Figure 7. Distribution of 2006 Employment within York Region Cities



3.2 Population and Employment Projections

As previously stated, the City of Vaughan is the fastest growing municipality in York Region with growth rates exceeding 7% and 8% for population and employment respectively. Analysis of demographic projections indicates that the City will continue to grow, but at a slower pace of approximately 2% annual rate for both population and employment. York Region has used the forecasts in the Provincial Growth Plan as input to a Region-wide population and employment forecast model update to determine the distribution of growth for the Region’s nine local municipalities. The results of this model application are updated forecasts of population and employment for York Region and its local municipalities. **Figures 8 and 9** present the City of Vaughan’s population and employment growth since 1971 and projected to 2031. The calculated growth rates between 1971 and 2006 are based on actual population and employment, while the illustrated growth rates from 2006 to 2031 are calculated based on the updated Regional population forecasts.

Figure 8. City of Vaughan Population Growth Since 1971 to 2031

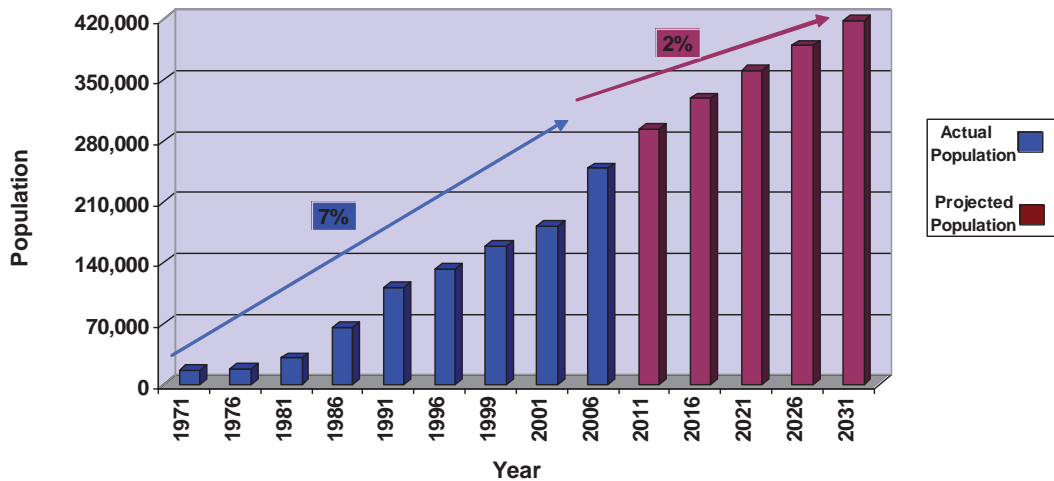
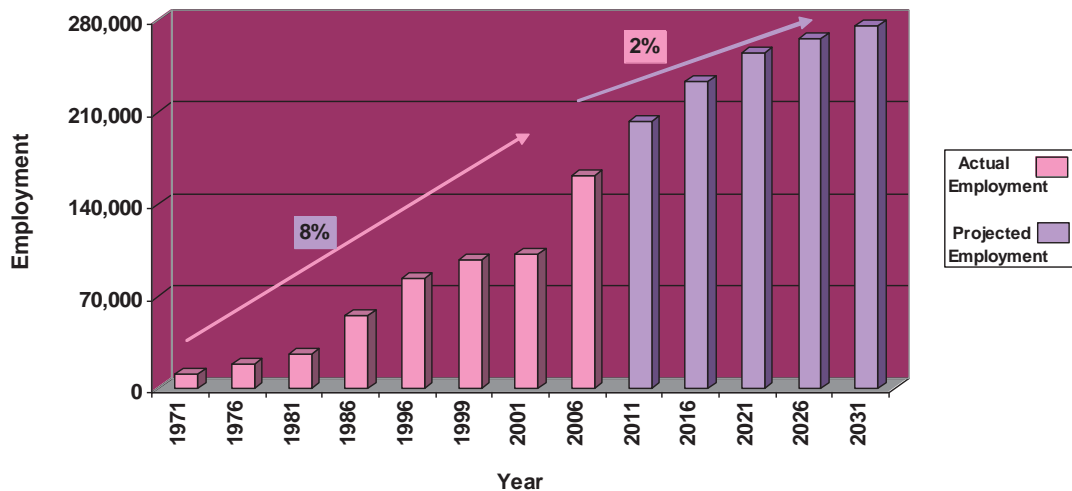


Figure 9. City of Vaughan Employment Growth since 1971 to 2031



Based on the city’s rapid growth trends and projected growth rates, it must ensure that its roads, transit services and rail facilities keep pace with the needs of the growing population and expanding employment base.

4. Existing Transportation Networks

4.1 Existing Road Network

This section describes the existing road network including highways, regional and municipal roads. A detailed inventory of the existing road network including number of lanes for segments and signalized intersections is depicted by **Figure 10**. **Table 1** summarizes the characteristics of the City's major roadways.

Figure 10. Existing Road Network

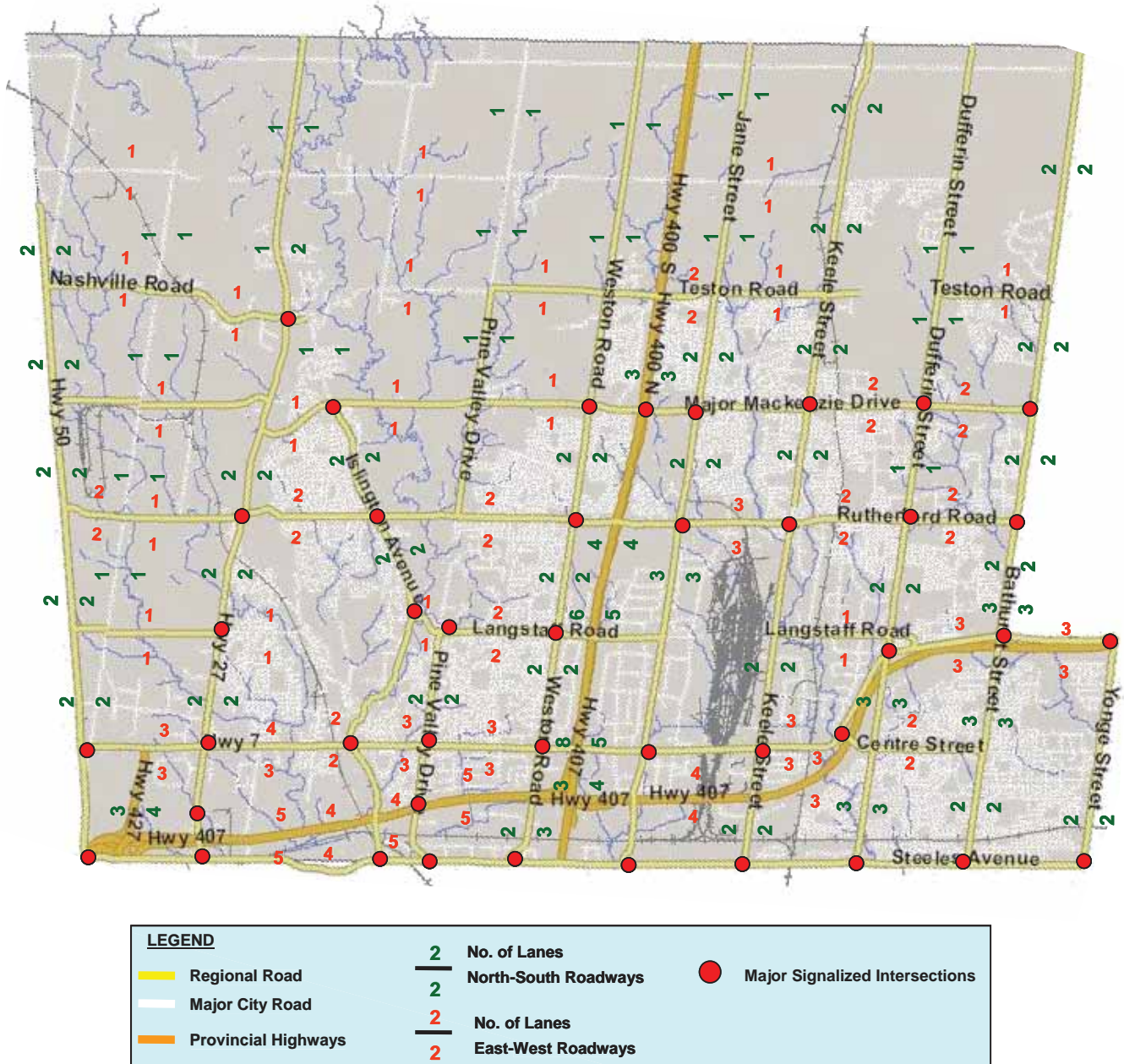


Table 1. Summary Characteristics of Major Road Network Elements

Road	Description
Major East-West Roadways (listed from south to north)	
Steeles Avenue	Steeles Avenue is a major arterial road under the jurisdiction of the City of Toronto paralleling Highway 407 on the south side along the southern border of the Vaughan. It carries 4 lanes of traffic between Highway 50 and Highway 400.
Highway 407	The 407 Express Toll Route (ETR), the east-west freeway serving the northern part of Greater Toronto Area, is tangent to the south side of the study area. Access to/from the study area is provided via interchanges at Highway 427, Highway 27, Pine Valley Drive, and Weston Road. The major interchange between Highway 407 and Highway 400 is located at the southeast corner of the study area.
Highway 7	Highway 7 is a major arterial road within the Regional road network. It provides transportation connections far beyond the Region and is a part of the provincial highway system beyond the GTA. It parallels Highway 407 on the north side. Within the study area limits, Highway 7 is mostly a 6-lane roadway (with the exception of a small section between Islington Avenue and Pine Valley Drive, where the cross-section is only 4 lanes). There are 20 signalized intersections along Highway 7 within the study area. A number of unsignalized intersections are also present on Highway 7.
Centre Street	Centre Street is the western segment of York Regional Road 71 which is a suburban east-west thoroughfare, formerly a concession road that runs through the southern part of the Region. Centre Street which was originally a segment of Highway 7, provides a 2-lane roadway connection between Yonge Street and Bathurst Street and 4 lane connection between Bathurst Street and Highway 7.
Langstaff Road	There are 3 disconnected road sections along this roadway alignment. On the west (within the study area), Langstaff Road provides a 2-lane roadway connection between Huntington Road and Kipling Avenue. The next section starts at Islington Avenue (2-lane section up to Balding Boulevard, and a 4-lane section farther east) and terminates at the CN Marshalling Yard east of Jane Street. The third section (east of the study area) connects Keele Street and Highway 7 east of Dufferin Street (4 lanes up to Dufferin Street and 4 lanes east of Dufferin Street)
Rutherford Road	Rutherford Road (York Regional Road #73) is a major east-west urban arterial in York Region. Regional Road 73 begins at the west from Highway 50 and stretches through the entire York Region, crossing the City of Vaughan and Towns of Richmond Hill and Markham. Rutherford Road becomes Carrville Road between Bathurst Street and Yonge Street and 16th Avenue east of Yonge Street. Rutherford Road has 3 lanes in each direction from Highway 400 to Weston Road. Between Highway 27 and Weston Road, Rutherford Road has 4 lanes with 2 lanes in each direction. West of Highway 27 to Huntington Road Rutherford has 1 lane in each direction and at the west side of Huntington Road, it becomes a 4 lane with 2 lanes in each direction. There are 10 signalized intersections along the Rutherford Road within the study area.
Major Mackenzie Drive	Major Mackenzie Drive (York Regional Road 25) is a major east-west arterial road in York Region (from Highway 50 on the west - Regional border between Peel and York) to Highway 48 on the east (Markham). Major Mackenzie Drive becomes 17th Avenue Further east and continues as a minor local road to the York-Durham Line. Within the study area, there is a short section of Major Mackenzie Drive from Highway 27 (starts approximately 1 km north of the main Highway 7/Major Mackenzie Drive intersection) to Highway 50, which operates as a minor local 2-lane road. Major Mackenzie Drive becomes Colerain Drive west of Highway 50 in the City of Brampton. The road has 4 lanes from Highway 400 to Weston Road and the 2 lanes west of Weston Road. There are 5 signalized intersections along Major Mackenzie Drive and several unsignalized intersections and driveways.
Teston Road	Teston Road spans eastward from Islington Avenue (originally Stegmans Mill Road) to east of Keele Street. It passes through the current northern development frontier of the City of Vaughan. Several sections of rural 2-lane roadway along concession lines constitute the Teston Road link.
Nashville Road	The western segment of York Regional Road 49 is called Nashville Road which is a two-lane rural thoroughfare starting at the east of York Regional Road 27 and ending at the York/Peel Regional Boundary.
Kirby Road	Kirby or York Region Road 29 is an east-west Collector Road providing a 2-lane roadway connection between Albion-Vaughan Road and Dufferin Street.
Major North-South Roadways (listed from west to east)	
Highway 50	Peel Regional Road 50 (formerly Highway 50) extends northward from Steeles Avenue to Highway 9. It is aligned along the border between the Regions of Peel and York. Highway 50 is a major arterial with a 4-lane section within the study area
Huntington Road	Huntington Road, a 2-lane collector road, starts at Highway 50 south of Highway 7 and continues north (approximately 12 km) up to the Humber River Valley north of Kirby Road through predominantly rural areas.

Table 1. Summary Characteristics of Major Road Network Elements

Road	Description
Highway 427	Highway 427 is a 400-series freeway that runs from the Queen Elizabeth Way/Gardiner Expressway interchange in Toronto to Highway 7 in Vaughan Extension of the freeway north to Major Mackenzie Drive is IEA and preliminary design process. In the interim, a short arterial extension to Major Mackenzie Drive is being constructed.
Highway 27	York Regional Road 27 (formerly Highway 27) is a major arterial road within the study area (4-lane cross-section). Highway 27 extends from the Highway 401/427 interchange area north to the City of Barrie, connecting numerous urban and rural communities along the way. There are 10 signalized intersections along the Highway 27 within the study area.
Martin Grove Road	Martin Grove Road extends from Burnhamthorpe Road in the City of Toronto to Highway 7 as a 4-lane arterial. The road parallels Highway 27 on the east. North of Highway 7, it becomes a 4-lane residential collector through recent residential developments and terminates at Highway 27 north of Langstaff Road.
Kipling Avenue	Kipling Avenue is comprised of several discontinued road links along the original concession line through the City of Vaughan. It is, however, a major north-south arterial within the City of Toronto.
Islington Avenue	Islington Avenue is a major north-south corridor extending through the City of Toronto (from as far as Lakeshore Boulevard in the south). It continues through the City of Vaughan as an arterial on the west side of the Humber River Valley to merge with Highway 27 north of Nashville Road. It has 4 lanes of traffic from Highway 7 north to Davidson Drive, 2 lanes north up to Langstaff Road, 4 lanes between Langstaff and Rutherford Road, and 2 lanes further north.
Pine Valley Drive	Pine Valley Drive from the Highway 7 interchange north to Langstaff Road is a major collector through predominantly residential areas. It is discontinued between Langstaff and Rutherford Road due to environmental constraints (Pine Valley Forest and Boyd Park). North of Rutherford Road it becomes a minor rural concession road.
Weston Road	Weston Road is a major regional link paralleling Highway 400 on the west side. Through the study area, Weston Road is an arterial servicing newly expanded urban development which is predominantly residential on the west side and commercial/industrial on the east side. Most of Weston Road has a 4-lane cross-section. There are 17 signalized intersections along the Weston Road within the study area.
Highway 400	Highway 400 is a 400-series freeway extending from Toronto (from Highway 401) through Barrie to Parry Sound, and further north to Sudbury (as a part of the Trans-Canada Highway). The freeway, north of Major Mackenzie Drive, has 3 lanes of traffic in each direction. Coming south, Highway 400 expands to 4 lanes in each direction. Between Rutherford and Highway 7 there are 5 northbound lanes and 6 and 8 southbound lanes south of Rutherford Road and Langstaff Road respectively.
Jane Street	Jane Street is a York Regional Road. It parallels Highway 400 on the east side and together with this freeway and Weston Road constitutes a wider Highway 400 corridor. Jane Street is a 4 lane arterial and crosses mostly newly urbanized areas (up to Teston Road).
Keele Street	Keele Street is another north-south York Regional Road, which is a parallel to Jane Street. Keele Street is a 4-lane arterial crossing mostly newly urbanized areas and ends at King Road in the township of King.
Dufferin Street	Dufferin Street (York Regional Road 53.) is a major north-south street in Toronto and York Region. It is a concession road, 2 concessions (4 km) west of Yonge Street. Within the study area, there is a section of Dufferin Street from Highway King-Vaughan Road to Rutherford, which operates as a minor local 2-lane road. The road has 4 lanes from Rutherford to Langstaff Road and become 6 lanes south of Langstaff Road. There are 5 signalized and several unsignalized intersections together with connecting driveways within the study area.
Bathurst Street	Bathurst Street is a north-south street in Toronto and York Region. North of Steeles Avenue, Bathurst runs through York Region, and is also referred to as York Regional Road 38 . It serves as the boundary between Vaughan and Richmond Hill within the study area. Bathurst Street is a 4-lane road but operates as a minor local 6-lane road from Highway 7 to north of Steeles Avenue.
Yonge Street	Yonge Street is a major arterial street in Toronto and its northern suburbs. Yonge Street, from Highway 407 to Steeles Avenue, operates mostly as a minor local 6-lane road. However in some places it does operate as a 4-lane road.

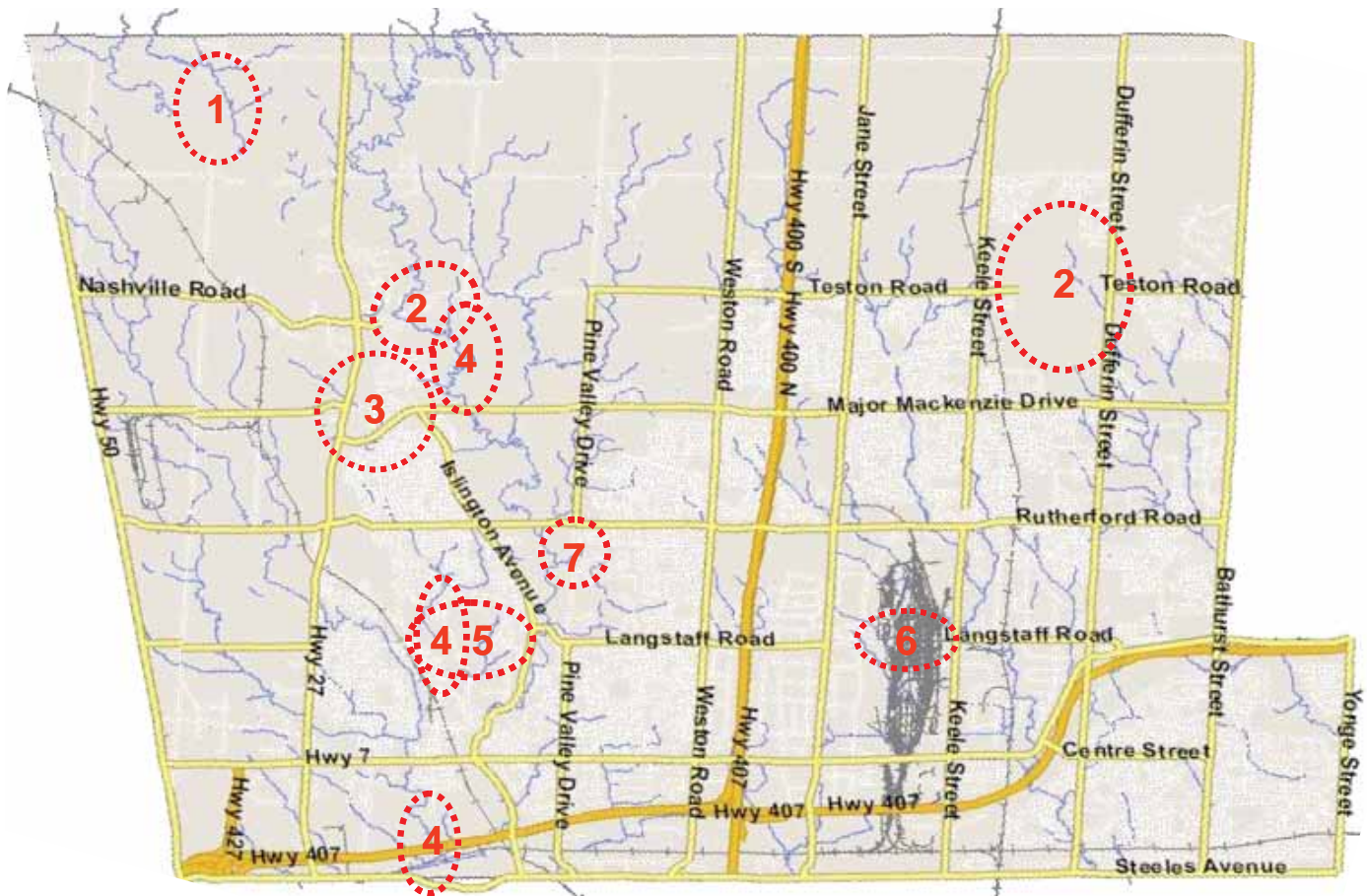
4.2 Road Network Discontinuities

There is significant discontinuity in the road grid within the City of Vaughan. The following list and the corresponding numbers on **Figure 11** present the description and location of gaps within the existing road network.

1. Huntington Road discontinuity between north of Nashville and King-Vaughan Road.
2. Discontinuities and jogs in the Nashville Road / Teston Road alignments.
3. A significant jog in Major Mackenzie Drive at Highway 27
4. Kipling Avenue fragmented alignment from south of Highway 7 throughout the study area
5. Langstaff Road discontinuity between Kipling Avenue and Islington Avenue
6. Langstaff Road discontinuity between Jane Street and Keele Street
7. Pine Valley Drive gap between Clubhouse Road and Rutherford Road

With respect to item 7 above, it should be noted that the completion of this missing link in Pine Valley Drive has been specifically prohibited by Provincial Minister of the Environment in her approval of the Terms of Reference for the western Vaughan Transportation Improvements Individual Environmental Assessment currently being conducted by the Region of York.

Figure 11. Regional Road Network – Missing Links



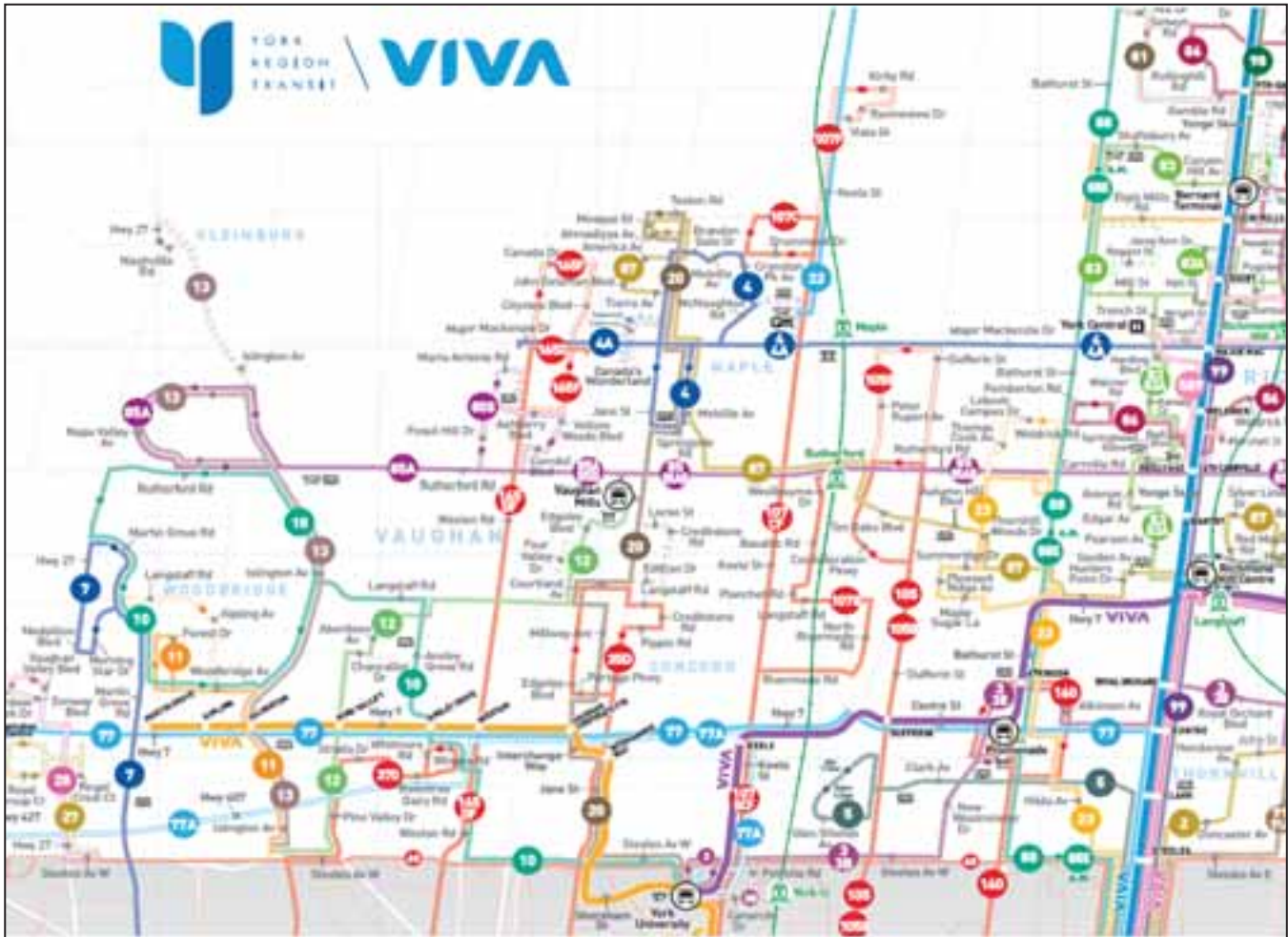
4.3 Existing Transit Network and Services

4.3.1 York Region Transit Services (YRT) Services

The population of York Region does not rely on transit service to a significant degree. According to the 2006 Transportation Tomorrow Survey, only 6% of the trips made by York Region residents on a 24-hour basis were transit trips. **Figure 12** shows the existing York Region Transit routes within the study area. Transit services available in the area include:

- VIVA Orange route along Highway 7 from Downsview Station to Martin Grove
- VIVA Purple route runs along primarily the Highway 7 corridor east of Keele Street, with the brief exception on Centre Street and on Bathurst Street
- Route 77 along Highway 7 connecting Finch Go Bus Terminal to Brampton City Centre
- Route 20 along Jane Street connecting to York University from Teston Road
- Route 12 along Pine Valley Drive from Islington and Steeles Avenue to Vaughan Mills Mall
- Route 85 along Rutherford Road from Islington to Markham Stouffville Hospital
- Route 7 along Martin Grove Road extending from Langstaff Road to Woodbine Racetrack
- Route 11 along Islington Avenue and Woodbridge Avenue from Steeles Avenue/Islington Avenue to Woodbridge Avenue/ Forest Drive
- Route 13 along Islington Avenue extending from Steeles Avenue to Rutherford Road
- Route 37D along Islington Avenue connecting to the Islington Subway Station from the intersection of Whitmore Road/Winges Road
- Route 165 DF along Weston Road from Major Mackenzie Drive to Wilson Subway Station
- Route 35D along Jane Street from Langstaff Road to Jane Subway Station.
- Route 3/3B runs along Steeles going through New west Minister, Centre Street, Royal Orchard Blvd., and Leslie street
- Route 4 runs along Major Mackenzie Starting at Weston Road going to Highway 48
- Route 5 runs along Clark Avenue connecting Finch station to Dufferin street
- Route 10 runs along Steeles Avenue, going north on Weston Road, connecting to Langstaff through Ansley Grove Road. Connecting York University to station at Rutherford and Islington Avenue
- Route 22 going north along Keele St. connecting Maple Community Centre to Seneca College (King Campus)
- Route 23 connecting Finch Station to Rutherford at Thornhill woods
- Route 27 runs along Highway 27
- Route 88/88E runs along Bathurst Street

Figure 12. Existing Transit (Bus) Routes and Services (York Region Transit/VVOVA)

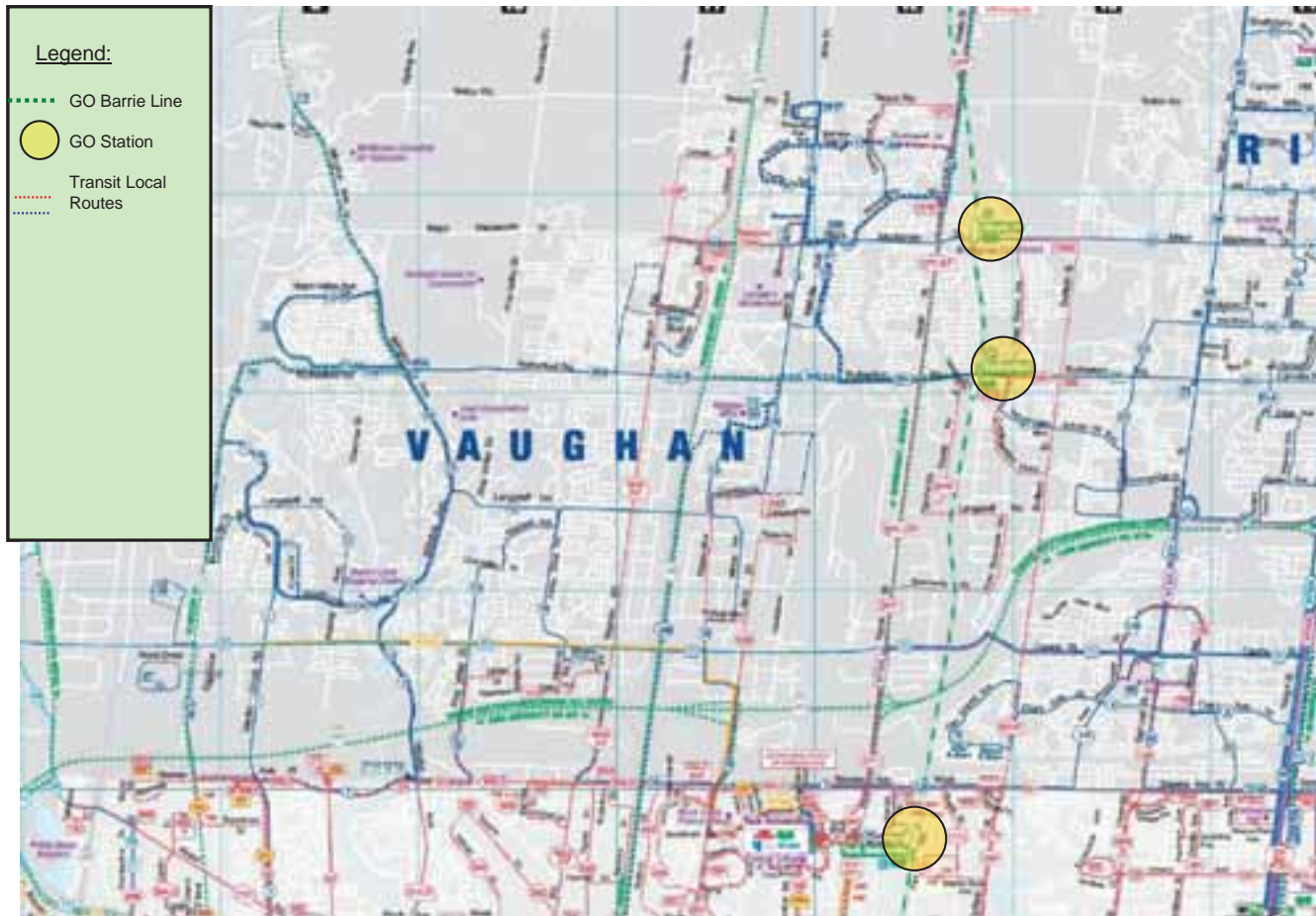


4.3.2 GO and Toronto Transit Commission (TTC) Services

While the City of Vaughan is not included in the Toronto Transit Commission (TTC) primary service area, TTC is contracted by York Region to provide limited services within the jurisdiction of Vaughan. This is due in part to the strong interrelationship between the Cities of Vaughan and Toronto. **Figure 13** shows the TTC service routes within the City of Vaughan.

Available GO Transit service within the City of Vaughan is presented in **Figure 13**. The city is currently served by only one community rail line (Barrie line with stops at Major Mackenzie Drive and Rutherford Road). A recent station has been added south of Steeles Avenue to serve York University. Express Go Bus service to Yorkdale is provided along Highway 400 with stops at various locations. Another express Go Bus service is provided along Highway 50 with stops at various locations.

Figure 13. Existing GO Transit (Bus and Rail) Routes and TTC Services



Vaughan Residents in the eastern part of the City have the option to use the Richmond Hill GO Rail service, which has York Region station at Major Mackenzie Road and Langstaff Road. Woodbridge area residents drive to Etobicoke North station for the Georgetown GO Rail line.

4.4 Bicycle and Pedestrian Network

The pedestrian network within the City of Vaughan can be described as a two-tier system. The first tier or primary system coincides with providing pedestrian facilities along major roads and providing connections to major City destinations. The secondary tier corresponds to the provision of pedestrian facilities that connect destinations that are more local in nature, such as local parks, community centres, school and plazas. The secondary tier systems are more neighbourhood-based and provide internal connections within a community.

Although the City of Vaughan has taken measures to ensure that pedestrian infrastructure is in place, adjustments to land use patterns and enhancements to pedestrian infrastructure could improve the pedestrian network in the City and help to achieve the goals and objectives of this Transportation Master Plan. The City of Vaughan has already taken measures to improve the pedestrian environment within the City. Some of these measures include the provision of raised sidewalks at locations where off-road pathways meet an intersection at grade.

The majority of sidewalk and pathway users (83%) within the City of Vaughan walk or cycle for recreational purposes. The most popular age group for sidewalk and trail users is 35 to 44, accounting for 33% of total users. The 25 to 34 age group is the second most popular, accounting for another 25% of the total. The majority of people who use the existing pedestrian and cycling systems are Vaughan residents.

The City of Vaughan is committed to improving and expanding conditions for walking and cycling for residents and workers in the Vaughan area. An expanded network of on and off-road pedestrian and cycling facilities can provide the citizenry with improved access to convenient travel modes that are practical alternatives to the private automobile. Implementing and promoting the network will also support the use of public transit by encouraging people to combine walk/transit and bike/transit trips. **Figure 14** shows Vaughan’s existing Walking and Cycling Network. **Figure 15** also shows the alternatives of regional cycling routes within the City of Vaughan as presented in York Region Pedestrian and Cycling Master Plan.

Figure 14. City of Vaughan Walking and Cycling Network

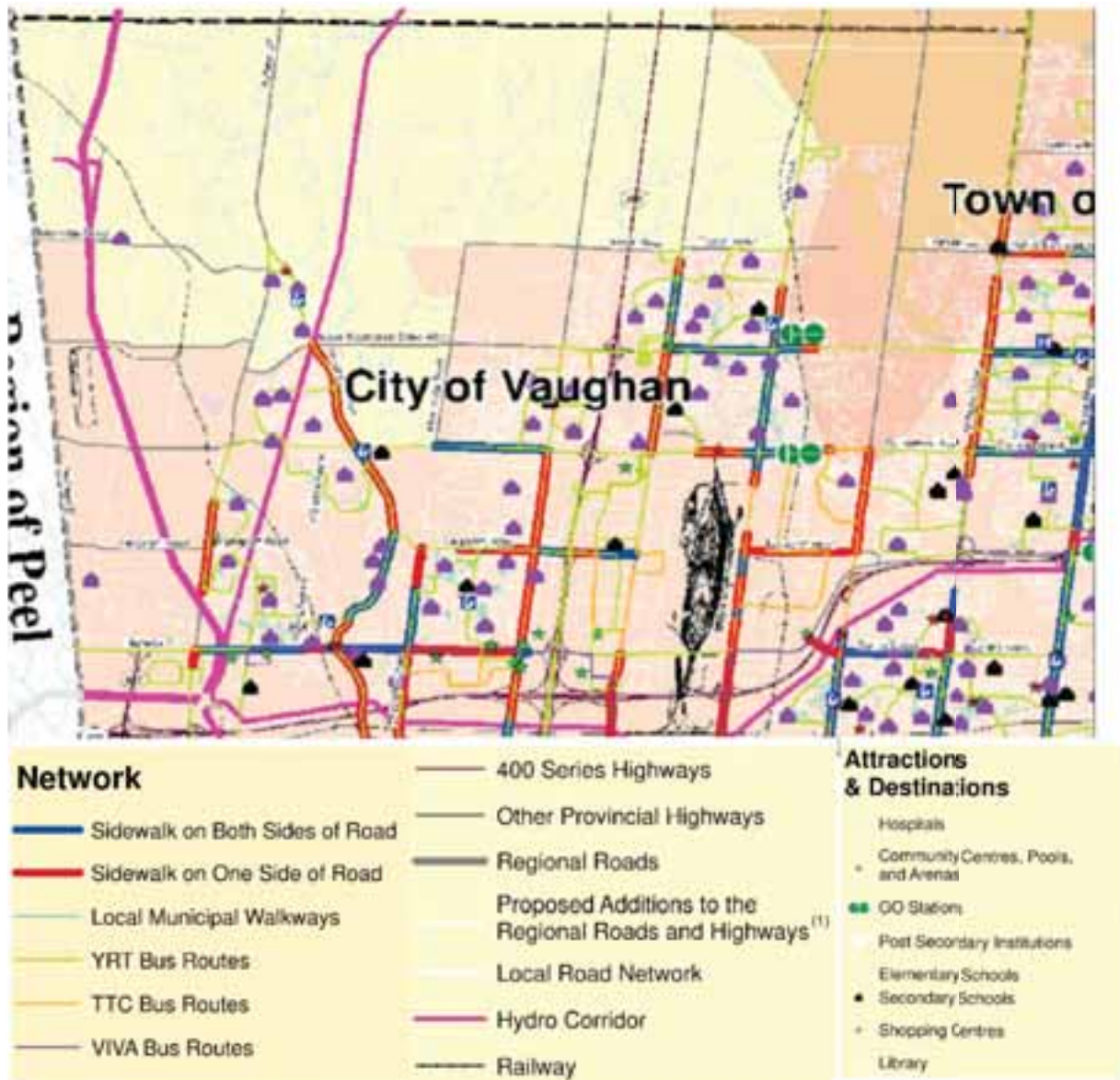
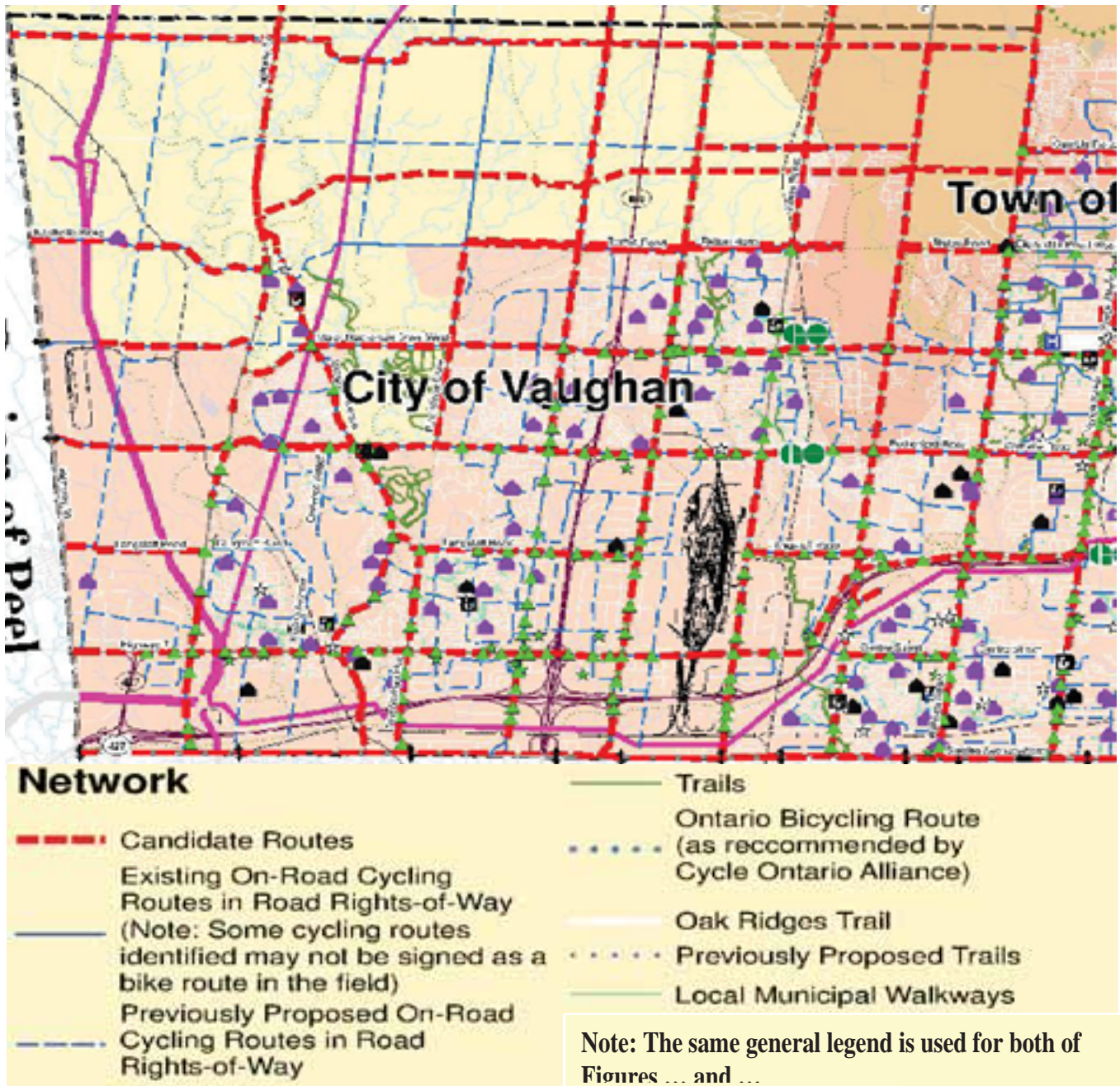


Figure 15. Candidate Cycling Route Alternatives along Regional Roads



Source: York Region Pedestrian and Cycling Master Plan

5. Travel Demands and Patterns

The City Vaughan is served by an extensive and complex multi-modal surface transportation system within York Region. It accommodates both passenger and freight transportation. The network is made up of roads, highways, transit and non-motorized transportation facilities.

5.1 General Travel Demands and Patterns

The total person trips generated within the Region of York on a typical day is approximately 1.8 million. The Vaughan area accounts for approximately 500,000 (27%) of these trips. **Table 2** presents the trip generation within York Region by jurisdiction. The average daily trip rate for the City of Vaughan is 1.96 trips per person, which is slightly higher than the 1.92 rate for York Region. The average trip lengths vary by mode from a minimum of 2.3 km for cycle, 11.2 km for auto, and 24.3 km for GO Rail. The average length for walking trips is about 700 meters.

Table 2. Trip Generation in York Region and City of Vaughan

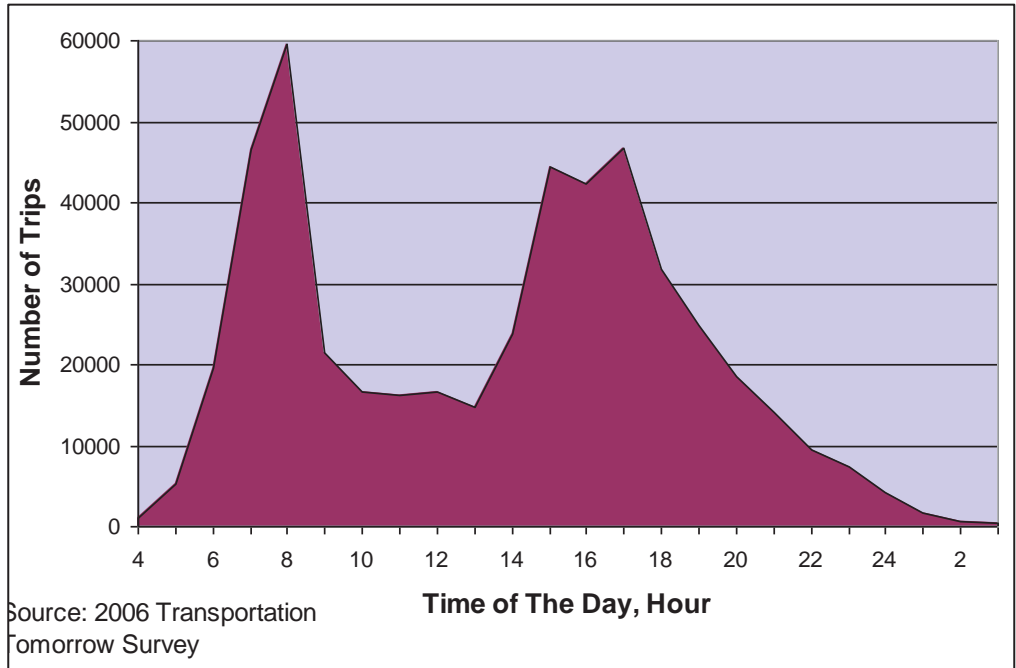
Origin	Number of Daily Generated Trip	Share of Trips from York Region (%)	Share of Trips from GTA (%)	Person Trip Rate
Georgina	63,157	4%	0%	1.42
East Gwillimbury	33,409	2%	0%	1.53
Newmarket	190,741	11%	1%	2.46
Aurora	96,876	5%	1%	1.95
Richmond Hill	301,895	17%	2%	1.78
Whitchurch-Stouffville	44,743	3%	0%	1.76
Markham	536,044	30%	3%	1.97
King	34,163	2%	0%	1.68
Vaughan	488,671	27%	3%	1.96
York Region	1,789,699	100%	11%	1.92
GTA	16,541,727	-	100%	3.01

Source: 2006 Transportation Tomorrow Survey

5.2 Trip Time Distribution

The majority of weekday trips generated from the City of Vaughan are concentrated in two peak periods - the AM and PM peak commuting periods. **Figure 16** shows trip time distribution for Vaughan generated trips in 2006. This figure illustrates that the AM peak period is more concentrated with a maximum of 12% of daily trips in the hour starting at 8:00. The PM peak period traffic spreads over several hours with two peak points starting at 15:00 and 17:00, the later hour being slightly higher.

Figure 16. Start Time Distribution of 2006 OD trips Generated by the City of Vaughan Residents



5.3 Mode Choice

A breakdown of the trip patterns within the City of Vaughan reveals significantly higher dependence on the automobile by its residents than for other modes of travel. **Figure 17** shows categories of AM peak period person trips by modes of travel for a typical weekday in 2006. Eighty percent out of the 118,000 trips were made with automobile while only 9% were made by York Region Transit, TTC, and GO Transit combined. Walking and cycling accounted for another 6% of the total trips made by Vaughan residents while the remaining 5% accounted for school bus trips. **Table 3** also shows the transit share of trips by different destination.

Figure 17. Person Trip Modes of Travel in AM Peak Hour

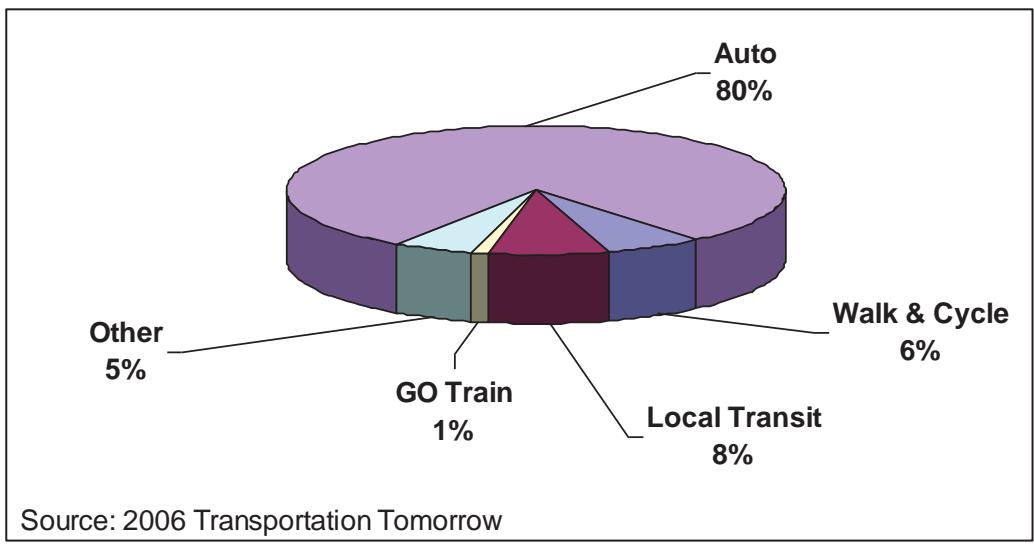


Table 3. Total Trips, Transit Trips and Transit Share For City of Vaughan By Origin and Destination

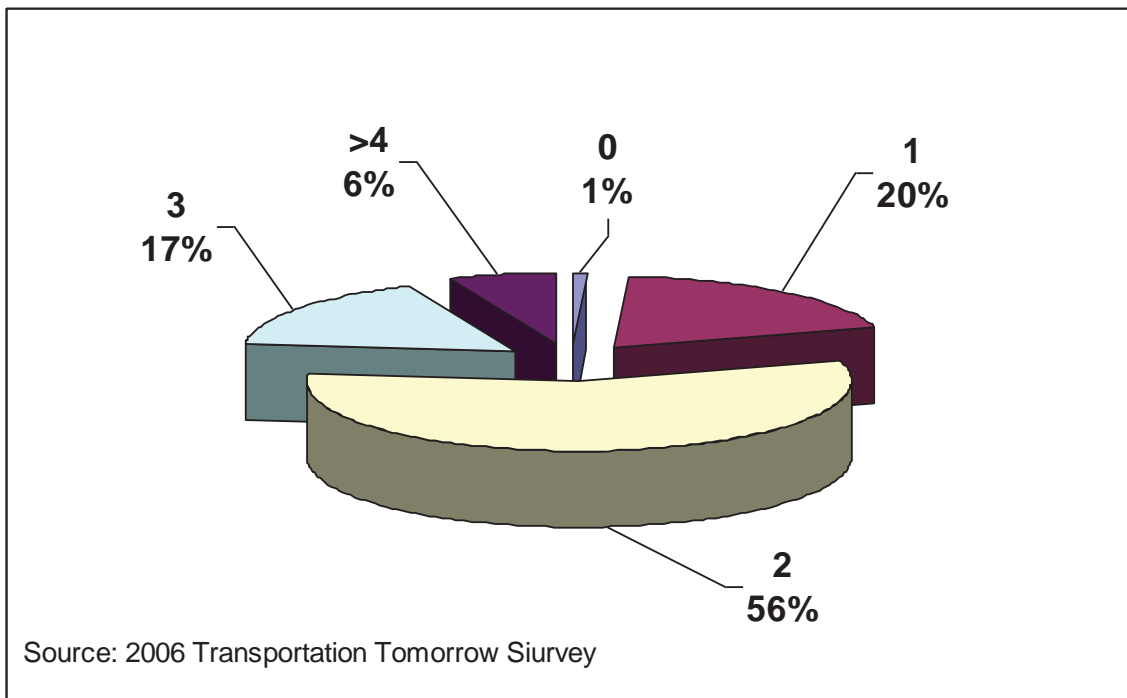
Planning District	Toronto	Durham	Georgina	East Gwillimbury	Newmarket	Aurora	Richmond Hill	Whitchurch-Stouffville	Markham	King	Vaughan	Mississauga	Peel	Halton	External	Others
Transit Trips																
From Vaughan To:	8651	0	0	0	0	0	177	0	170	71	1257	79	141	0	0	64
To Vaughan From:	2045	0	0	0	0	0	121	0	60	0	1257	18	117	0	0	0
Trips																
From Vaughan To:	43389	0	40	57	448	347	3908	40	5180	745	55116	4667	7279	440	142	792
To Vaughan From:	25499	0	244	280	1250	900	6023	298	3528	898	55116	3221	8947	855	124	2701
Transit Share (%)																
From Vaughan To:	20	0	0	0	0	0	5	0	3	10	2	2	2	0	0	8
To Vaughan From:	8	0	0	0	0	0	2	0	2	0	2	1	1	0	0	0

Source: 2006 Transportation Tomorrow Survey

5.4 Car Ownership

Car ownership acts as a very effective factor in determining mode choice. As shown in **Figure 18**, the high degree of dependency on personal vehicles is reflected by the number of available vehicles per household. Nearly 80% of the City’s households have access to 2 or more vehicles while only 1% lack access to a personal vehicle.

Figure 18. Available Vehicles Per Household



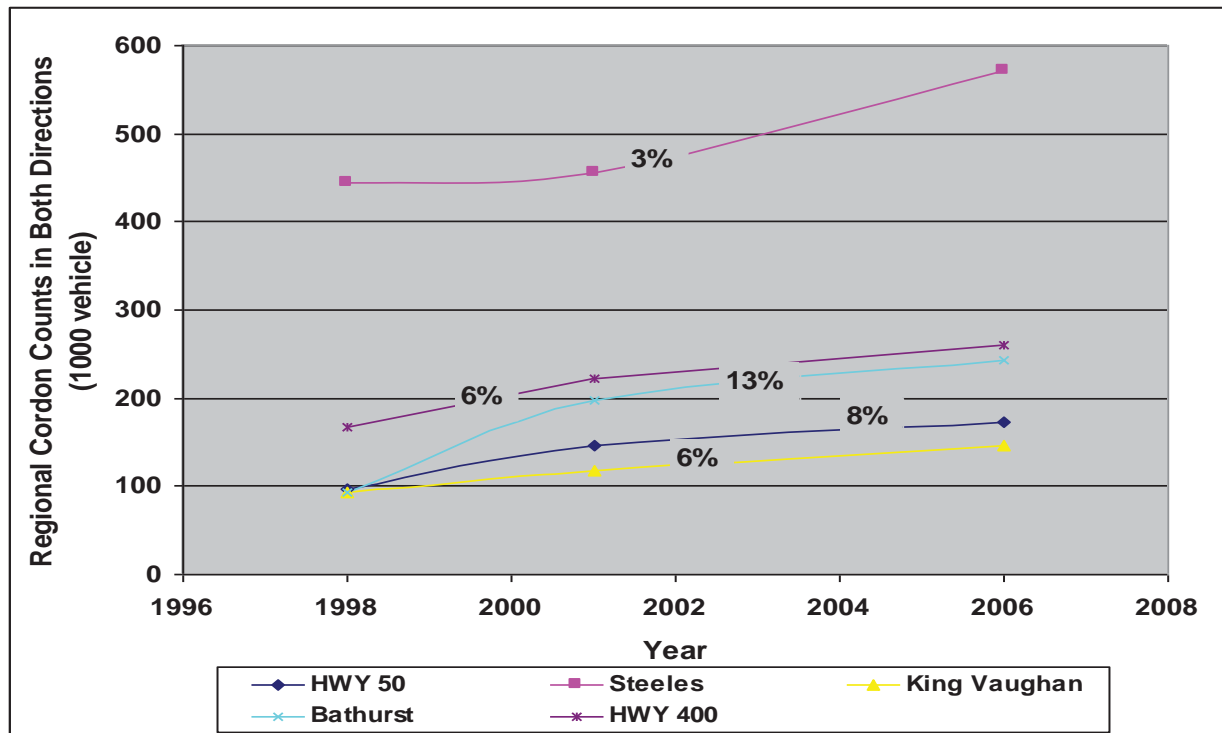
5.5 Work Trip Destinations

In 2006, the residents of Vaughan made 90,500 work trips on a daily basis. Approximately 47% of all work trips made by Vaughan residents are destined to the City of Toronto, with about 9,300 destined to the downtown core, 9,250 to central Toronto, and some 23,200 to the rest of the City. The share of work trips with internal to Vaughan destinations makes up approximately 30%, while trips destined for the rest of York and Peel Regions are estimated at 10% and 11% respectively.

5.6 Regional Cordon Counts

The City of Vaughan is generally surrounded by four regional screenlines; King Vaughan Road in the north, Steeles Avenue in the South, Bathurst Street in the east and Highway 50 in the West. Regularly conducted cordon counts provide the number of trips to and from the City of Vaughan. In addition, a 5th Regional screenline runs east of Highway 400. Figure 21 shows the traffic growth trends from cordon counts between 1998 and 2006. The highest increase in counts is observed at the Bathurst screenline. This increase is not simply related to time but also due to an increase in the number of new stations along the screenline. The minimum increase of 3% is observed at the Steeles Avenue cordon while the trips across the other screenlines have increased steadily.

Figure 19. Regional Daily Cordon Counts - Growth from 1998 to 2006



The directional peak hour (AM and PM) cordon counts show similar growth trends as the overall daily two directional cordon counts. As evident by **Figures 20 through 23**, the Bathurst Screenline shows the highest increase for both AM and PM directional counts. Steeles Avenue shows the minimum increase at all periods. The only exception is the inbound AM peak, as shown by **Figure 22**, where Steeles Avenue was second to last. The growth rates for all other cordons vary as shown by the **Figures 20 through 23**.

Figure 20. Directional (Out) PM Peak Hour Cordon Counts Growth from 1998 to 2006

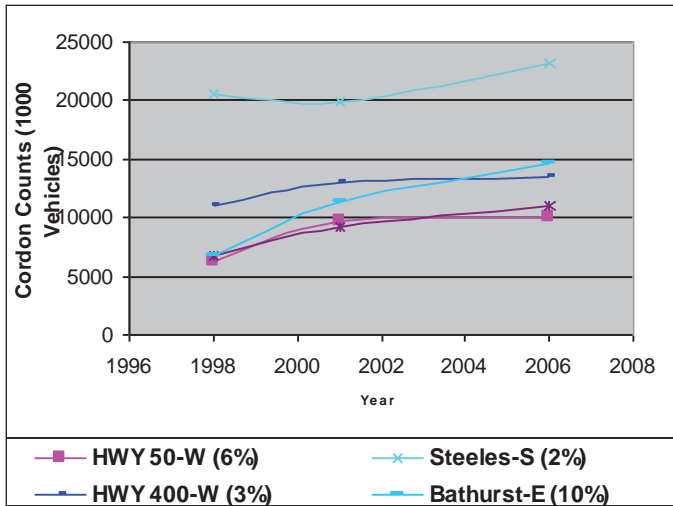


Figure 21. Directional (Out) AM Peak Hour Cordon Counts Growth from 1998 to 2006

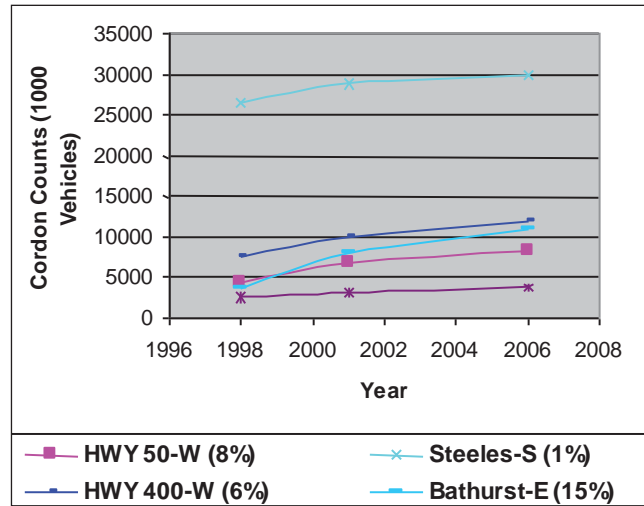


Figure 22. Directional (In) PM Peak Hour Cordon Counts Growth from 1998 to 2006

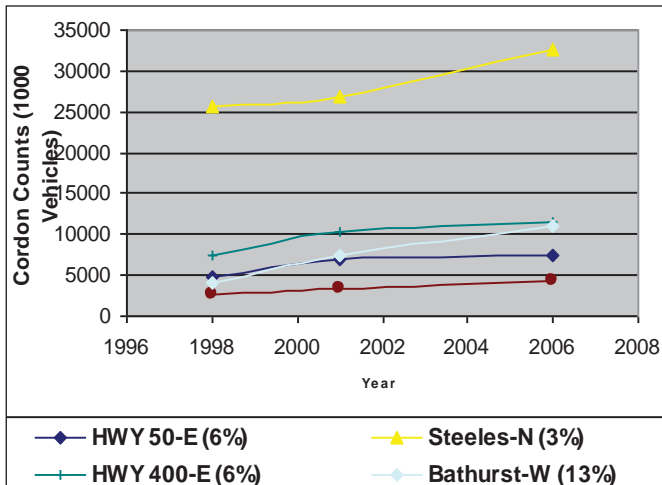
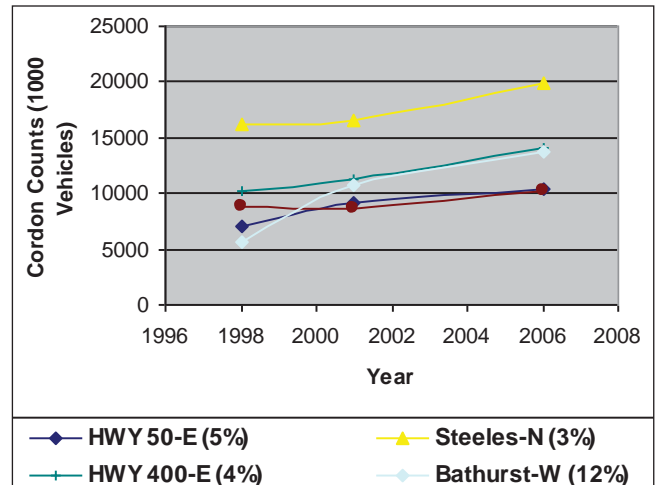


Figure 23. Directional (In) AM Peak Hour Cordon Counts Growth from 1998 to 2006



5.7 Road System Utilization

Hierarchical systems of north-south and east-west roadways serve the residents of Vaughan. **Figure 24** shows the 2005 Annual Average Daily Traffic (AADT) across the road network. The figure themes show the level of congestion or utilization of the network during a typical day of the week.

Figure 24. 2005 AADT across the City of Vaughan



6. Analysis of Existing Traffic Conditions

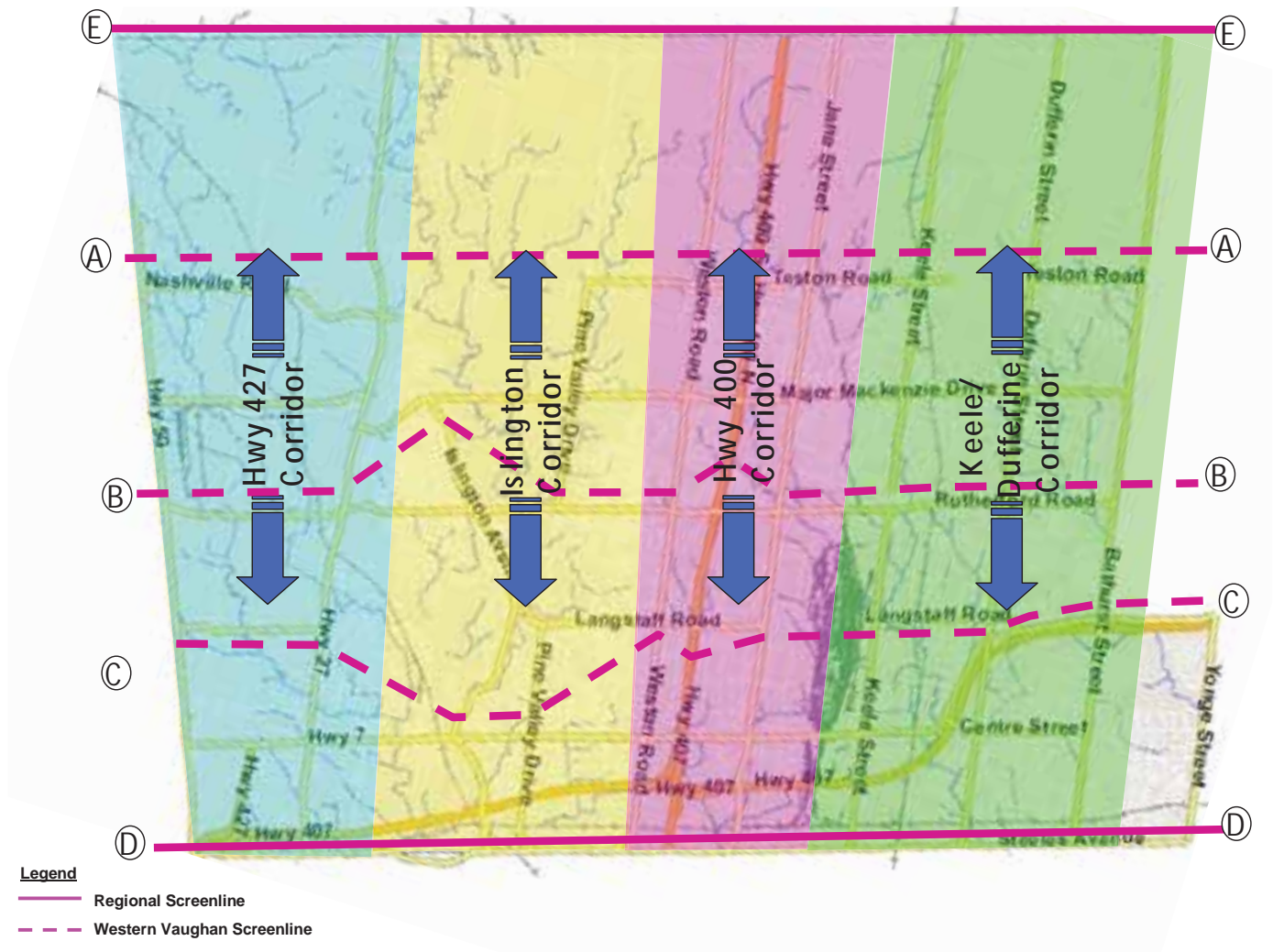
6.1 Screenline/Corridor Analysis

An analysis of the existing traffic conditions within the study area is conducted to identify deficiencies within the existing road network. A screenline/corridor methodology is adopted to perform a network wide diagnosis. This is an appropriate methodology for a large study area recognizing that long term travel forecast would be based on the application of the GTA wide travel demand model. Such a tool is not capable of producing sufficiently accurate traffic projections on a link by link basis. Characteristics of the existing weekday peak period and peak hour traffic were identified based on available traffic data. Link volumes and capacities, aggregated to corridors, are used to assess existing deficiencies at specific screenlines.

6.1.1 Defined Screenlines

Figures 25 and 26 present the defined corridors and screenlines. Four north-south corridors (Highway 427, Islington Avenue/Pine Valley Drive, Highway 400-Weston, Keele-Dufferin) corresponding five east-west screenlines were defined. Screenlines (A, B, C) are located north of Nashville Road and Teston Road, north of Rutherford Road, and north of Langstaff Road respectively. Screenline D (north of Steeles Avenue) corresponds to the City of Toronto and York Region boundary screenline used by these municipalities in their regular Cordon Count programs. Screenline E north of King Vaughan Road is a regional screenline at the boundary of the City of Vaughan and King Township, which is also used by their regular Cordon Count programs. Thus, a rich time series database exists at a number of the north-south and east-west screenlines.

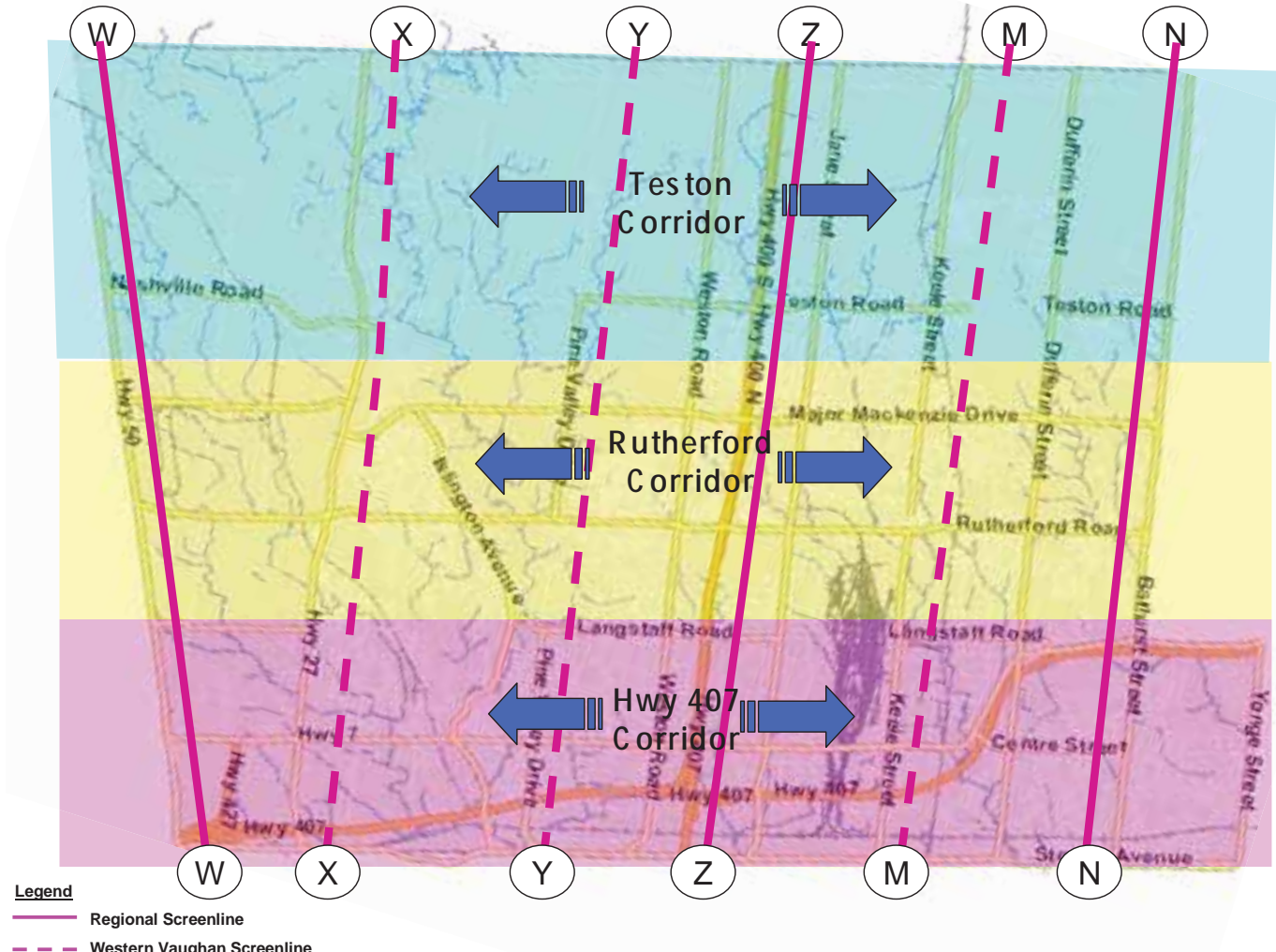
Figure 25. Study Area North-South Corridors and East-West Screenlines



Three east-west corridors (Highway 407, Rutherford, Teston) and corresponding six north-south screenlines were identified. Screenlines X, Y and M respectively are located at the west of Highway 427, west of Pine Valley Drive and Islington Avenue, and west of Keele Street. There are three other north-south screenlines within the City of Vaughan, west of Highway 50, east of Highway 400 and east of Bathurst Street, which are already defined as regional screenlines used by Regions regular Cordon Count Programs. Screenline W (east of Highway 50)

corresponds to screenline N (west of Bathurst Street) are the City of Vaughan boundary screenline used by York Region regular Cordon Count Program.

Figure 26. Study Area East-West Corridors and North-South Screenlines



6.1.2 Traffic Data Analysis - Existing Traffic Volumes and Capacities

Traffic counts for the study area and screenlines stations were obtained from the Region of York, the Ministry of Transportation (MTO) and or the City of Vaughan. Additional traffic counts should be conducted at screenlines where up-to date information is not available. Link flows/traffic counts are used in existing transportation conditions analysis and transportation model calibration.

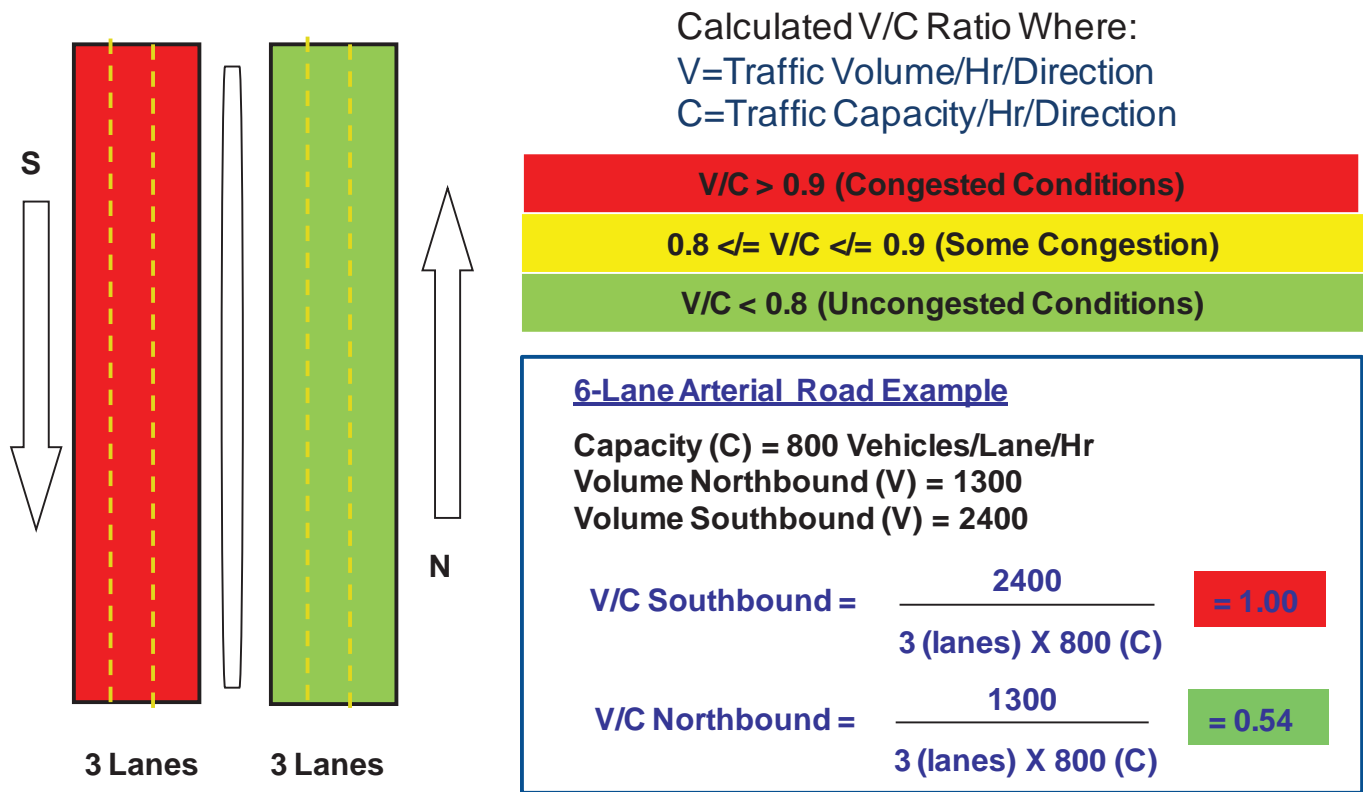
The number of lanes and link capacities for regional roads were obtained from the York Region Transportation Model. The number of lanes for local road segments should be provided by the City of Vaughan. To conduct an initial corridor analysis, Google Map and Western Vaughan IEA are used as information sources for missing lane numbers. The lane configurations should be verified in the field and by using up-to-date aerial photography available from the Region.

6.1.3 Methodology

Corridor volumes and capacities were computed at each screenline location, by aggregating the information for individual roadways. **Figure 27** presents the methodology together with an example of how to calculate the volume to capacity (V/C) ratio. The threshold V/C ratio values are also defined for three categories of congestion:

- Uncongested (V/C < 0.80)
- Some congestion (V/C between 0.80-0.90)
- Congested ((V/C > 0.90)

Figure 27. Level of Traffic Service (V/C ratio) Methodology



6.1.4 Existing Conditions – Identified Deficiencies within Road Network

This section provides a summary of results of the screenline analysis and identifies existing deficiencies within the road network using the Regional cordon counts available from The DMG website. **Figure 28 to 31** graphically depict the existing corridor V/C ratio levels at the defined screenlines. The Highway 400 corridor in both AM and PM peak periods for both directions is congested. The Keele-Dufferin corridor is also congested during the AM and PM peak periods. Congested east-west Corridors are Highway 407 in the west-east direction at AM and east-west direction in the PM peak period. The Rutherford corridor is congested in both directions during the peak periods.

Figure 28. N-S Corridor V/C Analysis (AM 2006)

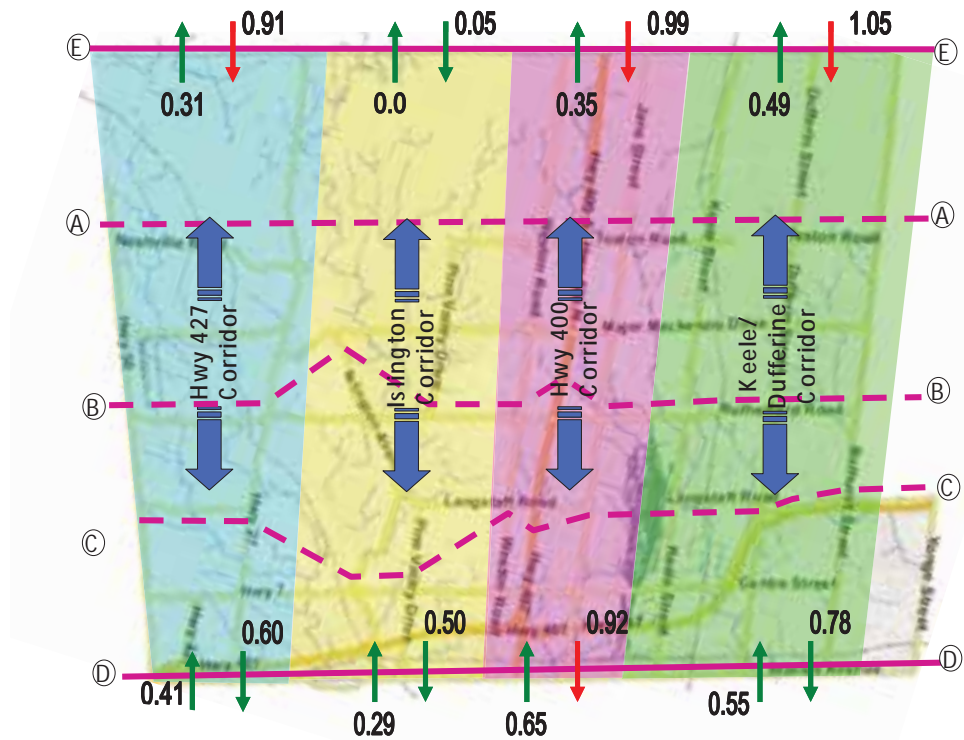
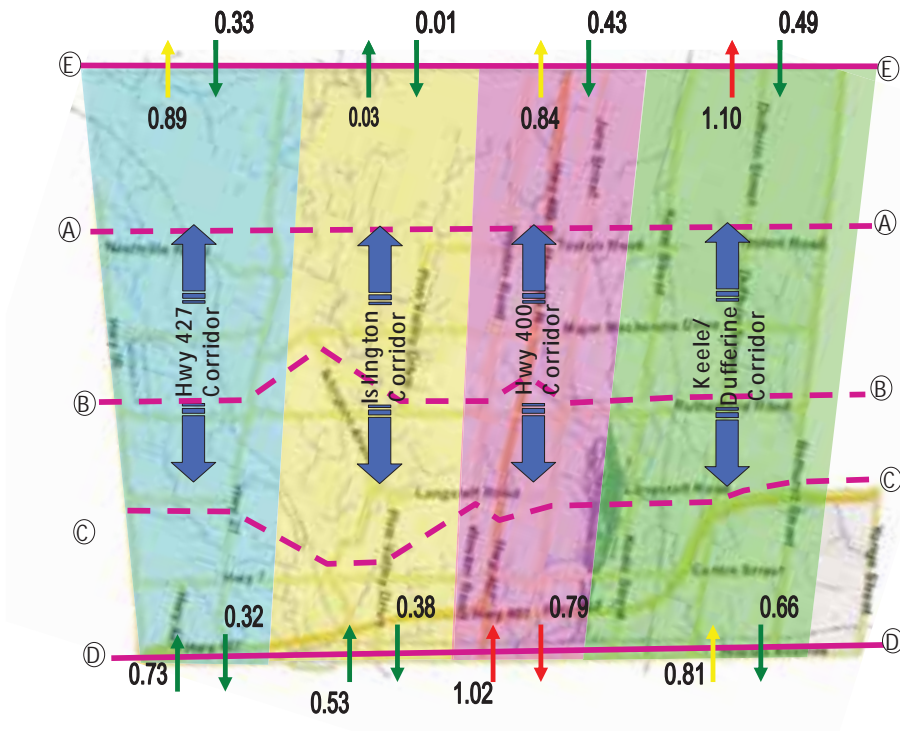


Figure 29. N-S Corridor V/C Analysis (PM 2006)



Legend

- Regional Screenline
 - - - Intermediate Screenline
- V/C Arrow's Color Code**
- V/C > 0.9 Congested
 - 0.8 <= V/C <= 0.9
 - V/C < 0.8 Uncongested

Figure 30. E-W Corridor V/C Analysis (AM 2006)

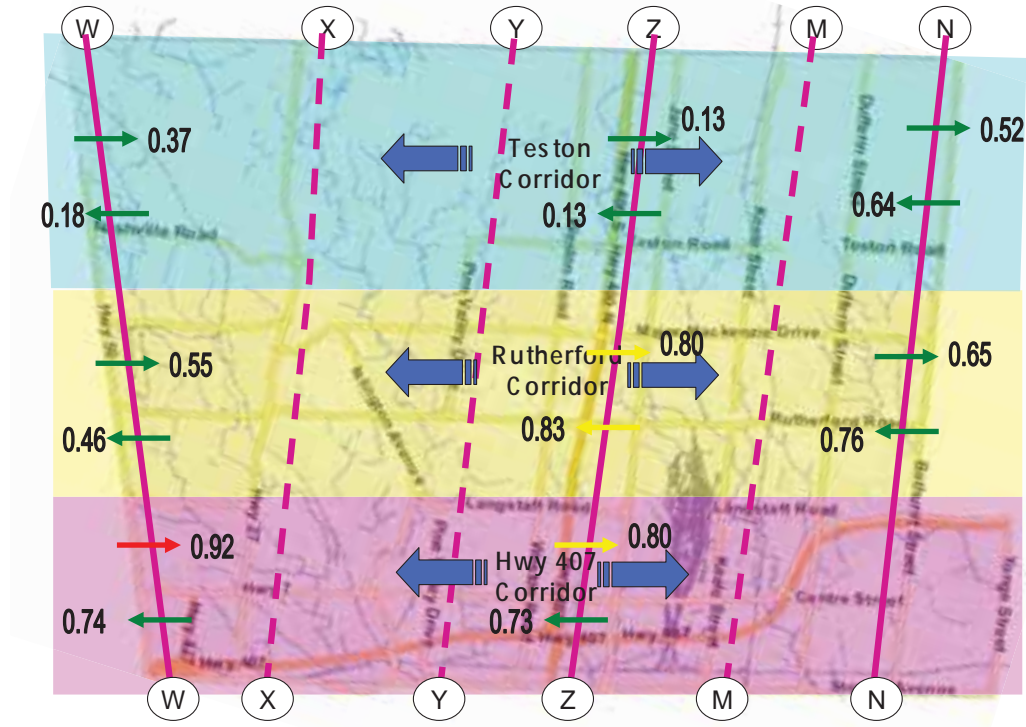
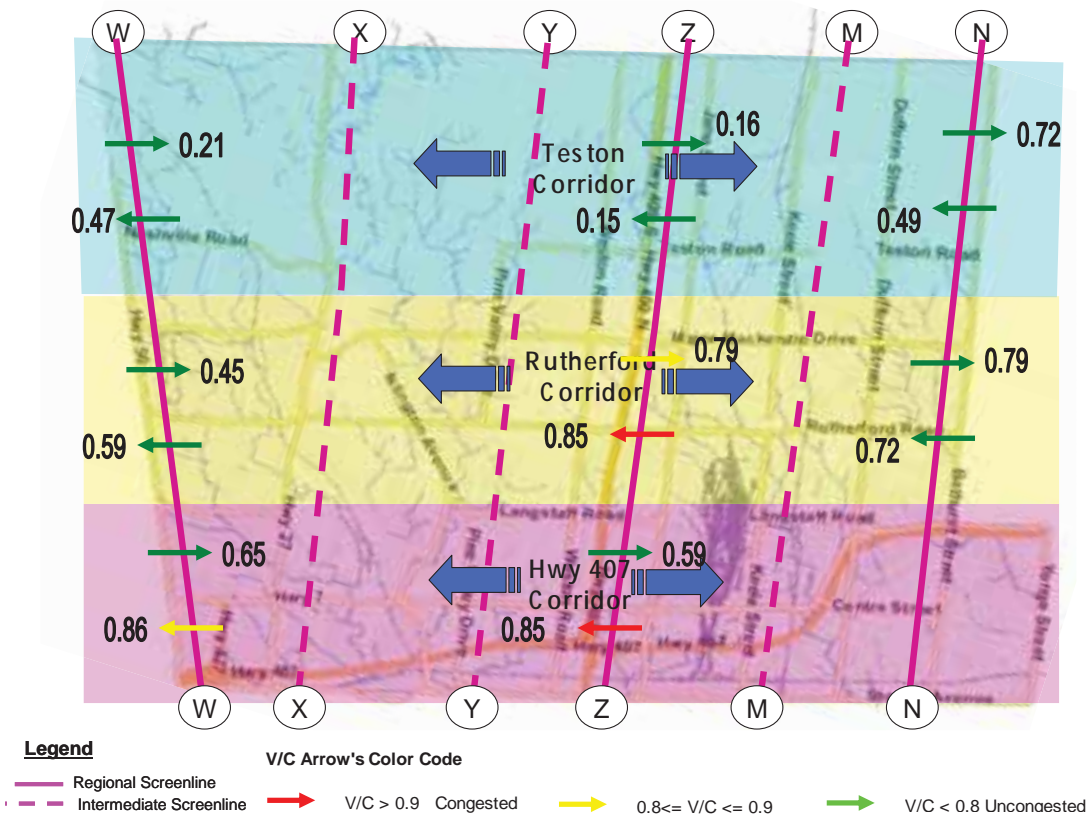


Figure 31. E-W Corridor V/C Analysis (PM 2006)

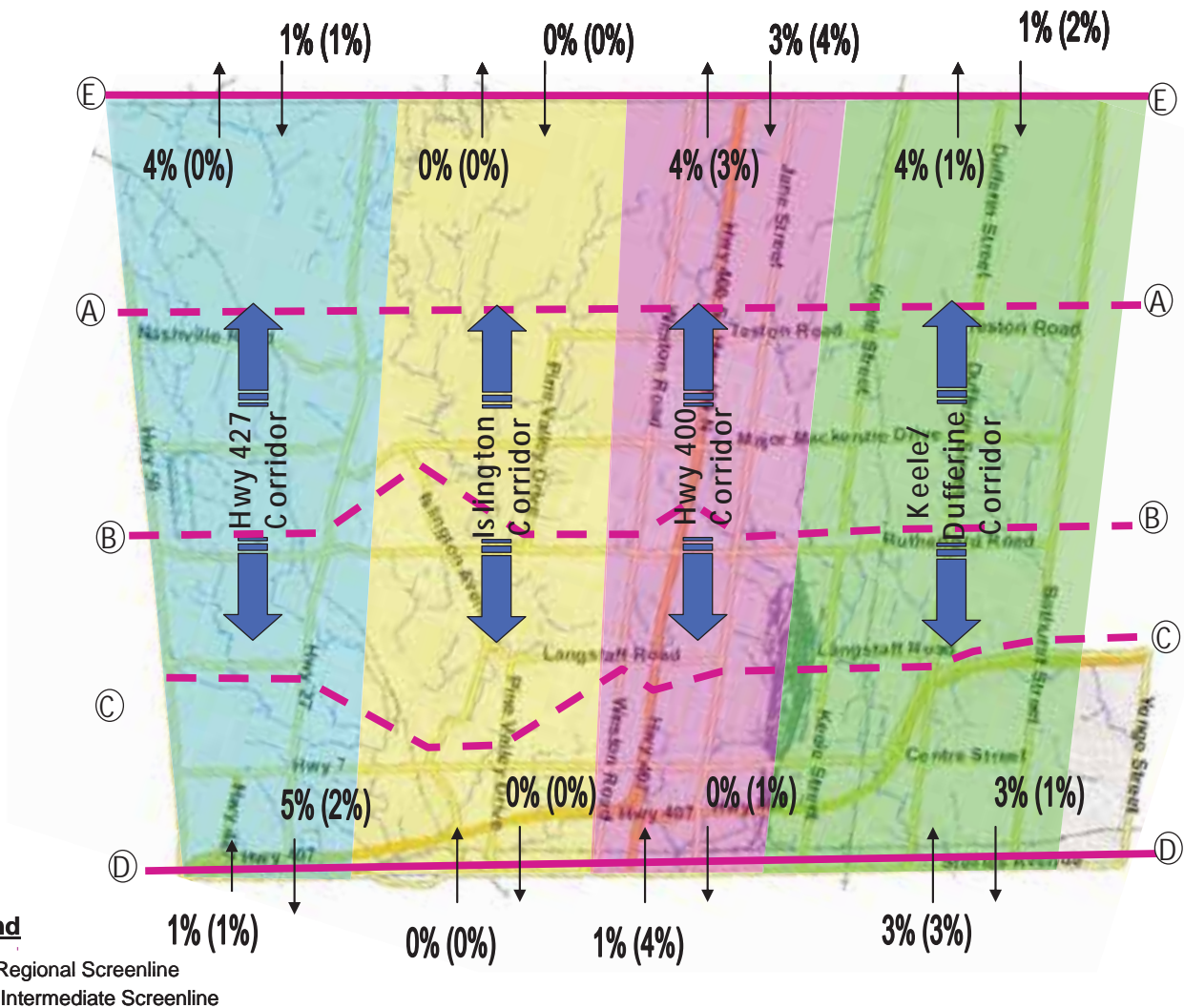


6.1.5 Other Travel Characteristics for the Study Area

The available traffic data, in particular Regional Cordon Count Data, provided information allowing development of additional characteristics of traffic conditions within the study area including the existing transit share, vehicle occupancy rates and truck traffic patterns. This information is also aggregated and analyzed on a corridor and screenline basis.

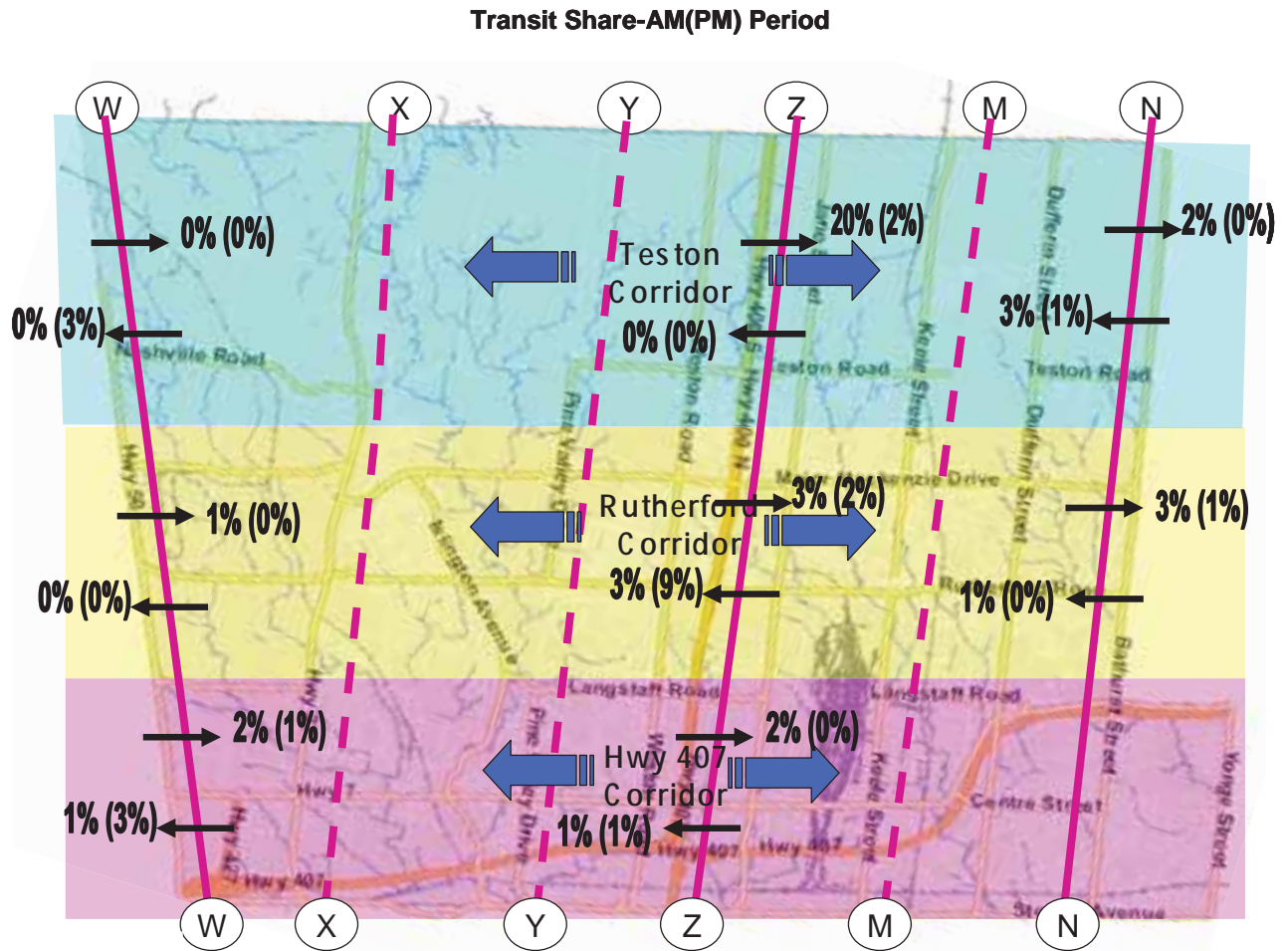
Transit ridership is calculated for each corridor using the regional cordon counts for 2006. **Figures 32 and 33** show the transit share of total trips in two AM and PM peak periods for north-south and east-west corridors.

Figure 32. Transit Share of Total Person Trips in N-S Corridors in AM (PM) 2006



DMG website, Regional Cordon Counts, 2006

Figure 33. Transit Share of Trips in E-W Corridors in AM (PM) 2006



Legend

- Regional Screenline
- - - Intermediate Screenline

DMG website, Regional Cordon Counts, 2006

Truck Traffic patterns vary significantly in relation to the level of road classification and surrounding land uses. While most of the roads experience some level of heavy vehicles in traffic flows, there are areas where the percentages are significantly higher. Notable examples are along sections of the Highway 427 corridor where the percentage of truck traffic reaches 24%. The intermodal terminal located within this corridor and significant development activities in the area most likely contribute to this high level of truck traffic. **Figures 34 and 35** show the truck share in N-S and E-W corridors during AM and PM peak periods.

Figure 34. Truck Share in N-S Corridors AM (PM) 2006

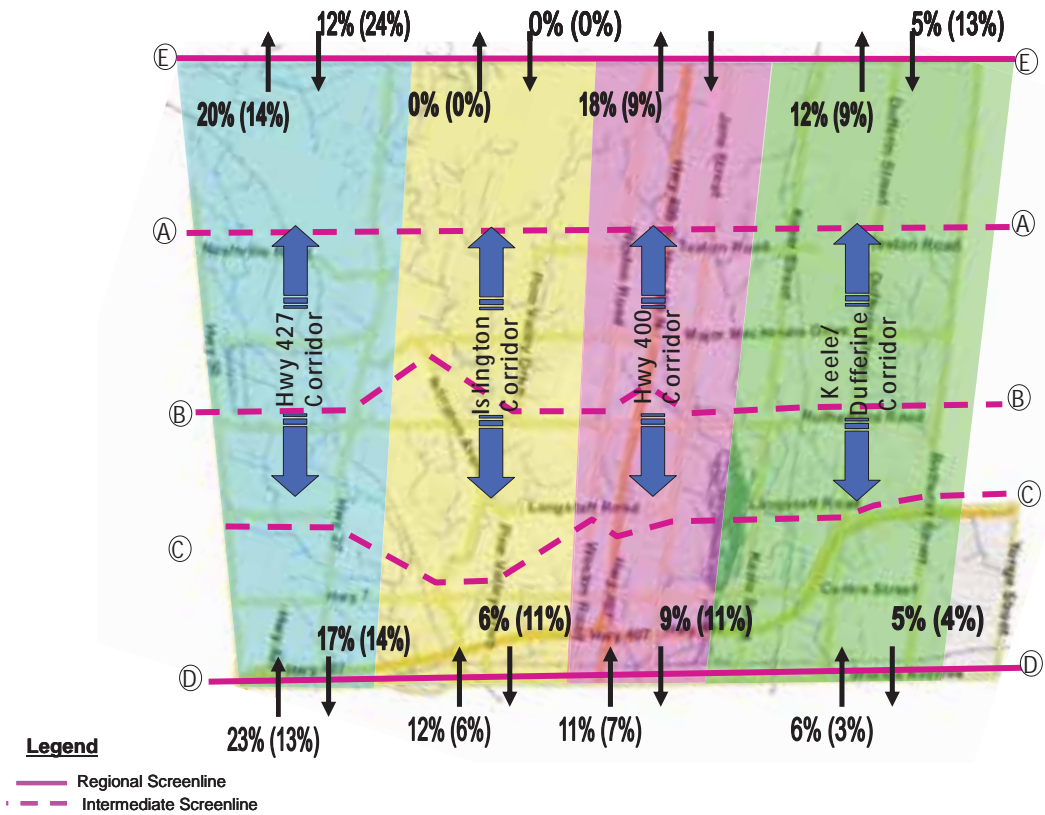
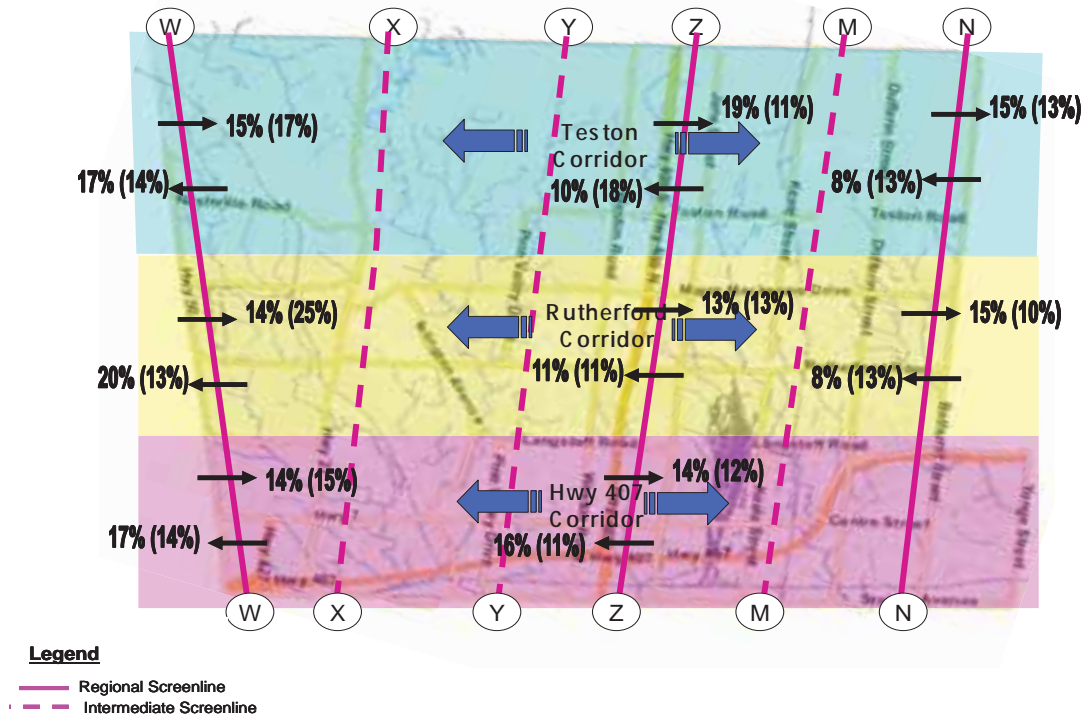


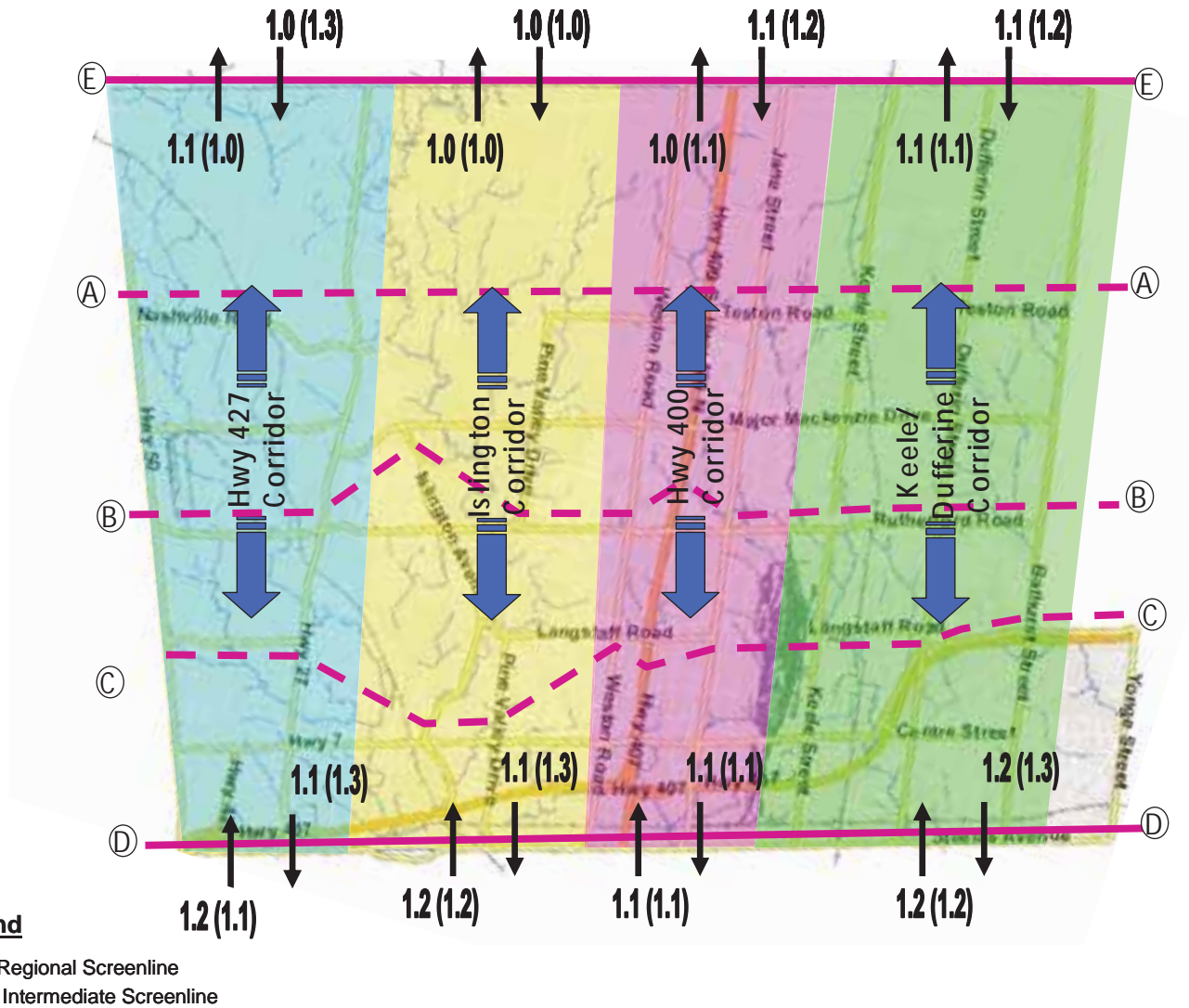
Figure 35. Truck Share of Total Vehicles in E-W Corridors AM (PM) 2006



Source: DMG website, Regional Cordon Counts, 2006

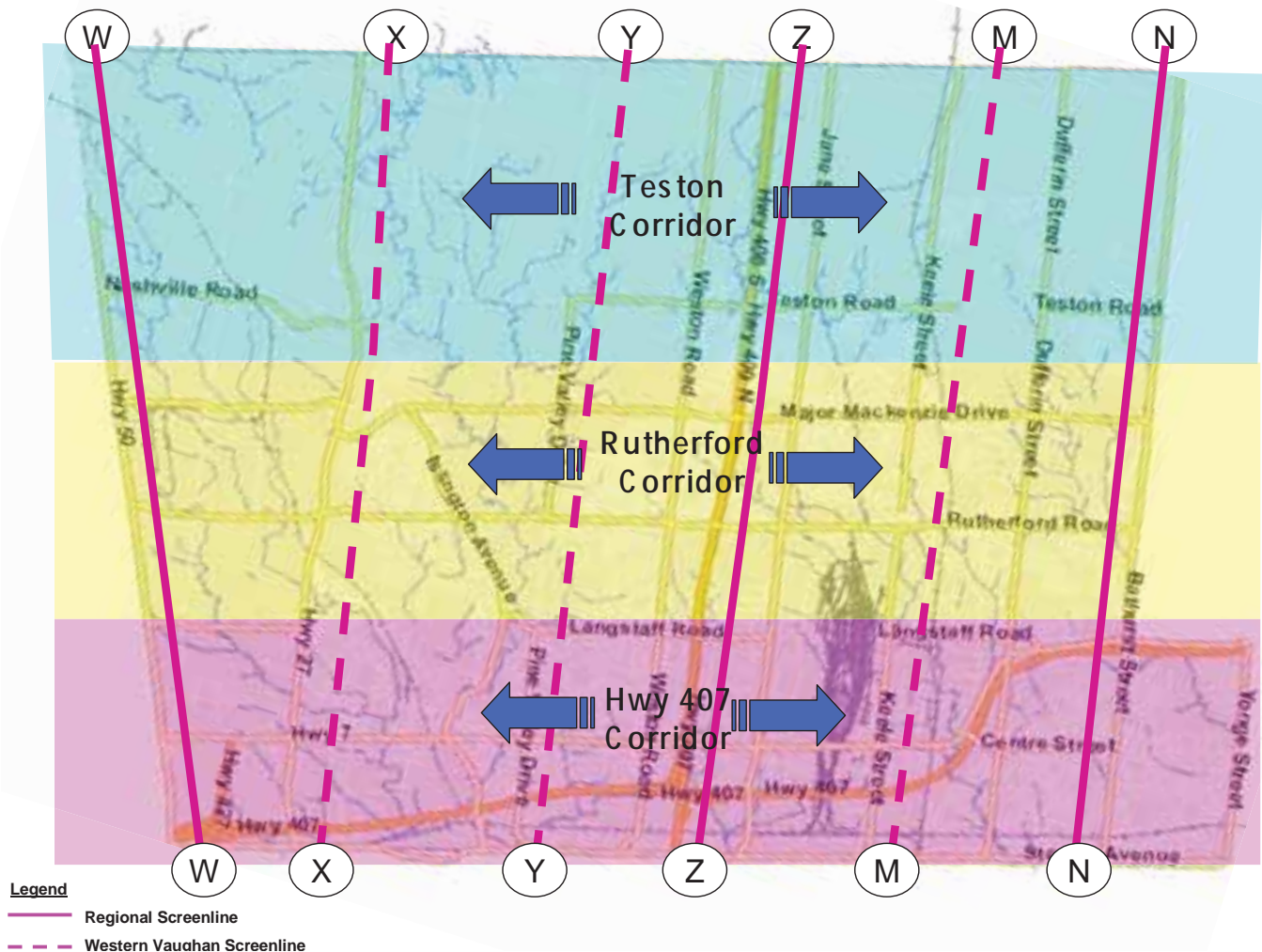
There is little variation in the vehicle occupancy ratios in the study area with an average of 1.1 persons per vehicle. The historical data shows a slight decline of the vehicle occupancy over the last few years (the cordon counts are usually conducted by the Region in 2-3 year intervals). **Figures 36 and 37** show the auto occupancy factors in each north-south and east-west corridors for AM and PM peak periods.

Figure 36. Vehicle Occupancy Ratios on N-S Corridors, AM (PM), 2006



Source: DMG website, Regional Cordon Counts, 2006

Figure 37. Vehicle Occupancy Ratios in E-W Corridors, AM (PM), 2006



Source: DMG website, Regional Cordon Counts, 2006

7. Movement of Goods and Services

The economic vitality of Vaughan depends in large part on the safe and efficient transportation of good and services. The following describes transportation system as it relates to the movement of goods and services. There are a number of viable modes of transportation currently employed within the City of Vaughan and the broader GTA for the movement of goods and services. This discussion focuses on the dominant mode of transportation system including road and rail systems.

7.1 Roadways Heavily Used by Trucks

The extensive network of major highways in the GTA and arterial roads in the Region of York and Peel and the City of Toronto promotes easy access for trucks within the city and beyond. The Provincial Highways serving the City of Vaughan are Highway 407, Highway 427 and Highway 400. The arterial roads are generally under jurisdiction of

York Region. Truck volumes are generally high on the roads feeding key industrial areas such as the CN and CP inter-modal terminals. **Figure 38** depicts major truck activity areas including:

1. Keel Valley landfill and Maple industrial area;
2. Weston-400 North, Weston 400, Keele, Fernstaff North and Tudor Industrial Areas and CN Freight Yard;
3. Highway 427, West Woodbridge & Martin Grove Industrial Areas; and
4. Steeles West, Steeles East & Adesso Industrial Parks.

Figure 38. Major Industrial Areas

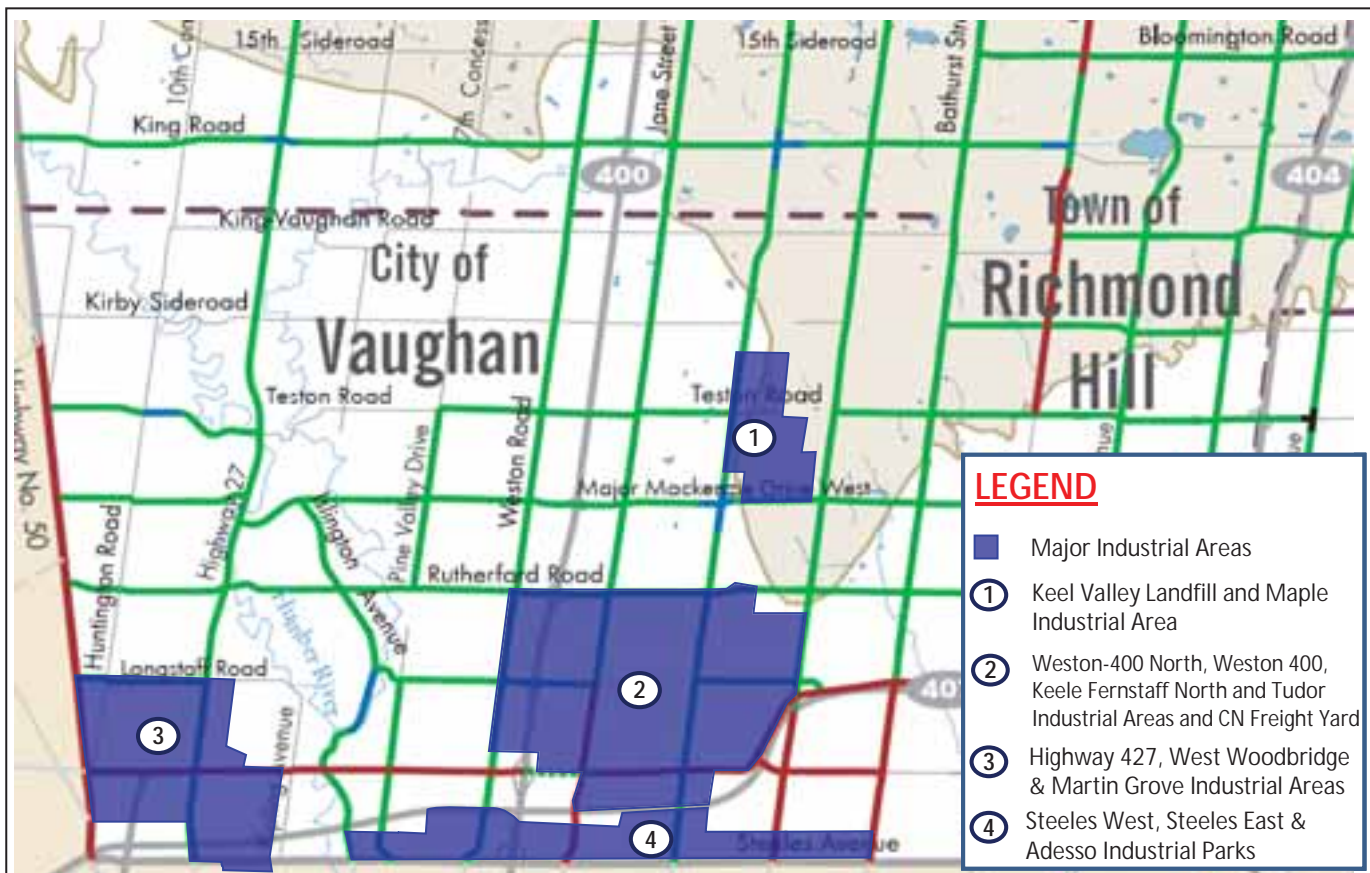


Figure 39 categorizes counts of truck volumes on the existing road network into high, medium and low. High truck volumes refer to road segments carrying more than 1,000 vehicles per hour while volumes exceeding 500 are categorized as medium. Road segments carrying less than 500 truck volumes are categorized as low. The Regional road network in the study area south of Major Mackenzie Drive and west of Dufferin Street generally carries high truck volumes. Highway 7 and Highway 50 are characterized as major truck routes in the City of Vaughan.

Figure 39. Truck Volumes on Major Roads



Source: Region of York

The City of Vaughan accommodates the top 10 intersections carrying the highest truck volumes within the Region of York. A list of these intersection and associated truck volumes is presented in **Table 4**.

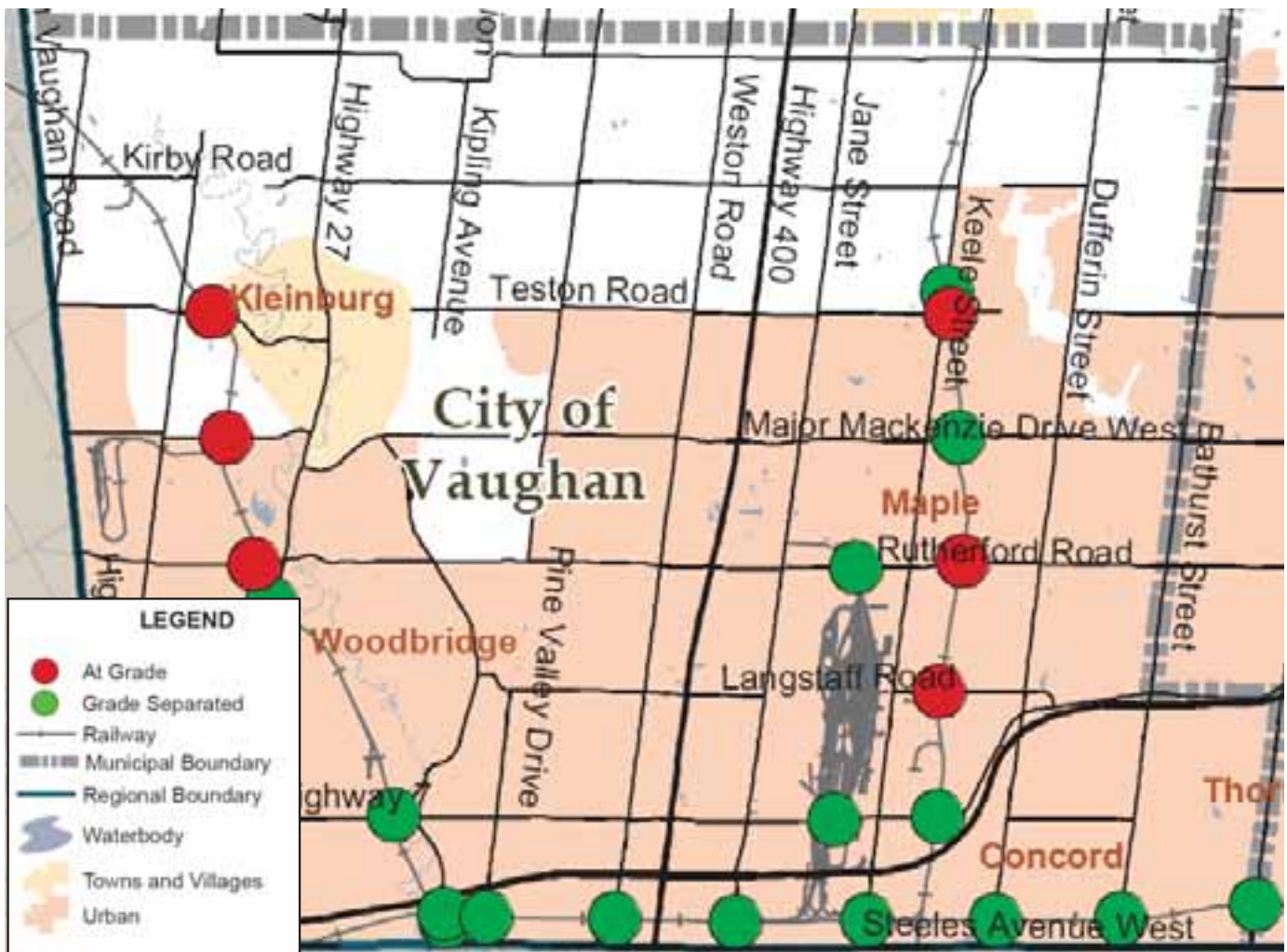
Table 4. The Highest Truck Volume Intersections in the City of Vaughan

RANK	DESCRIPTION	Count Date	Total Trucks	Total Cars	Total 8 Hour Volume	% of Trucks
1	Highway 7 @ Jane St	06-Jun-06	4935	35258	40193	12%
2	Highway 7 @ Huntington Rd	05-Dec-06	4662	24276	28938	16%
3	Creditstone Rd @ Highway 7	20-May-03	4569	23889	28458	16%
4	Edgeley Blvd @ Highway 7	06-Jun-06	4516	33325	37841	12%
5	Highway 400 N/E Ramp @ Highway 7	06-Jun-06	4509	44470	48979	9%
6	Highway 50 @ Rutherford Rd	13-Apr-06	4302	26554	30856	14%
7	Colossus Dr @ Highway 7	06-Jun-06	4249	44501	48750	9%
8	Commerce St @ Highway 7	12-Dec-06	4194	36228	40422	10%
9	Highway 27 @ Highway 7	05-Oct-06	3909	35469	39378	10%
10	Highway 7 @ Millway Ave	06-Jun-06	3778	26373	30151	13%

7.2 Railway Cargo

The railway network constitutes another important mode of transportation for goods and services within the City of Vaughan. The main cross-Canada freight routes (CPR and CN) pass through the Central Ontario Region. Both CPR and CN have connections in all directions including links to New York, Windsor/Detroit, Chicago, Montreal, Halifax, and Western Canada. CPR and CN have many terminal facilities serving York Region including the industrial areas within the City of Vaughan. An example is the Intermodal Terminal located just east of Highway 50, north of Rutherford Road that is served by CPR in handling domestic and international containers. CN rail owns a similarly large distribution centre located north of Highway 7 between Keele Street and Creditstone Road, which is used for all types of distribution including metal, auto and cargo. **Figures 40 and 41** show the rail network within the City and the extent of the CN distribution centre complex respectively.

Figure 40. Railway Network and Crossings



Source: Region of York

Figure 41. CN Rail Concord Distribution Centre Complex



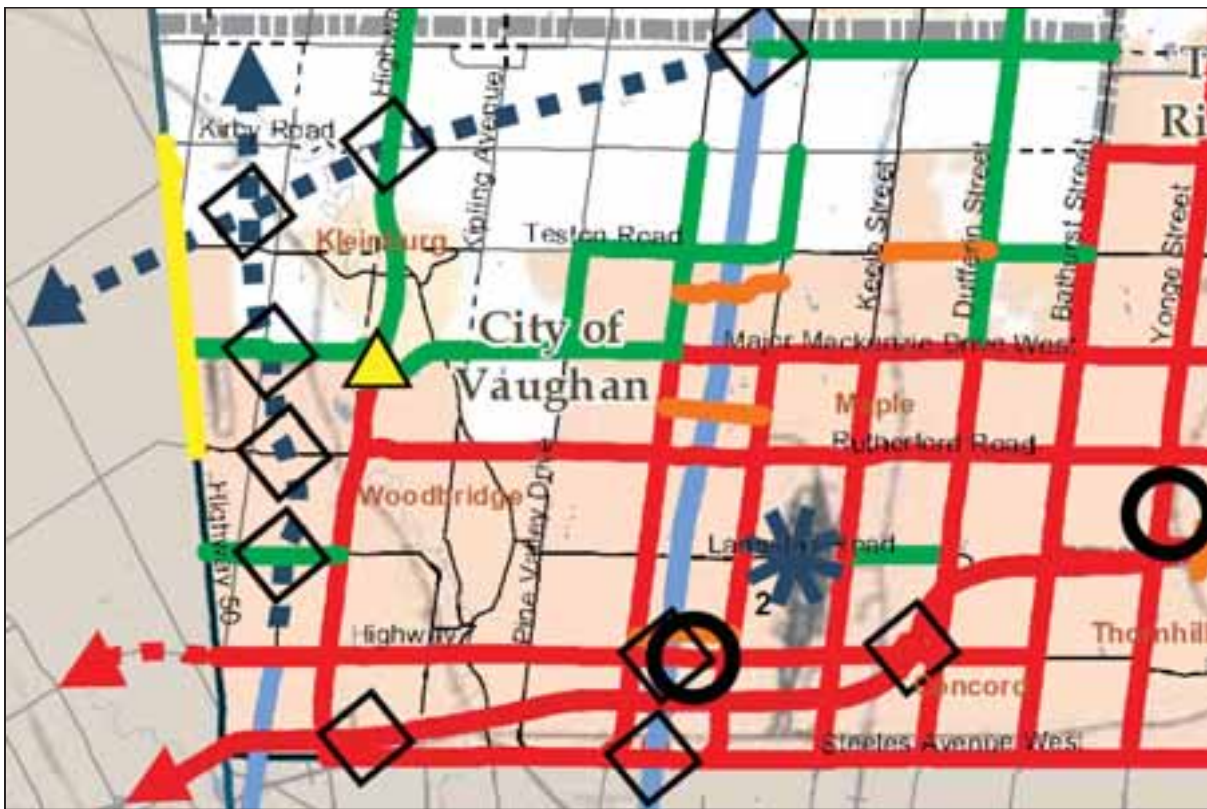
Source: Region of York

8. Committed and Proposed Improvements to Road and Transit Networks

8.1 Proposed and Committed Improvements to Road Network

Figure 42 presents the long-term improvements to the road system contemplated by the Ministry of Transportation and the Region of York. Most of the major roads are considered for widening from either 2 to 4 lanes or 4 to 6 lanes. Collectively, these will provide a significant increase in the capacity of the existing network. Major elements of the plan include the widening of Highway 400 to 5 lanes northerly to King Road, Highway 427 extension along the west edge of the city, and a new Provincial GTA West corridor extending through the northwest corner of the City and terminating at Highway 400.

Figure 42. York Region 2031 Road Network Improvements (York Region TMP Update)



Source: York Region TMP

Legend:	
	Jog Elimination
	New or Improved Highway Interchange
	Regional Centers
	New Local/Regional Road
	Arterial Road Improvement
	Arterial Road Improvements to 6 Lanes
	Road Improvements to Support Transit
	New Provincial Road
	Provincial Road Improvement

The following lists other proposed improvements:

- The widening of Highway 50 to 6 lanes from Rutherford Road to Kirby Road.
- Improvements of Highway 27, Weston Road, Jane Street, Keele Street, and Dufferin Street to support transit from Steeles Avenue to Major Mackenzie Drive.
- Bathurst Street and Yonge Street improvements to support transit from Steeles Avenue to Kirby Road.
- Pine Valley Drive improvement from Major Mackenzie Drive to Teston Road.
- Weston Road, Highway 27 and Dufferin Street improvements from Major Mackenzie Drive to Kirby Road and beyond.
- Road improvements to support transit for Steeles Avenue, Highway 7, and Rutherford Road from Yonge Street to Highway 50 and beyond
- Langstaff Road improvements from Dufferin Street to Keele street and from Highway 27 to Highway 50.
- New local roads crossing Highway 400.
- Major Mackenzie Drive improvements from Highway 50 to Weston Road and its improvement to support transit from Weston Road to Yonge Street and beyond.
- Teston Road improvement from Pine Valley Drive to Jane Street and from Dufferin Street to Bathurst Street.
- Kirby Road improvement to support transit from Bathurst Street to Yonge Street.
- King-Vaughan Road improvement from Highway 400 to Bathurst Street.
- Jog elimination at Highway 27 / Major Mackenzie Drive.
- New and or improved interchanges along the extension of Highway 427 at Langstaff Road, Rutherford Road, and Major Mackenzie Drive.
- New partial interchanges of Highway 407 at Martin Grove Road and at Centre Street.
- Improved interchanges of Highway 400 at Steeles Avenue, Highway 7, and King Road.

8.2 Proposed and Committed Improvements Transit Network

Figure 43 presents the Transit Priority Networks as included in the York Region Transportation Master Plan. Major elements of the plan include:

- Rapid Transit service along Highway 7 throughout York Region and extending into the Region of Peel.
- Transit priority along Highway 27 (from Steeles Avenue to Rutherford Road), along Rutherford Road (from Highway 27 to Yonge Street and beyond), along Weston Road from Steeles Avenue to Major Mackenzie Drive, and along Major Mackenzie Drive from Weston Road to Yonge Street and beyond.
- Freeway Express Bus services along Highway 400 and Highway 407.
- New GO Transit Rail Services along the Bolton line with 3 stations considered at Nashville Road, Highway 27 / Rutherford Road and at Kipling Avenue north of Highway 7

Figure 43. Rapid Transit and Transit Priority Networks (York Region TMP Update)



Source: Region of York

8.3 Bike Network Facilities, and Walking Path and Sidewalk Improvements

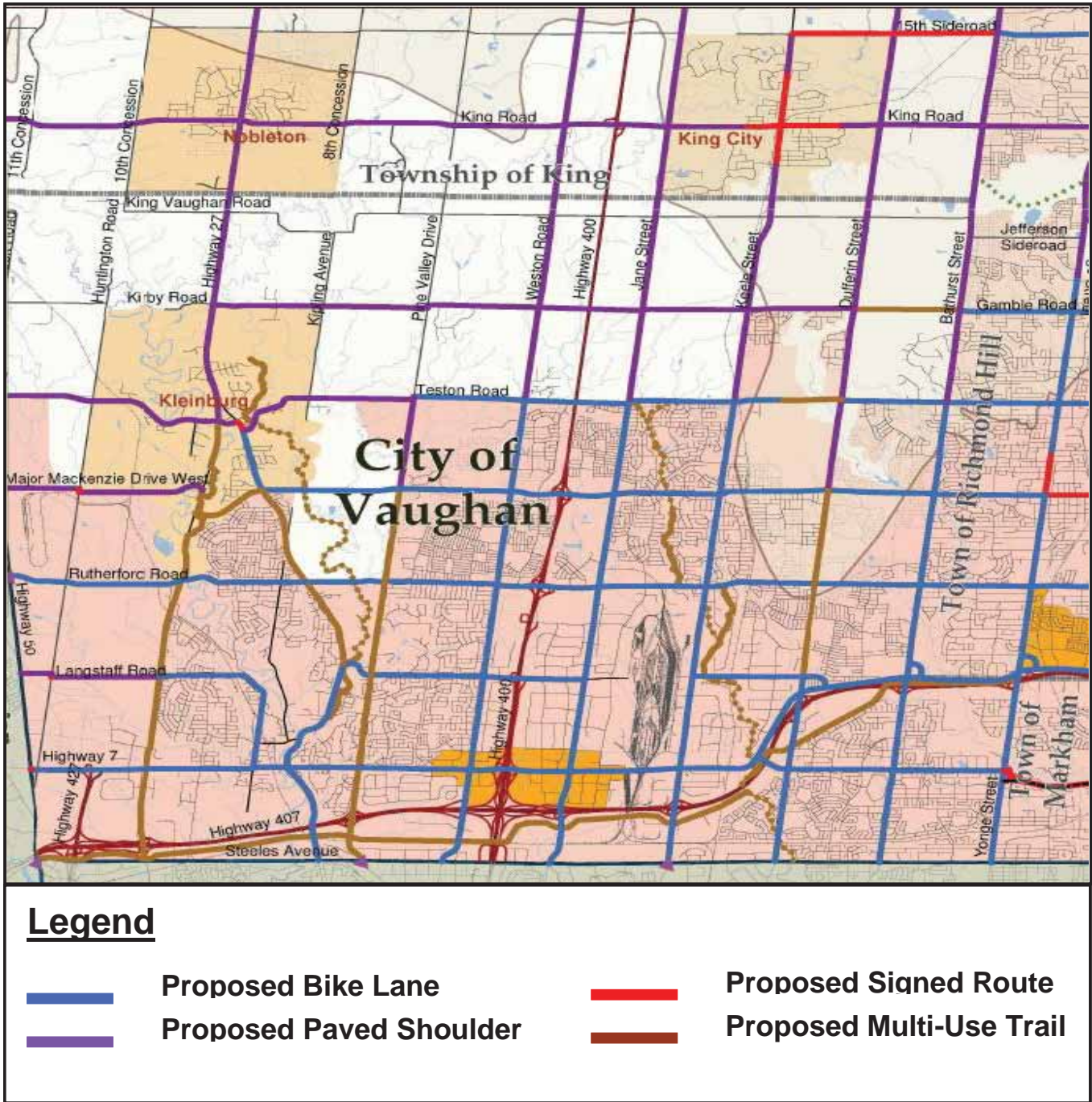
There is a current effort by York Region, together with the City of Vaughan, to provide convenient and continuous system of sidewalks and a designated cycling network on regional and local roads. The Region and City have completed bicycle and pedestrian master plans detailing bicycle and trail networks as well as sidewalk improvements at the regional and city levels. The planned Regional network (see **Figure 44**) includes paved shoulders, bike lanes, and marked cycling routes. This planned network connects to the local municipal cycling routes (see **Figure 45**) to provide approximately 1,035 km of on-road facilities and 209 km of off-road facilities. To provide future flexibility, the Pedestrian-Cycling Network will be delivered by York Region in three phases over a 25 year period. Phase 1 is a 5 year action plan which is proposed to deliver:

- 260 km of bike lanes/paved shoulders
- 34 km of multi-use trails
- 85 km of signed bike routes
- 45 km of sidewalks

Phase 2 includes programs for the following 5 years proposed to deliver:

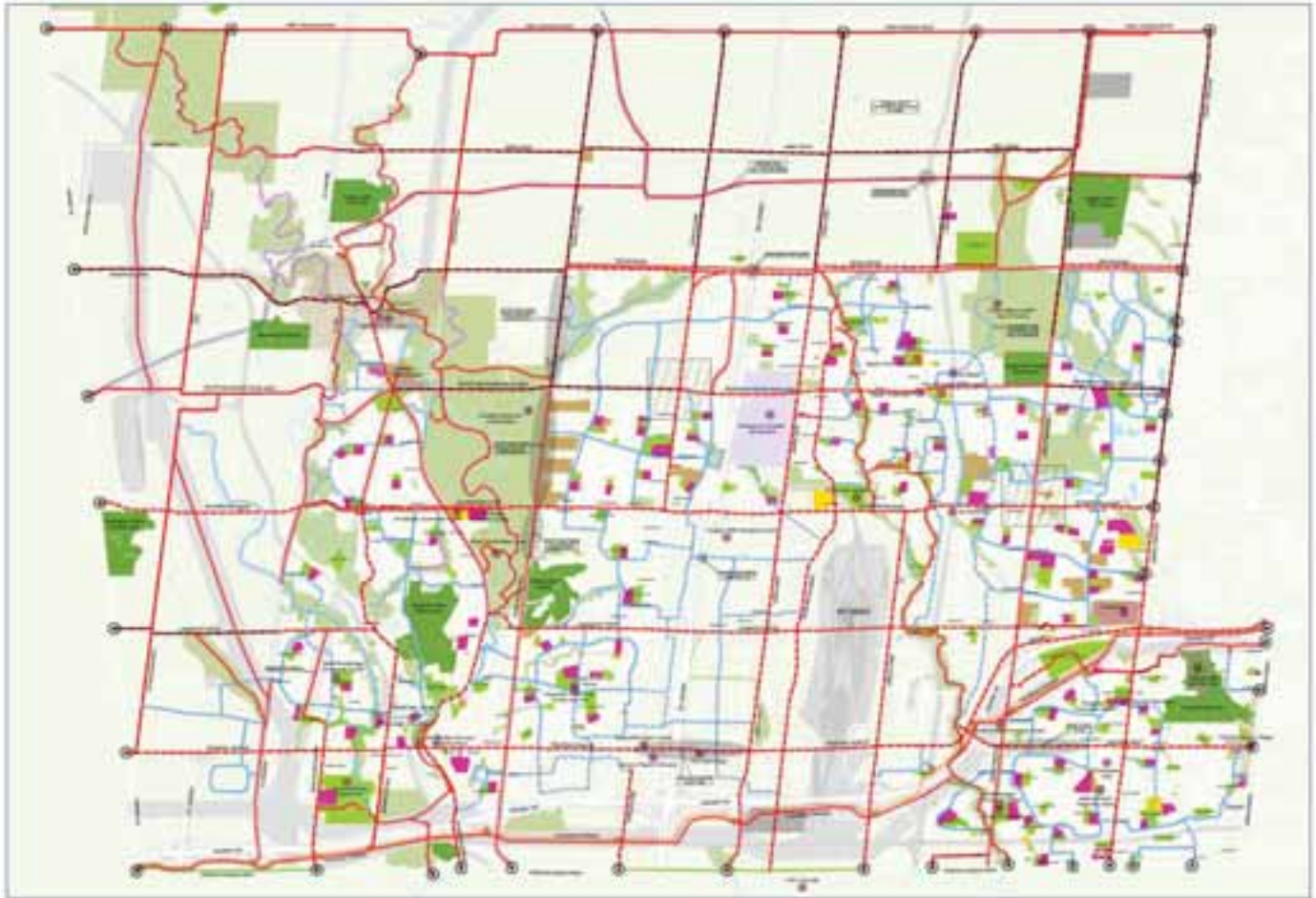
- 198 km of bike lanes/paved shoulders
- 27 km of multi-use trails
- 39 km of signed bike routes
- 17 km of sidewalks

Figure 44. Proposed Cycling and Pedestrian Network (York Region Bicycle and Pedestrian Master Plan)



Source: Region of York

Figure 45. Pedestrian and Bicycle Network by Facility Types Proposed by City of Vaughan Bicycle and Pedestrian Master Plan





D2. Transportation Demand Management

City of Vaughan

Transportation Master Plan Transportation Demand Management (TDM)

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April, 2012

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1. Introduction

1.1 Understanding TDM

Although most jurisdictions have in the past focused on transportation supply such as construction of additional roadway facilities to address the ever increasing travel demands, scarcity of available resources has led to the realization that more emphasis must be laid on managing travel demands to better satisfy the overall mobility requirements and ensure sustainability. Transportation policies and initiatives that cater for motor vehicles as well as other modes of travel like transit usage, cycling and walking contribute to greater transportation choices, less traffic congestion, cleaner air, healthier citizens, stronger communities, a more sustainable economic climate and a higher quality of life for residents.

One such initiative that aims at giving individual travellers choice in a sustainable manner is Transportation Demand Management (TDM). TDM is a series of specialized policies, targeted programs, and innovative mobility services and products that work to influence **whether, why, when, where** and **how** people travel. Simply stated, the purpose of TDM is to manage and maximize the movement of “people”, rather than motor vehicles, within the transportation system. TDM is often primarily directed at commuter travel, although in some communities these strategies have also been used to manage other transportation markets, including special event transportation. Such actions can include offering travellers one or more alternative transportation modes and/or services, providing incentives to travel on these modes or during off-peak hours, and/or incorporating growth management or traffic impact policies into local development decisions.

Most TDM programs have a primary goal of reducing single occupant vehicles (SOV) use, in an effort to reduce traffic congestion and many of the adverse impacts associated with transportation systems. Many communities that have embraced TDM, however, have also experienced a number of other mobility, social, and health benefits in their communities.

1.2 How TDM Works

The main objective of TDM is to make personal travel decisions more sustainable and to make more efficient use of our existing transportation system. According to the “*Report on Canadian Alternative Transportation Program*”, a study prepared by the Association for Commuter Transportation of Canada (ACT Canada), one of the key ways of achieving this objective is to positively change the various transportation choices that individuals make when considering travelling. These choices include:

Mode Choice..... Commuters are encouraged to shift from travel SOV to a mode with spare capacity or with less environmental and economic impact like transit, cycling and walking. If they choose to drive they are encouraged to adopt environmentally responsible driving practices (anti-idling, proper tire pressure, etc.).

Time Choice..... Encouraging commuters to travel during off peak periods where possible, or just outside the existing peak demand timeframes.

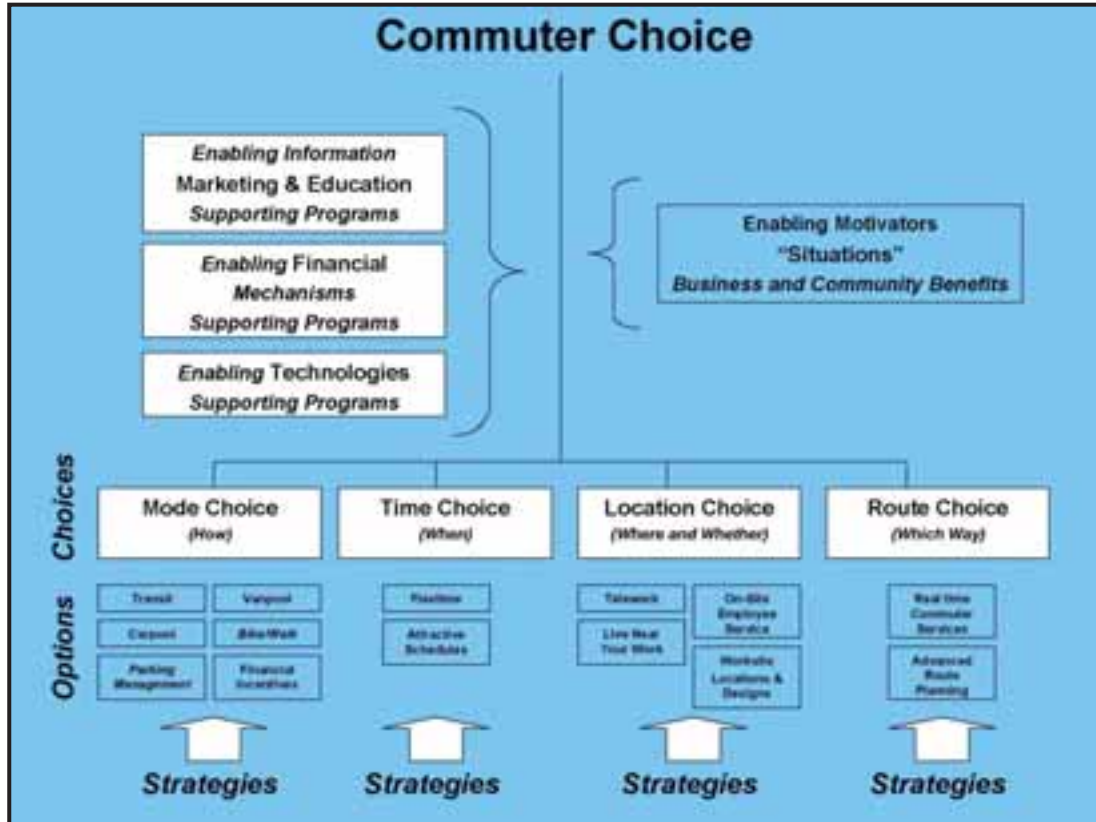
Location Choice *Trip Reduction* – Reducing the number or length of trips (measured in vehicle-kilometres traveled (VKT)) (i.e., employee lives near work or shops at local stores rather than traveling across town to shop)

Trip Elimination – Eliminating some or all trips by eliminating the need for travel (i.e., telework, or compressed week)

Route Choice..... Trip chaining or trip planning to minimize short trips, leverage carpooling or vanpooling in order to encourage efficient travel. The technology associated with route choice is often linked with intelligent transportation systems.

Figure 1 below summarizes the commuter choice conceptual framework as described by the FHWA report¹.

Figure 1. The Commuter Choice Conceptual Framework



Source: The US FHWA

There are many different TDM strategies that influence the choices made by residents. Although most individual TDM strategies only affect a small portion of total travel, the cumulative impacts of a comprehensive TDM program can be significant². These strategies are discussed further in Section 2.

1.3 Active Transportation Concept

Active transportation concept recognizes and seeks to enhance human-powered travel modes such as walking, cycling, skating, skiing, and manual wheelchairs. It provides economic, social, environmental and health benefits. It is closely related to TDM since it involves non-auto modes of travel. Conventional travel surveys typically show that the concept accounts for 5% or less of the modal share, although that is considered to be an underestimate in most cases. With suitable policies aimed at encouraging it, active transportation could play a significant role and contribute much to solve transportation problems in a City like Vaughan.

1. *The Development of Commuter Choice Primer: An Employer's Guide to Implementing Effective Commuter Choice Programs*
 2. *Why Manage Transportation Demand?*, Todd Litman, Victoria Transport Policy Institute, May 10, 2005

1.4 Role of TDM in the Vaughan TMP Study

The key ingredient to a good TDM program is to provide attractive commuting options to the travelling public. The intended result of TDM is not to force people to abandon their cars but to rather offer them a convenient, reliable and affordable transportation choice, thereby reducing the demands for auto travel at the same time. As an integral part of the Transportation Master Plan (TMP), a TDM strategy can offer great potential and opportunity to achieve a multitude of planning goals. Through co-ordination, transportation demand management offers the large potential for a large return on investment when combined with other TMP elements.

As the TMP is a guideline for infrastructure investment decisions as well as a blueprint for action, TDM plays an important role in the development of the TMP particularly in defining goal oriented, sustainable objectives of the TMP. TDM strategies and methodologies are incorporated to outline and achieve certain desired goals. The TMP will include specific policies that will revolve around specific TDM initiatives such as transportation and land use planning as part of a comprehensive TDM Program.

2. TDM Policy Context and Strategies

2.1 Policy Context

2.1.1 Link to Sustainability

As the population has grown and technology has made travel more convenient and affordable, personal travel demands have grown at a faster pace than population. Since the introduction of the automobile, most of our urban transportation systems have evolved to support travel by car. Societal and economic changes in North America, have resulted in many households becoming dependant on the automobile, with many owning two or more vehicles. As a result, auto ownership levels in Canada have reached record levels and that has been coupled with a dramatic increase in SOV use, increasing the level of congestion in urban areas.

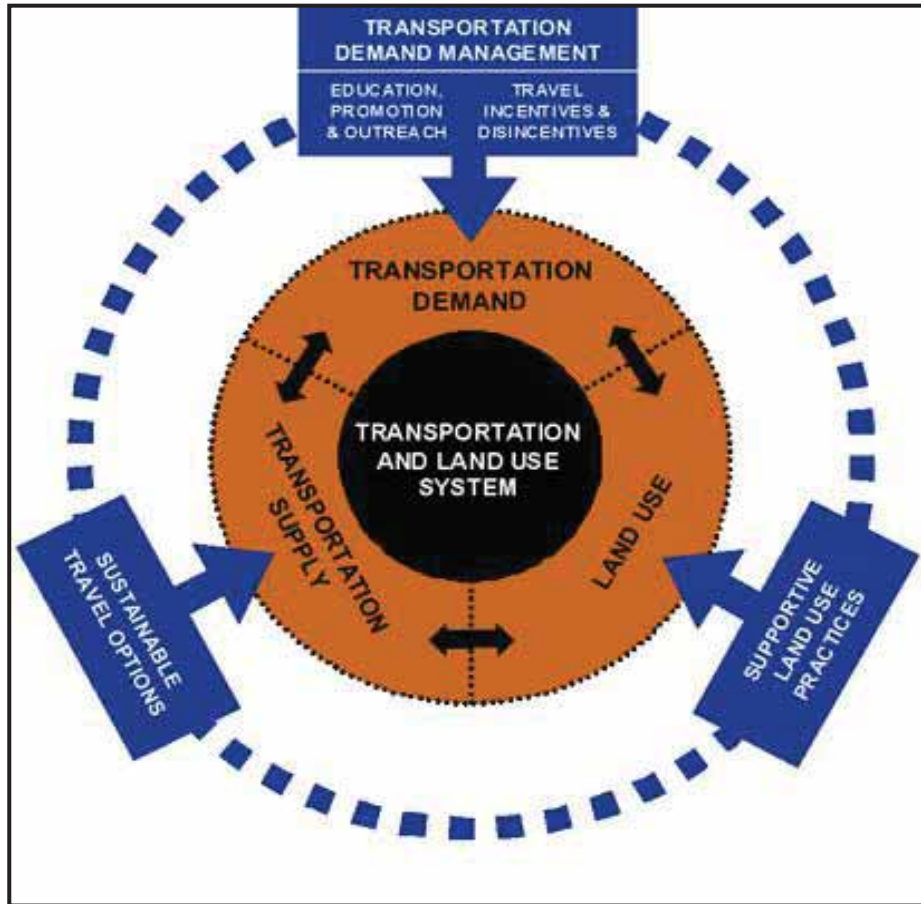
This system has proven to be unsustainable, consuming excessive energy, affecting the health of populations, and delivering a declining level of service despite increasing investments. In order to achieve a sustainable transportation system, communities are continuously searching for better alternatives including a set of measures that commuters can rely upon so they can change the way they commute. The Canadian [Centre for Sustainable Transportation](#) defines a sustainable transportation system as one that:

- "Allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations;
- Is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy; and
- Limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable resources, limits consumption of renewable resources to the sustainable yield level, reuses and recycles its components, and minimizes the use of land and the production of noise".

According to the ecoMOBILITY program supported by Transport Canada, The creation of more sustainable mobility systems will require concurrent action in several areas, (**Figure 2**):

- improvements to sustainable travel options that build the capacity and quality of transportation infrastructure and services
- more supportive land use practices that reduce the distances between origins and destinations and make transit, walking and cycling more practical
- the use of transportation demand management (TDM) to shape other key factors that influence personal travel decisions, such as attitudes and prices.

Figure 2. Transportation and Land Use System



Source: Transport Canada

Based on the success stories gathered from many cities in North America, TDM can represent an important part of a sustainable transportation solution. It has been proven that an appropriate TDM program can encourage new travel behaviours, reduce the impacts of single occupancy commuter travel, and improve opportunities and access to other transport choices. Thus, TDM is a major link in a program that will lead to a more sustainable transportation system.

2.1.2 Places to Grow

Places to Grow is the Ontario government’s plan to manage growth and development in Ontario in a way that supports economic prosperity, protects the environment and helps communities achieve a high quality of life. Through Places to Grow, the province has provided a planning framework that directs where and how communities within the Greater Golden Horseshoe (GGH) should grow and identifies policies to guide government investments in infrastructure to support growth. The City of Vaughan is a constituent municipality of the Region of York, which is one of the key growth nodes in the area. The Growth Plan for the GGH was released in 2006 and is a 25-year plan that aims to create complete communities that offer options for living, working, learning, shopping and playing and to reduce traffic gridlock by improving access to a greater range of transportation options amongst other objectives.

To support future growth, the plan proposes an infrastructure strategy including a transportation system that will increase options available for traveling including convenient access to transit, cycling and walking opportunities. In

In addition to establishing a number of land use policies, the Growth Plan also identifies a number of key TDM initiatives to encourage alternative modes of travel including the following:

- Municipalities will develop and implement Transportation Demand Management policies in official plans or other planning documents, to reduce trip distance and time, and increase the modal share of alternatives to the automobile;
- Public transit will be the first priority for transportation infrastructure planning and major transportation investments; and
- Municipalities will ensure that pedestrian and bicycle networks are integrated into transportation planning.

2.2 TDM Strategies

Transportation Demand Management strategies are classified under three general categories including market based strategies, behaviour based strategies, and land use based Strategies. Each of these strategies uses different types of incentives to encourage people to re-think their travel choices, including the need to travel at all. Examples of initiatives that fall under each strategy are summarized below.

2.2.1 Market Based Strategies

Market based strategies tend to use economic incentives to encourage desired behavioural outcomes. The incentives are most effective because they are direct and affect the motorists' pocketbooks. However, they are also the most controversial, for precisely the same reason. Examples of market based strategies include the following:

- **Parking Cash-Out:**
Offers a subsidy to users of other modes, that is equivalent to the value of a free parking space. A parking space subsidy can be offered in other forms such as cash or other equivalent benefits. For instance, employees can choose between a free parking space, a vanpool subsidy, free monthly transit pass, or monthly cash subsidy. These incentives could reduce automobile commuting by 10-30%.
- **Road Pricing:**
Motorists pay directly for driving on a particular roadway, (such as toll roads) or in a particular area. Highway 407 Express Toll Route (ETR) is a local example of a toll road that uses variable pricing to manage demand levels throughout the day. The variable toll rate structure is set up to charge higher tolls during peak periods in order to reduce demand and maintain acceptable levels of service on the facility.
- **Congestion Pricing:**
Congestion pricing (Value pricing or Peak Hour Road Pricing) refers to variable road pricing applied in an area to modify traffic usage and congestion level of the roads. Congestion pricing helps by shifting peak hour traffic to other transportation modes or to off-peak periods and enables the roadway system to flow more efficiently through the same physical available space. Area based road pricing was found to reduce traffic volumes by between 18 to 30% in Central London England, in October 2003.

2.2.2 Behaviour Based Strategies

Behaviour based strategies tend to use a combination of marketing, incentives, and improved infrastructure / services to provide a wider range of transportation choices and encourage residents to re-consider the transportation choices they make. Some of the common behaviour based strategies include:

- **Marketing Alternative Modes of Transportation:**
These programs include targeted marketing strategies to stimulate both short term and long term shifts to alternative transportation modes including transit. Short term campaigns are designed to encourage people to try to make environmentally-friendly lifestyle choices by using a different mode of travel for one day or longer. Social or individualized marketing campaigns are also used to encourage people to make more sustainable transportation choices. For example, employers in an area can be encouraged to support flexible work hours and work at home programs as a means to improve morale, productivity, and employee retention. Employees could be encouraged to use flexible work hours, telecommute, or ride the Bus Rapid Transit (BRT) system. Similar marketing initiatives have also been used in Portland, Oregon and Sydney, Australia with a higher degree of acceptance than some of the more traditional, “standard” marketing initiatives.
- **Encouraging Shifts to Transit:**
Many transit systems are now incorporating secure cycling racks at bus station terminals and provide bicycle racks on their buses so as to allow cyclists to ride a bus and continue faster on their journey. Flexible use of transit passes is another way to provide an incentive to shift to transit that provide a variety of different transit pass options that offer discounts from the single fare price. Student passes, multi-ride tickets, monthly passes, swipe cards, and daily passes are often used. Students may also receive a transit pass as part of their enrolment.
- **Flexible Hours and Peak Spreading:**
Flexible work hours involve the rescheduling of work times to eliminate work trips or spread them out to non-peak periods. It may include compressed work weeks (four day weeks) to eliminate trips of the fifth day, or starting work late and ending late to ensure travel during the off-peak period. As an example, staggered shift times have been used for a number of years at the Oshawa General Motors (GM) assembly plant.
- **Telecommuting:**
Involves working from home or other remote place to take advantage of advances in information technology. The implementation of telecommuting programs is typically initiated at the employer level with a good example being the Nortel Networks in the City of Ottawa. With an aggressive marketing effort and ensuring that basic infrastructure (such as high speed internet services) is in place, it is expected that up to 10% of all employees could use telecommuting by 2031.
- **Ridesharing or Carpooling:**
Is an effective transportation strategy for implementation at large employment centres. Ridesharing can be informal, such as a couple sharing the same car to drive to work, or one spouse dropping off a child at school. This is the most common form of ridesharing that occurs, and is often tied to household auto ownership levels.

2.2.3 Land Use Based Strategies

Land use strategies attempt to use land use at a variety of geographic scales to provide transportation choice to residents and encourage non auto modes of transportation. The strategies include more compact forms of

development with higher densities, mixed land use options that reduce the need to travel outside the community, and neighbourhood designs that promote safe and pleasant environments to support walking and cycling, provide transit supportive land use design, and reduce the amount and impact of parking. Some strategies to achieve these types of benefits within urban neighbourhoods could include:

- Encouraging a variety of land uses within a neighbourhood, such as stores and services
- Promote the redevelopment of single uses into mixed-use developments
- Design communities so that kids can walk to school.
- Encourage and provide safe and direct pedestrian routes to transit stops
- Use visual cues and design elements to indicate pedestrian rights of way and minimize conflicts
- Avoid use of large scale parking lots and situate parking to enhance the pedestrian environment and facilitate access between destinations
- Make places walkable for aging populations in response to new demographics and special needs
- Retrofit existing streets to provide sidewalks to promote more walkable communities in both residential and employment areas
- Concentrate critical services near homes, jobs, and transit
- Plan neighbourhood street networks in a grid patterns with high levels of connectivity and short blocks rather than long blocks with looping street segments and numerous cul-de-sacs
- Locate mixed use activity centres around transit hubs
- Require sidewalks in all new developments and on both sides of all collector and arterial roads
- Cluster freight facilities near ports, airports, and rail terminals

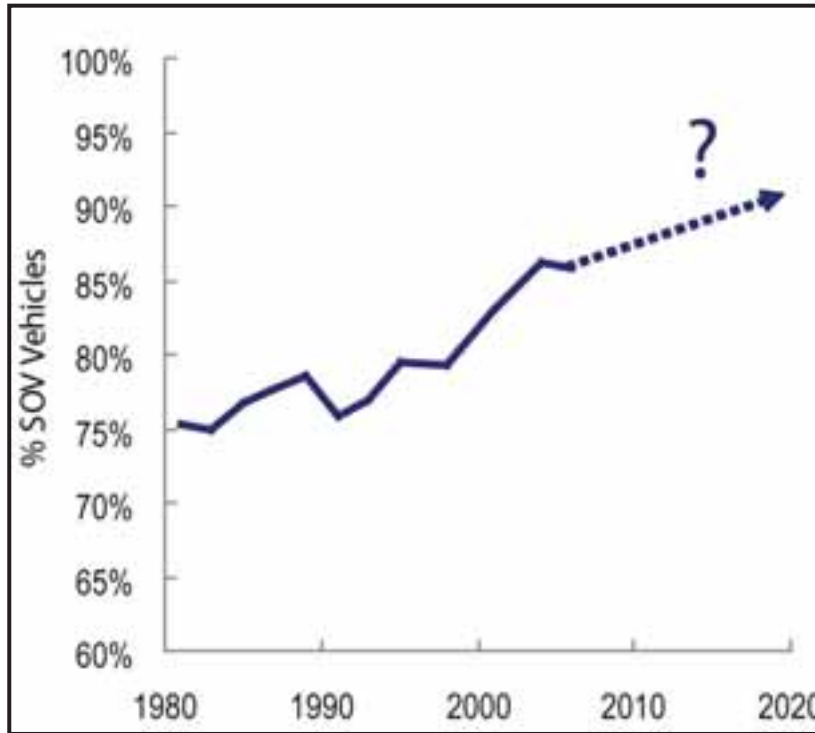
3. Experiences in Other Jurisdictions

3.1 Existing GTHA Policies

The Greater Toronto Area and the City of Hamilton (GTHA) is considered to be the largest metropolitan area in Canada. With a continuously increasing population of approximately 5.1 million people, the GTHA has generated more than 2.5 million jobs. About half of both the population and employment are located in the City of Toronto. In the next decade, it is anticipated that the GTA population and employment will grow by 30 and 40 percent respectively.

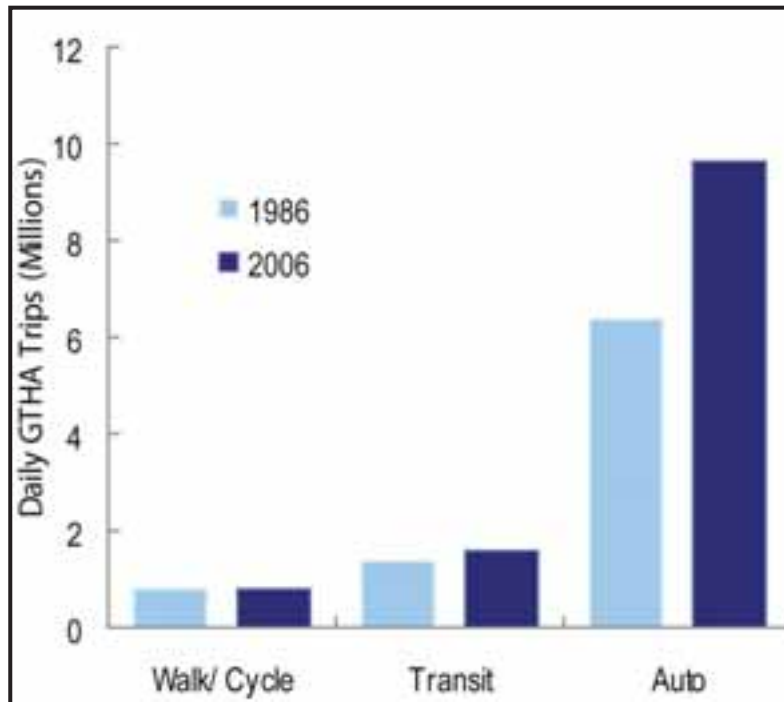
It has been proven that over the past 20 years, there has been a continuous increase in the automobile use as a primary mode of travel. Furthermore, SOV has risen from 75% in 1981 to 85% in 2006 as shown in Figure 3. Active transportation only accounts for a small proportion as shown in Figure 4. Due to the continued population and employment growth, automobile trips are estimated to increase 64% by the year 2021.

Figure 3. The portion of SOV Trips in the GTHA



Source: Metrolinx and Data Management Group

Figure 4. Travel Mode in the GTHA



Source: Metrolinx and TTS

This tremendous growth in auto demand has forced municipalities and employers in the GTHA to aggressively search for and implement programs, such as TDM, which begin to increase the number of travel options available to commuters in the hopes of decreasing the number of vehicle trips and changing the way people commute. As such, several municipalities have developed TDM tools and policies that are currently implemented throughout the GTHA including the Smart Commute Initiative and other private sector / employer-specific programs.

The Smart Commute program strives to encourage commuters to shift from driving and to utilize other forms of transportation, be it public transit, carpooling, vanpooling, walking, or bicycling. A Smart Commute program is usually promoted by the municipality or Regional TDM co-ordinator. As of 2004, Smart Commutes have been established in Markham, Richmond Hill, Mississauga, Northeast Toronto, Brampton-Caledon, Halton, Durham, and Central York. The smart Commute program became a part of Metrolinx at the beginning of 2008, and will continue to support the implementation of TDM measures across the GTHA.

Other TDM strategies, which do not fall under the Smart Commute program, have also been implemented to various degrees in the GTHA:

- Online trip planners for various local transit services;
- TDM programs at several college and university campuses
- Electronic tolling on Hwy 407 that varies by time of day and vehicle type
- Introduction of the Presto Smart Card pilot program to integrate fare payment across multiple transit services
- Active and Safe Routes to School programs that encourage children to walk and bicycle to school;
- HOV lanes to encourage carpooling
- City of Toronto's cycling promotion program and CAN-BIKE educational efforts
- Changes in policy (City of Toronto requirement for a TDM plan as part of development application)
- Discounted transit pass sales for specific targeted groups
- Car Sharing groups
- On-Line Carpool Matching and Riderssharing Sites:

The implementation of the tools and initiatives in the GTHA has shown some positive results to date. According to the GTA Commuter Behaviour Survey conducted in 2006, 19% of commuters in the Highway 400 corridor currently telework occasionally and 30% would like to do so if the option was available. Another strategy that has displayed early results is the HOV priority lanes constructed on Highways 403 and 404. Within a few months of opening, travel time savings of eight to nine minutes were experienced compared to adjacent general traffic lanes. After one year in service, the peak morning peak period carpools increased from 15% to 40%. Furthermore, GO Transit has reported that their bus service has experienced decreased travel time and increased reliability on both Highway 403 and 404.

3.2 Metrolinx Regional Transportation Plan

Operating within the legislative framework of the Greater Toronto Transportation Authority Act, 2006, Metrolinx was created by the Government of Ontario to develop and implement an integrated multi-modal Regional Transportation Plan (RTP) for the Greater Toronto and Hamilton Area (GTHA). This region, Canada's largest and most rapidly growing metropolitan area, encompasses the City of Toronto, the four surrounding regional municipalities (Durham, Halton, Peel and York) and the City of Hamilton. The main objectives of this RTP is to set out priorities, policies and programs in order to achieve a more efficient and sustainable transportation system in that region and to assist decision-making in the day-to-day planning, co-ordinating, and implementation of that system.

The Metrolinx Draft Regional Transportation Plan (RTP) has proposed a number of policies designed to improve the available transportation choices and travel experience for the travelling population. The Transportation Demand Management vision outlined by Metrolinx involves four elements:

- Bringing TDM into the mainstream of public life, planning, and decision making
- Building TDM into infrastructure investments
- Using incentives and disincentives to motivate behaviour change
- Advancing to the forefront of technology solutions

To support the future transportation system, Metrolinx has developed various strategic directions to guide transportation decision making in the future. These directions include policies that emphasize public transit, transit supportive land use planning and support to TDM objectives. More specifically, the Draft RTP proposes various TDM initiatives that are targeted to various market sectors. Table 1 below highlights a summary of possible TDM measures, identified by Metrolinx, which have been grouped according to the specific market that they may target.

Table 1, Summary of Metrolinx TDM Strategies

Target Market	Key Metrolinx TDM Actions
Public Sector Employers	<ul style="list-style-type: none"> • Develop TDM strategy for all provincial ministries and agencies such as school boards, hospitals and universities that include actions, timelines and budgets.
Municipalities	<ul style="list-style-type: none"> • Establish guidelines and model policies to help municipalities develop and implement TDM policies in their Official Plans and Transportation Master Plans
Corridors	<ul style="list-style-type: none"> • Require a TDM strategy, including social marketing where applicable, as a condition of provincial funding for all major road and transit projects.
Neighbourhood Level	<ul style="list-style-type: none"> • Require a TDM strategy as part of local Official Plan / Site Plan applications for any major commercial or employment development.
Employers	<ul style="list-style-type: none"> • Encourage private sector employers to implement TDM programs. • Encourage employers to offer their employees a choice between a free subsidized parking space or a cash equivalent. • Encourage employers to offer their employees discounted transit passes by adding a clause in the employee's contract agreement.
Individual	<ul style="list-style-type: none"> • Provide financial incentives to encourage transit use (local transit subsidy, U-Pass programs, employer provided or subsidized transit passes, and bulk discounts for transit passes).

3.3 TDM Across North America

Table 2 provides a summary of some of the TDM programs in a number of North American Cities and jurisdictions that were reviewed:

Table 2. Summary of Selected TDM Programs in North America

City/Jurisdiction	Key Program Elements and Outcomes
Atlanta, Georgia, USA, 1999	Eight transportation management associations in the Atlanta region that: <ul style="list-style-type: none"> • Involved media campaigns with employer and individual outreach services • Encouraged carpooling, vanpooling, transit use, biking, walking, teleworking and compressed work week schedules • Resulted in fewer daily trips, mode shift and emission reductions
Seattle, Wa, US. In 2005, TDM programs as part of a Green Ribbon Commission	<ul style="list-style-type: none"> • Increasing the supply of frequent, reliable and convenient public transportation • Significantly expanding bicycling and pedestrian infrastructure • Leading a regional partnership to develop and implement a road pricing system. • Implementing a new commercial parking tax • Expanding efforts to create compact, green, urban neighbourhoods • SOV reduction from 70.9% in 1993 to 65.5% in 2007. Also reduced emissions, petroleum consumption by 7.9 million gallons, saving over \$23 million in fuel costs.

City/Jurisdiction	Key Program Elements and Outcomes
Portland, Or, US, TravelSmart and SmartTrips Programs	<ul style="list-style-type: none"> Targeted marketing to over 14,000 residents living in the catchment area for the new service Individualized marketing information on transit, walking and cycling and some received follow-up visits Each household in a SmartTrips area receives a newsletter with a calendar of nearby walks, clinics, and bicycle rides. Achieved a reduction of 9 to 13 percent in drive-alone car trips by all area residents with a corresponding increase in walking, bicycling, and transit mode shares
Calgary, Alberta, Transportation Solutions	<ul style="list-style-type: none"> Emphasis on individualized marketing Partnered with Commuter Connections to develop, implement, and promote an internet car-pooling service for the surrounding Calgary area. 1,000 residents were utilizing this ride matching service and 143 car pools formed resulting, 250 cars off the road each day within one year
The Town of Markham, Ontario 2002	<ul style="list-style-type: none"> Operates a TDM office to encourage the efficient use of roadways Offering carpool and ridematching programs to Town employees. Working in partnership with Smart Commute to offer various programs in the Highway 404/Hwy 7 corridor More employees now carpool to work

3.4 Summary of Lessons Learned

Based on the above review, the following is a summary of some of the key lessons learned:

- The demand for auto trips will remain, particularly where alternative travel modes are not available. TDM programs should seek ways to provide options in these situations, while also providing choices to those who only need to use their car occasionally.
- Land use and transportation are intrinsically linked. Transit improvements, transit oriented development (TOD) and Smart Growth must coexist to achieve significant results in promoting sustainable transportation and the use of public transit.
- Collaboration with different partners and stakeholders is important to the success of TDM.
- Target-specific marketing strategies will prove to be highly beneficial. Individualized marketing approaches have been used to reach out to residents and employers in effective ways;
- Economic incentives are powerful motivators that can induce change and interest in TDM efforts.
- Recognize constraints that people face and develop solutions to overcome common barriers.

4. TDM in the City of Vaughan

4.1 Region of York Policies

The City of Vaughan is a constituent municipality within the Region of York and is impacted by the various regional planning policies and initiatives.

4.1.1 Region of York TMP Update and TDM Policies

York Region is updating its Transportation Master Plan which was developed in 2002. The purposes of the update is to move forward the long term transportation vision, policies and infrastructure plans defined in the 2002 Plan.

The 2002 Plan included a comprehensive TDM strategy to manage growth of peak hour traffic volumes. The plan called for flexible employer TDM programs with specific areas of York Region where congestion problems were identified. The TMP also recommended inclusion of TDM strategies as one of the requirements in the development approval. In addition, ridesharing was identified as an important TDM component as well as implementation of High

Occupancy Vehicles Lanes (HOV) lanes within some corridors including Highway 404. Other additional recommendations most of which have been implemented included:

- Recruit a TDM co-ordinator;
- Identify incentives for employers to initiate TDM programs;
- Work with the area municipalities and employers to establish TMAs in the Highway 404/Highway 7 corridor; and
- Encourage area municipalities and other public sector agencies to develop and implement TDM programs

As part of the ongoing TMP update, additional strategies are being considered including:

- Parking Management Strategies;
- Commuter Financial Incentives;
- Rideshare Matching programs ;
- Teleworking;
- Guaranteed Rode Home;
- Transit improvements

4.2 The City's Policies

The City of Vaughan's envisions a growth management strategy that will be realized through the Official Plan and Master Plan documents for Transportation, Environment, Parks and Recreation, and Pedestrian and Cycling amongst others.

4.2.1 Vaughan Corporate Centre

The City's overall plan includes the "Vaughan Corporate Centre" that is a planned downtown development with business offices, residences, entertainment and cultural facilities, and pedestrian shopping areas. It is planned on 1,500 acres with the core development consisting of a 125-acre site along the Avenue 7 corridor, just east of Highway 400. The Centre is well positioned to connect to the Region's VIVA transit services and the upcoming subway extension from Toronto. This Centre offer opportunity for incorporating of the key TDM strategies including land use strategies and transit supportive development.

4.2.2 Pedestrian and Bicycle Master Plan

The City of Vaughan's Pedestrian and Bicycle Master Plan was designed to reduce auto dependency, improve the health and quality of life of the residents Vaughan and establish the City as an active and environmentally-conscious place to live. The planning of active transportation facilities has increasingly become a priority for municipalities across Ontario, including the City of Vaughan. People are increasingly aware of the importance of health and exercise and the need to reduce the impact motor vehicle use is having on the environment.

The plan defines a cycling network within the City consisting of multi-use pathways, bike lanes, signed routes and off road cycle paths, noting that construction of convenient pedestrian and cycling facilities would lead to greater cycling or walking activities. The planning process found that recreational purposes accounted for the majority (83%) of sidewalk and pathway users implying that there is potential for a higher level of usage if more residents start using the facilities for utilitarian purposes as well.

4.3 Smart Commute North Toronto Vaughan

Smart Commute - North Toronto, Vaughan (formerly Smart Commute – Black Creek) is an award winning non-profit committed to reducing traffic congestion, improving air quality and advocating for sustainable transportation with a service area including North Toronto and all of the City of Vaughan.

Smart Commute North Toronto, Vaughan (NTV) partners with the City of Vaughan, Regional Municipality of York, City of Toronto, TRCA, York University and other groups to help reduce business costs and foster healthier work environments.

Among the various initiatives, Smart Commute NTV are:

- Plays advocacy roles for a subway to the Vaughan Corporate Centre and improvements to sustainable transportation infrastructure in the City of Vaughan
- Provides trip reduction programs in collaboration with York University and other businesses in North Toronto, representing a significant portion of the City of Vaughan's commutershed;
- Operates an active Smart Commute NTV Bicycle User Group (BUG) and carpooling websites tailored to area employers;
- Participates as part of the York Region Corporate Clean Air Task Force and is stakeholder of the Growth Plan for the Greater Golden Horseshoe; and
- Works with local transit agencies to promote increases in ridership, frequency and accessibility.

4.4 Opportunities and Constraints

Based on a review of the City's and Regions policies and TDM initiatives, the following opportunities and constraints were identified:

- The activities of Smart Commute NTV provide an opportunity to expand an existing and largely successful TDM program that is already operational in the City;
- Opportunity to build upon the recently completed Pedestrian and Bicycle Master Plan to provide residents with Active Transportation options;
- Opportunity to engage the Region of York in incorporating broad based initiatives on a regional basis as part of the Region's TMP update

5. Moving Forward on TDM

To enable the City to move forward on TDM in the community, a series of potential TDM policies/ initiatives have been identified for consideration in the development of the TMP. These measures are intended for discussion purposes and may evolve or change in the course of the Study. The measures include:

5.1 Land Use and Transportation Integration

- Work with the Region of York to provide immediate transit service to new residential areas to be funded by the Developers;
- Provide fully wired all new homes for high-speed internet;

- Ensure secure and permanent bike parking built at all schools, major work places, and commercial centres
Establish minimum bicycle parking requirements for all new medium and high-density residential and commercial buildings;
- Include walking, cycling, carpooling and transit component assessments in Transportation Impact Studies for all developments; and
- Pursue amendments to the Development Charges Act to enable municipalities to levy charges for all TDM-related infrastructure, including pedestrian and cycling facilities, and TDM programs.

5.2 Transportation Supply

- Continue to plan and expand utilitarian and recreational cycling facilities and expand pedestrian facilities in accordance with the City's Pedestrian and Cycling Master Plan;
- Build park 'n' ride facilities with bike parking facilities at various locations throughout the City;
- Work with the Region of York to provide buses at a minimum frequency of 10 – 15 minutes on major transit corridors; and
- Continue to install and promote bike racks on all transit vehicles;

5.3 Education, Promotion and Outreach

- Work with Metrolinx and to increase the number of employers participating in the Smart Commute NTV initiative including ridesharing and telecommuting programs to local employers;
- Promote flexible work hours programs for City employees;
- Work with the Region to recruit local employers for potential YRT Corporate Pass Discount programs and encourage employers to provide some transit subsidies;
- Consider individualized and targeted group marketing, in co-ordination with any similar initiatives planned by the Region of York;
- Work with school boards to encourage secondary and post-secondary schools to adopt TDM programs (e.g., carpooling); and
- Develop a municipal TDM monitoring program to measure results.

5.4 Travel Incentives and Disincentives

- Develop an overall parking implementation plan;
- Proactively pursue shared parking policies, which focus on the overall parking supply for an area, rather than the required parking for each separate land use;
- Work with Region of York to consider provision of permanent transit passes (GRT) for each home/residence within the Region including the City;
- Provide telephone access to traveler information; and
- Consider constructing schools in initial development phases of new developments.



D3. Role of Transit

Role of Transit Discussion Paper

City of Vaughan Transportation Master Plan (TMP)

Final Report

August 2009

Halcrow Consulting Inc

Role of Transit Discussion Paper

City of Vaughan Transportation Master Plan (TMP)

Draft report

August 2009

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1 Introduction

1.1 *Context*

1.1.1 The City of Vaughan has been growing rapidly for the past twenty years and this momentum is expected to continue with an estimated increase of 170,000 additional residents and 113,700 additional jobs by 2031. In order to integrate this growth, the City is taking a proactive approach by initiating the Vaughan Consolidated Growth Management Strategy – 2031. As part of this endeavour, the new Transportation Master Plan (TMP) will identify the transportation infrastructure needs of the City and support the City's commitment to sustainable development through appropriate land use and transportation strategies.

1.1.2 The transit initiatives proposed in the 2002 York Region TMP (York Region – On the Move – toward sustainable transportation) are being implemented with considerable success, including improvements to GO Rail and YRT services and the introduction of the VIVA BRT services. However, as will be discussed in the subsequent sections, transit's greatest successes so far have been in serving commuters living in Vaughan or in other south York Municipalities that work in transit-oriented activity centres like downtown Toronto, North York City Centre (NYCC) and York University, where transit is competitive. North York City Centre and York University are locations where transit is competitive because of the well established existing transit services, urban design form (intensification and mixed use developments) and co-related factors such as limited and expensive parking. The current challenge for the City of Vaughan is how to create urban environments where transit can be more competitive, especially for travel to the growing employment areas and activity centres within the City.

1.2 *Study Objectives*

1.2.1 As part of the Vaughan TMP Study, this discussion paper has two primary objectives:

- a) to assess transit's past, present and future role in serving the evolving transportation needs of the City of Vaughan and its constituent communities and employment areas, and

¹ Based on 2006 population and 2031 forecast. "York Region 2031 Population and Employment Forecasts." York Region Planning and Economic Development Committee. Jan. 2009.

- b) to describe the City's potential roles in maximizing transit's market share and minimizing auto vehicle demands based on case studies, and assessment of various land use planning and related policies and programs.

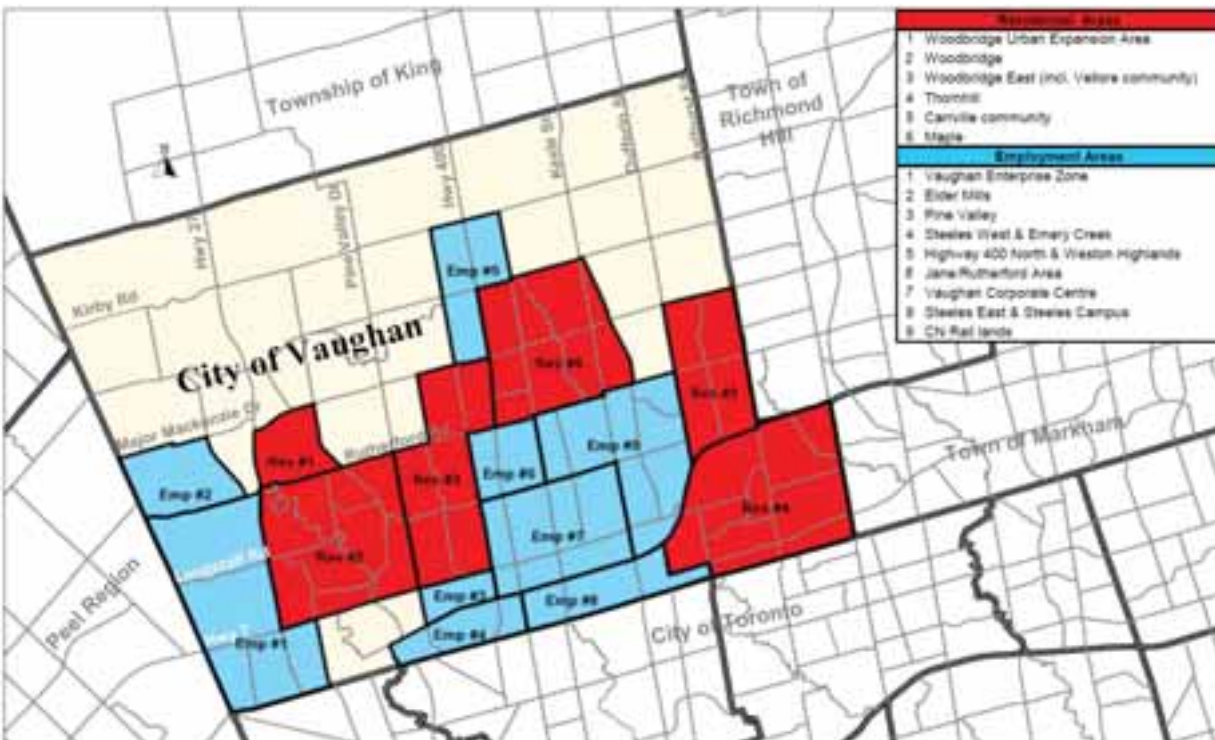
1.2.2 In undertaking these objectives, this Paper will make reference to the Metrolinx Regional Transportation Plan (RTP), which includes existing and planned transportation/transit infrastructure within Vaughan as a part of a wider network to achieve the sustainable growth imperative envisioned for the next 15 and 25 years; as well as the York Region Transportation Master Plan Update.

2 Transit's Past and Present Role in Serving Vaughan

2.1 Study Scope

2.1.1 This chapter describes recent growth and related socio-demographic and employment changes within Vaughan, with special attention to major residential communities and employment areas². Six residential and nine employment areas were defined based on historical boundaries and 2001 Transportation Tomorrow Survey (TTS) traffic zones, as shown in **Figure 1**. The changes that occurred between 1986 and 2006 within these distinct areas will be the focus of subsequent analyses.

Figure 1 - Major Residential and Employment Areas



² Analyses are based on the 1986, 1996, and 2006 Transportation Tomorrow Survey (TTS)

2.2 Population and Employment Trends

2.2.1 Changes in Vaughan travel demands reflect land use trends, such as population and their socio-demographic characteristics as well as location and availability of employment.

Population 1986 - 2006

2.2.2 A pattern of steady population growth within the six residential areas can be seen in **Figures 2 and 3**, and **Table 1**. Between 1986 and 1996, Thornhill experienced the greatest increase in population and labour force, as did Maple and Woodbridge East. Between 1996 and 2006, Maple, followed by Woodbridge East, experienced the greatest growth in population and resident labour force, while the more recently developed areas including the Woodbridge Urban Expansion Area, Maple and Carrville, experienced the fastest growth.

Figure 2 – Population Trends in Residential Communities

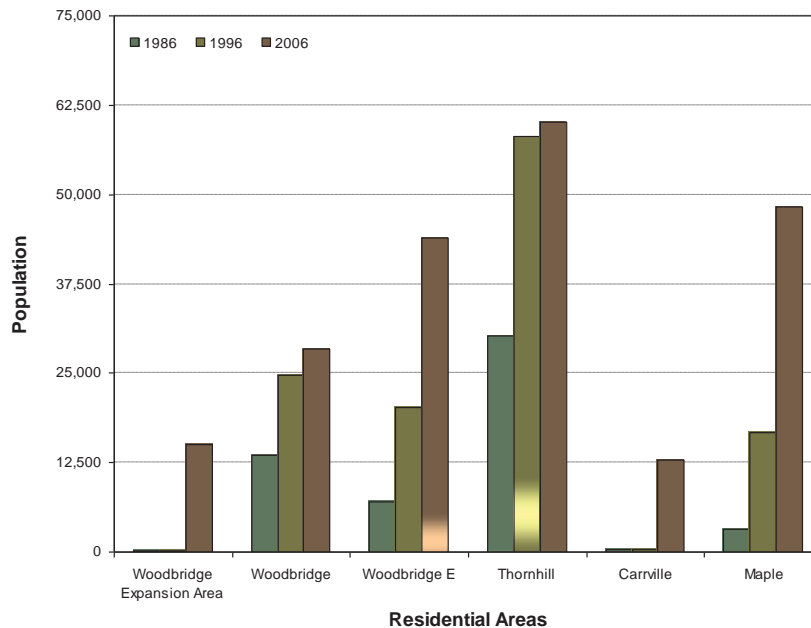


Figure 3 – Labour Force Trends in Residential Communities

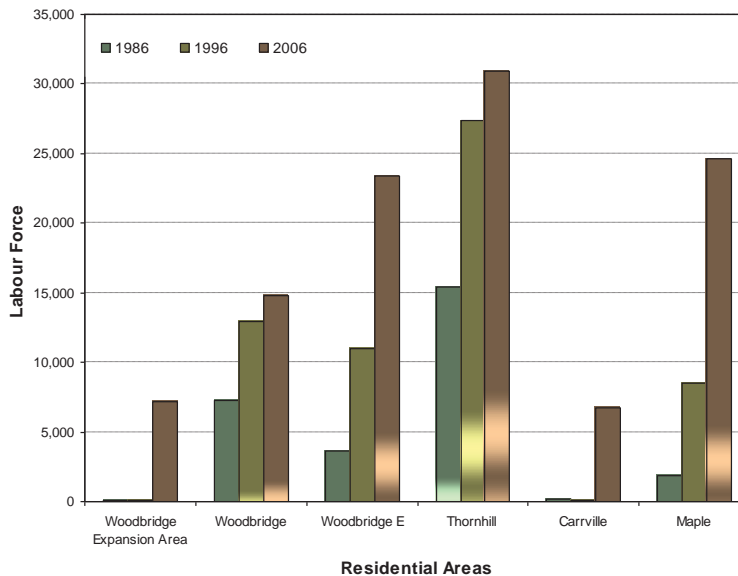


Table 1 – Population and Labour Force Trends in Residential Communities

ID	Residential Area	Population			Difference		Compound Annual Growth	
		1986	1996	2006	86' to 96'	96' to 06'	86' to 96'	96' to 06'
1	Woodbridge Expansion Area	189	115	15,015	- 74	14,900	-4.8%	62.8%
2	Woodbridge	13,470	24,735	28,379	11,265	3,644	6.3%	1.4%
3	Woodbridge E	6,977	20,245	43,884	13,268	23,639	11.2%	8.0%
4	Thornhill	30,224	58,083	60,083	27,859	2,000	6.8%	0.3%
5	Carrville	378	295	12,848	- 83	12,553	-2.4%	45.8%
6	Maple	3,218	16,670	48,269	13,452	31,599	17.9%	11.2%
Total		54,456	120,143	208,478	65,687	88,335	8.2%	5.7%

ID	Residential Area	Lbr Force (Full time & Part time)			Difference		Compound Annual Growth	
		1986	1996	2006	86' to 96'	96' to 06'	86' to 96'	96' to 06'
1	Woodbridge Expansion Area	48	59	7,191	11	7,132	2.1%	61.7%
2	Woodbridge	7,226	12,897	14,832	5,671	1,935	6.0%	1.4%
3	Woodbridge E	3,639	11,027	23,433	7,388	12,406	11.7%	7.8%
4	Thornhill	15,417	27,409	30,895	11,992	3,486	5.9%	1.2%
5	Carrville	143	46	6,716	- 97	6,670	-10.7%	64.6%
6	Maple	1,897	8,484	24,631	6,587	16,147	16.2%	11.2%
Total		28,370	59,922	107,698	31,552	47,776	7.8%	6.0%

Auto Availability, Ownership and License Status 1986 - 2006

2.2.3 The population of licensed drivers and their auto availability are strong indicators of mode choice. These indicators have remained relatively stable in Vaughan over the last two decades. **Figure 4** displays the trends in car ownership levels and license status for 16+ Vaughan residents over the past twenty years. It is apparent that licensed drivers with access to cars constitute the majority of the City's population, with well over half of the population possessing licenses and having access to at least 2 vehicles. A relatively small proportion of the Vaughan population can be considered as "passenger captive," i.e. people with no license or living in a household with no access to a car. The "passenger captive" demographic has remained relatively stable at approximately 15% of the total 16+ population (see **Table 2**).

Figure 4 – Auto Availability, License Status of Vaughan Residents

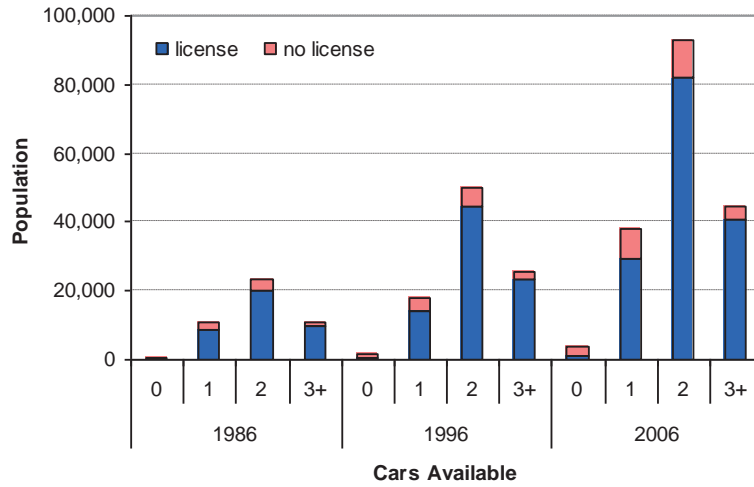


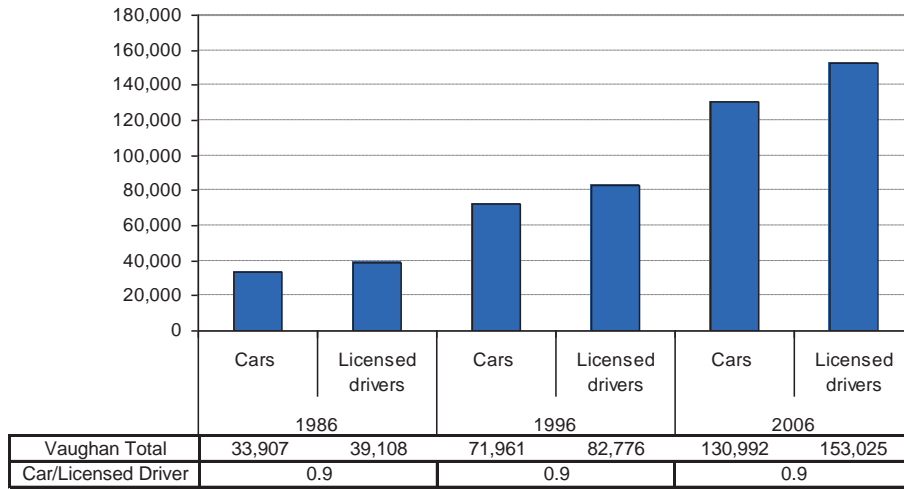
Table 2 – Car Ownership and License Status Trends for Vaughan Residents (Age 16+)

	1986			1996			2006		
	licensed	no license	pop (16+)	licensed	no license	pop (16+)	licensed	no license	pop (16+)
0	215	374	589	492	1,127	1,619	855	2,911	3,766
1	8,789	2,191	10,980	14,144	3,886	18,030	29,315	8,708	38,023
2	20,275	2,865	23,140	44,803	5,011	49,814	82,219	10,515	92,734
3+	9,829	1,016	10,845	23,337	2,158	25,495	40,636	4,105	44,741
Total	39,108	6,446	45,554	82,776	12,182	94,958	153,025	26,239	179,264
% of total pop	86%	14%	100%	87%	13%	100%	85%	15%	100%
Pgr Captive	14.6%			13.3%			15.1%		

2.2.4

Over the past 20 years, the total number of cars has grown alongside population so that the average number of cars available to each licensed driver remained constant at 0.9 cars/driver over the past 20 years (see Figure 5).

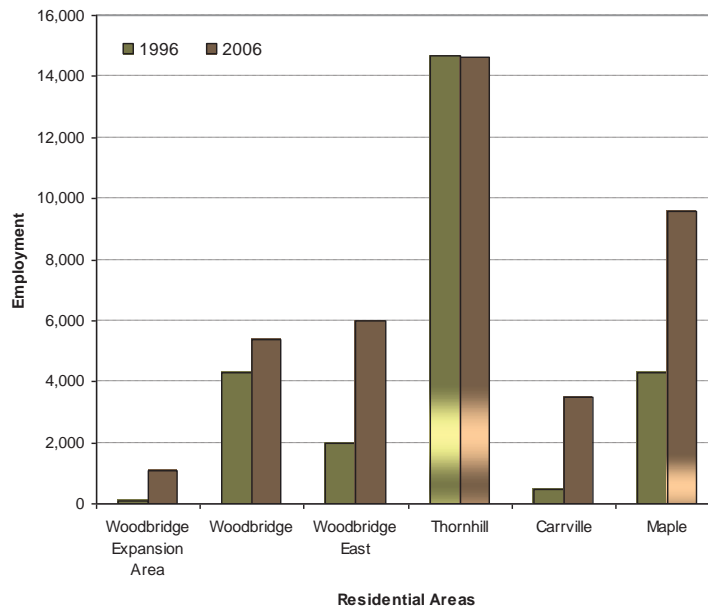
Figure 5 – Car Ownership and Population Trends



Employment 1986 - 2006

2.2.5 The influx of population in Vaughan has generated employment within residential areas, i.e. retail or service jobs that cater to the needs of a community (see **Figure 6**). Between 1996 and 2006, these residential-related jobs grew by approximately 14,000 and the areas of greatest employment growth were also the areas of significant population growth, in Maple, Woodbridge East and Carrville.

Figure 6 – Employment Trends within Residential Communities



2.2.6

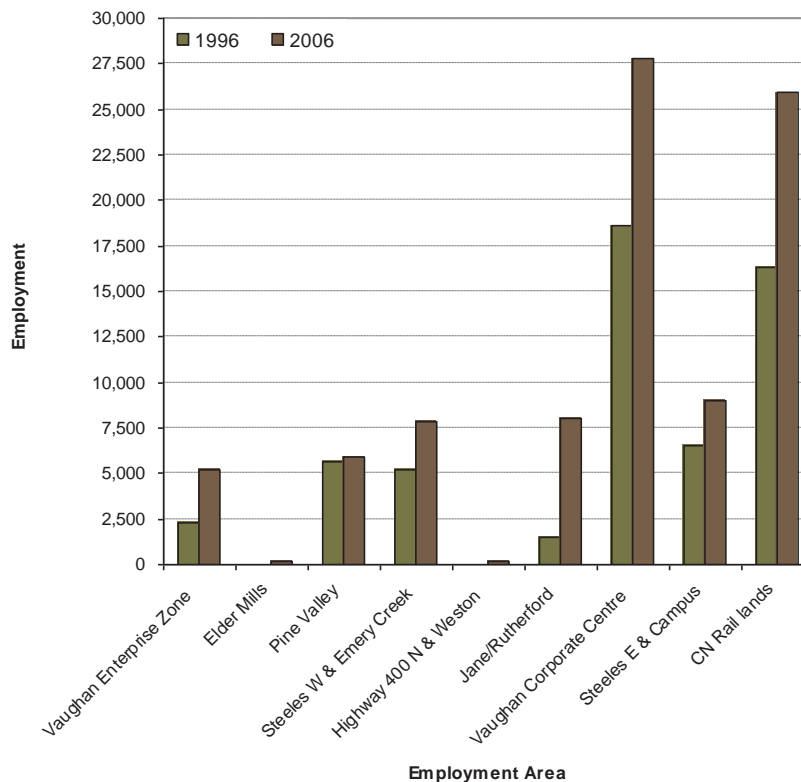
The location of the City's nine major employment areas can be found in **Figure 1** of **Section 2.1.1** and employment trends within these areas are shown in **Table 3** and **Figure 7** below. The magnitude of total employment growth between 1996 and 2006 is mainly due to growth within the CN rail lands and the Vaughan Corporate Centre (VCC). The VCC is the largest employment centre in Vaughan with approximately 19,000 jobs in 1996, which grew to almost 28,000 in 2006. The CN rail lands are the second largest with approximately 16,000 jobs in 1996 and almost 26,000 in 2006. The fact that a high concentration of employment is already in place within the VCC prior to TTC subway extension and implementation of transit-oriented development plans is indicative of the area's importance and growth potential.

Table 3 – Employment Areas Growth Trend

ID	Description	Employment*		Absolute Diff.
		1996	2006	96 to 06
1	Vaughan Enterprise Zone	2,332	5,229	2,897
2	Elder Mills	39	164	125
3	Pine Valley	5,650	5,933	283
4	Steeles W & Emery Creek	5,248	7,824	2,576
5	Highway 400 N & Weston	24	161	137
6	Jane/Rutherford	1,524	8,072	6,548
7	Vaughan Corporate Centre	18,649	27,765	9,116
8	Steeles E & Campus	6,526	9,032	2,506
9	CN Rail lands	16,283	25,961	9,678
Total		56,275	90,141	33,866

* TTS data was only available for 1996 and 2006

Figure 7 – Employment Area Trends



2.2.7 In general, both labour force and employment have exhibited significant growth over the past twenty years. A comparison of employment and labour force statistics between 1996 and 2006 (in **Table 4**) shows that jobs in Vaughan's key residential and employment areas continue to exceed the number of resident workers. However, labour force has grown more rapidly than employment, which explains the decrease in the jobs per resident worker ratio from 1.37 to 1.21.

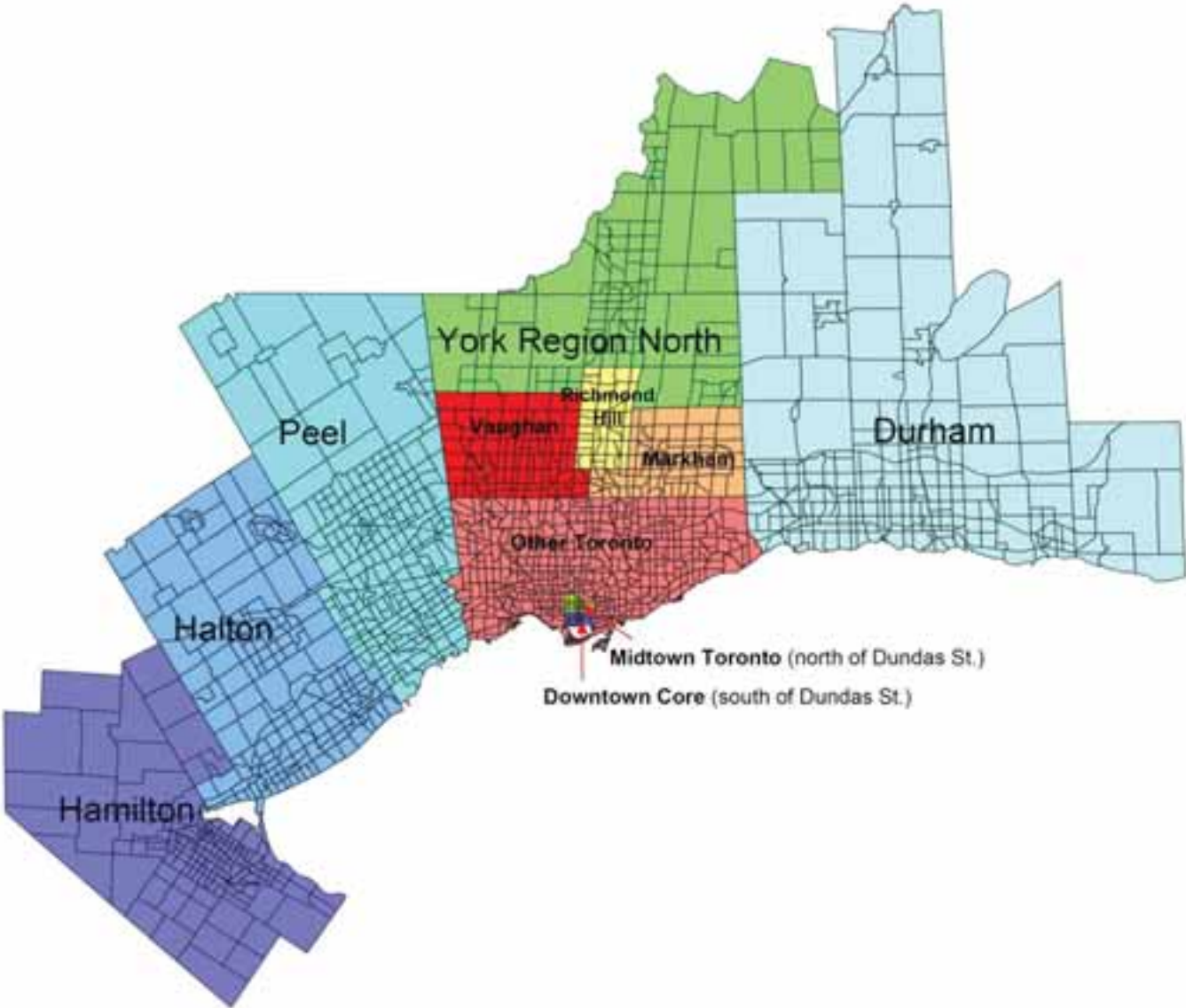
Table 4 – Labour Force and Employment Comparison

Statistic	1996	2006	Compound Growth Rate
Jobs in residential areas	25,768	40,165	4.5%
Jobs in employment areas	56,275	90,141	4.8%
Total jobs	82,043	130,306	4.7%
Resident labour force	59,922	107,698	6.0%
Jobs / resident worker	1.37	1.21	

2.3 *Travel Market Analysis – 1986, 1996, 2006*

2.3.1 The growth documented in the preceding section has influenced travel patterns and mode choice behaviour. The following sub-sections will focus on changes in AM peak period (6:00 AM – 9:00 AM) work and school trips, i.e. where Vaughan's residents are travelling to and where workers/students in Vaughan are coming from, as well as the role of transit in servicing these inbound and outbound demands. This analysis, which defines the peak period demands that largely determine road and transit system requirements, has been summarized for the key areas identified in **Figure 1** of **Section 2.1.1** and the various origins/destinations shown in **Figure 8**.

Figure 8 – Travel Origins and Destinations used in Analysis



Age Groups

2.3.2 Historically, transit ridership within Vaughan is highest for the younger age cohort (15-24 years) who are less likely to drive and/or own a personal use vehicle. **Figure 9** presents the distribution of Vaughan residents who are transit riders by age in 2006. On a City-wide level, the younger cohorts (15 to 24 years) tend to be the dominant group of transit users and the percentage of transit riders tends to decline with age. This trend is mirrored by the overall trend for Canadian transit ridership (see **Figure 10**)³. In this sense Vaughan is comparable to other Canadian centres in that the 15-24 cohort accounts for a disproportionate share of total transit use.

Figure 9 – Vaughan Transit Ridership by Age Group (on typical weekday)

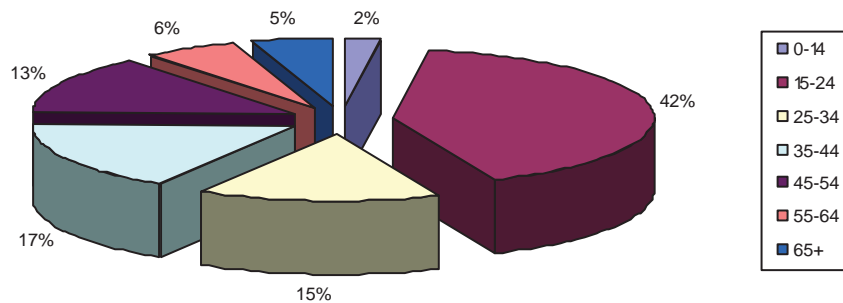
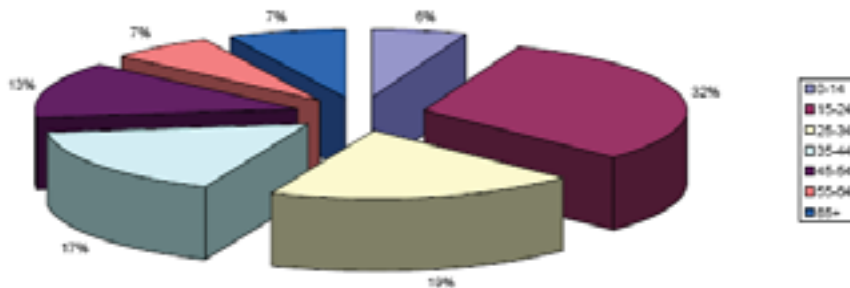


Figure 10 – Canadian Transit Ridership by Age Group (on typical weekday)



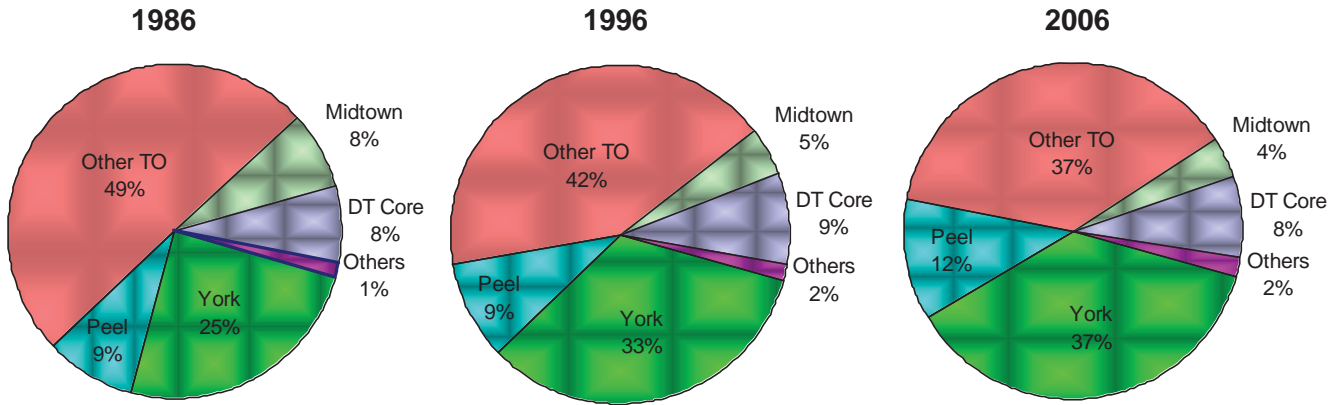
Residential Communities

2.3.3 The following sections examine outbound trip patterns from Vaughan's key residential communities. Between 1986 and 2006, the majority of Vaughan's resident workers travelled beyond the City's boundaries to their places of work (in the AM peak period), primarily to the City of Toronto (see **Figure 11**). During this period, the "other Toronto" areas lost and York Region gained their respective share of Vaughan workers, becoming on par with each other in

³ "A Profile of Canadian Transit Ridership". Halcrow Consulting Inc., in association with Brendon Hemily, Ph.D. for Canadian Urban Transit Association (CUTA) and Transport Canada. September, 2007
Doc No Rev: Date: April 2009

2006. York Region gained 12% of outbound trips from Vaughan (from 25% in 1986 to 37% in 2006) while other Toronto areas lost 12% (from 49% in 1986 to 37% in 2006). The downtown core (south of Dundas St.) held steady with about 8% of Vaughan workers between 1986 and 2006. This consistency in downtown-destined trips points to the impacts of major GO Transit improvements and of downtown parking costs on transit ridership.

Figure 11 – AM Peak Period Work Trips from Vaughan to Key Destinations (Total Trip Distribution)



2.3.4 Although more Vaughan workers are commuting to York Region, Vaughan's transit users are still heavily oriented to the Toronto's Downtown including the Downtown Core, south of Dundas Street, where transit (both TTC and GO) is highly accessible and parking costs are high (see **Figure 12**) and the Mid-town/University of Toronto area north of Dundas, which has excellent TTC subway service and high parking charges. Relative to other destinations, Midtown Toronto and the Downtown Core, despite having a relatively small proportion of total trips, consistently attract the largest proportion of transit users, with consistently high transit modal shares (see **Figure 13**).

2.3.5 The regional municipalities of York and Peel attract significantly less transit users. As shown in **Figures 12 and 13**, transit trip distribution and modal shares for York Region and Peel Region are consistently low between 1986 and 2006. A drop in transit modal shares in York Region and "other Toronto" areas and the downtown core can be observed in 1996, which could reflect the cutbacks in support for public transit during that period. Modal share recovery in 2006 is suggestive of the substantial improvements in transit service levels in York Region and Vaughan with the development of the improved YRT and VIVA services.

Figure 12 – AM Peak Period Work Trips from Vaughan to Key Destinations (Transit Trip Distribution)

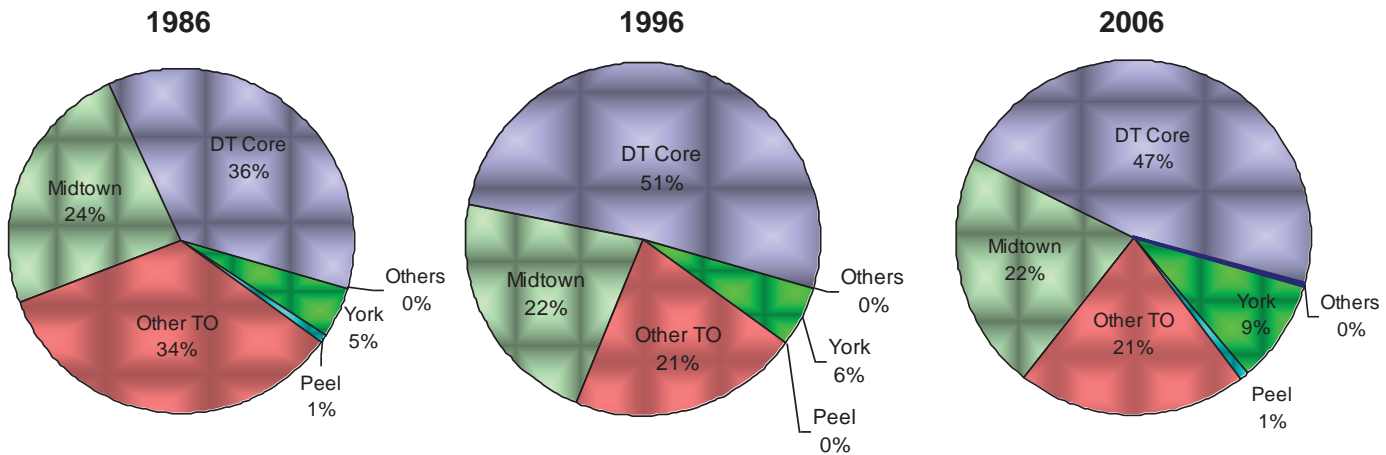
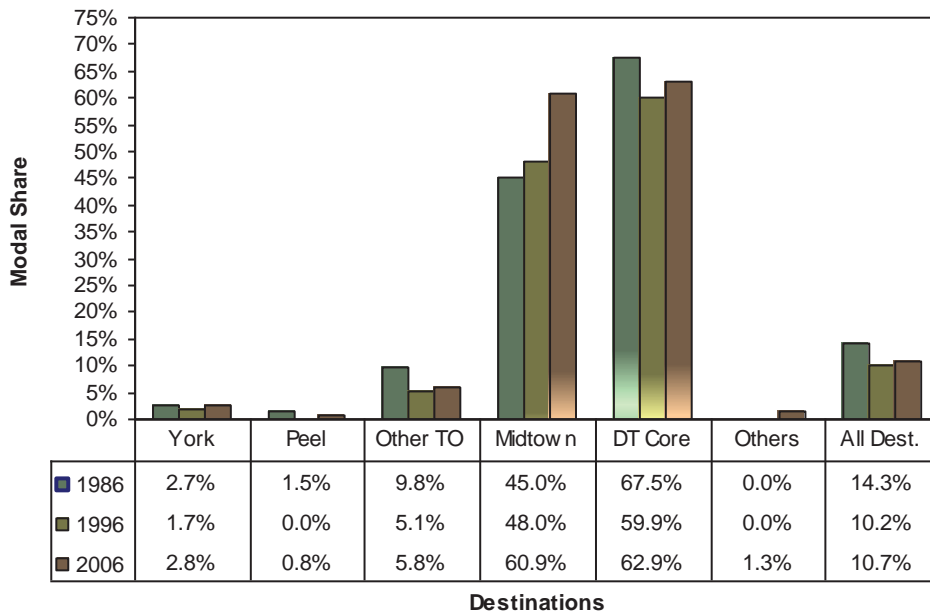


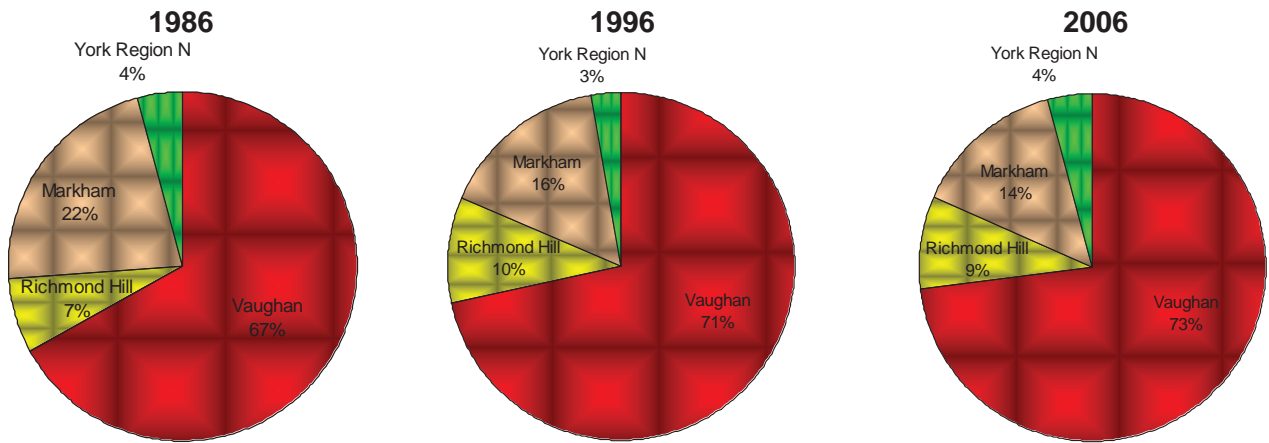
Figure 13 – AM Peak Period Work Trips from Vaughan to Key Destinations (Modal Share)



2.3.6 Vaughan-based workers trips destined to York Region were examined in greater detail. **Figure 14** shows that between 1986 and 2006, the vast majority of trips contained within York Region were destined for Vaughan, followed by Markham and Richmond Hill. However, transit modal share has consistently been low in Vaughan, at 2.2% in 1986, 1.5% in 1996, and 2.8% in 2006.

2.3.7 In 2006, more workers are living in Vaughan (see **Table 2**) and more of these workers are commuting to Vaughan for work (see **Figure 14**), compared with 1986 or 1996. But the low transit modal share in the City means that the increased level of self containment in Vaughan is mostly serviced by the automobile instead of transit.

Figure 14 – AM Peak Period Work Trips to York Region (Total Trip Distribution)



2.3.8 Between 1986 and 2006, local transit (TTC/YRT) serviced the majority of Vaughan transit users destined for the Downtown Core area, that portion of the Downtown that is south of Dundas Street. However, GO ridership has increased rapidly, from 8% of all transit trips in 1986 to 40% of all transit trips in 2006. **Figure 15** illustrates the absolute increase in the number of transit trips from Vaughan into the Downtown Core and **Figure 16** illustrates the relative growth. Note that in both these figures local transit refers to TTC/YRT service and GO transit includes trips conducted exclusively with GO rail or involving feeder service.

Figure 15 – AM Peak Period Work Trips from Vaughan to Downtown Core (Local vs. GO Transit)

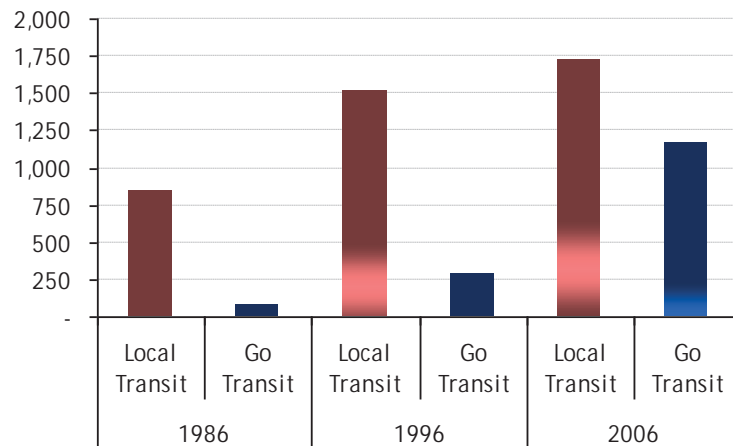
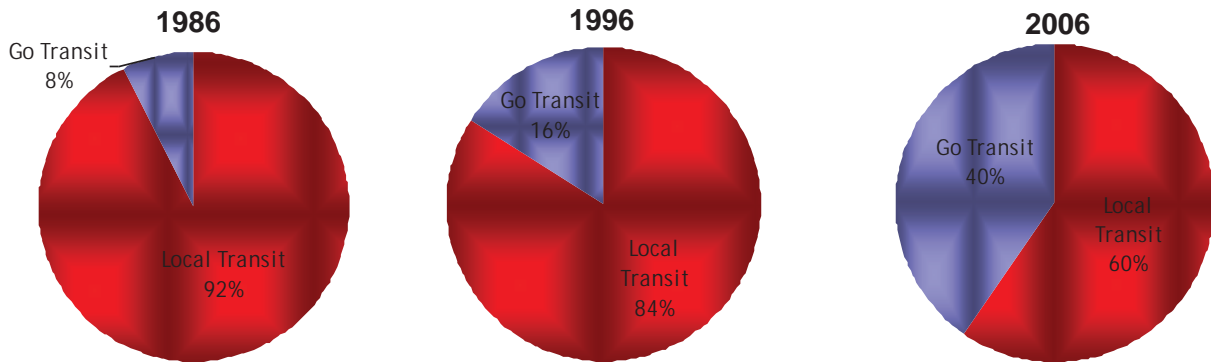


Figure 16 – AM Peak Period Work Trips from Vaughan to Downtown Core (Local vs. GO Transit)



2.3.9 This dramatic increase can be largely attributed to the expansion of GO Transit service in Vaughan. As a result, the residential communities closest to the Maple Station and new Rutherford station (i.e. Carrville, Maple) have experienced the highest rates of outbound GO ridership growth between 1996 and 2006 (see Table 5). While local transit use has continued to increase, the total increase in transit use for trips from Vaughan to the Downtown Core is explained by the growth of GO Rail ridership from less than 100 in 1986 to almost 1,200 by 2006.

Table 5 – AM Peak Work Trips from Vaughan to Downtown Core (By Residential Community)

ID	From Residential Area	1986 Transit Trips for DT Core			1996 Transit Trips for DT Core			2006 Transit Trips for DT Core		
		Local Transit	Go Transit	Total	Local Transit	Go Transit	Total	Local Transit	Go Transit	Total
1	Woodbridge Expansion	-	-	-	-	-	-	41	124	165
2	Woodbridge Core	111	44	155	149	17	166	60	60	120
3	Woodbridge East	-	-	-	170	36	206	226	289	515
4	Thornhill	714	26	740	1,162	124	1,286	1,322	114	1,436
5	Carrville	-	-	-	-	-	-	23	158	181
6	Maple	24	-	24	38	114	152	60	419	479
Total		849	70	919	1,519	291	1,810	1,732	1,164	2,896
% distribution		92.4%	7.6%	100.0%	83.9%	16.1%	100.0%	59.8%	40.2%	100.0%

Employment Areas

2.3.10 The following sections examine inbound trip patterns to Vaughan’s key employment areas. The pattern for trips travelling inbound to Vaughan’s employment areas is similar to that of the outbound trips, with the “other Toronto” area dominating, followed by York Region and Peel Region (see Figure 17). A similar shift has also taken place between 1986 and 2006, with commuters from the “other Toronto” area (outside the downtown) decreasing by approximately 19%, while York region-based commuters increased by 11%, becoming almost on par with the other Toronto areas’ share of commuters.

2.3.11 Despite this shift in trip patterns between the “other Toronto” area and York Region, transit plays a limited role in serving York Region destinations and most of these transit riders come from Toronto. As shown in Figure 18, the proportion of total transit trips is distributed highly in favour of the “other Toronto” area. While York Region’s share of transit trips has

increased, its transit modal share remains low at about 2% compared to over 10% for trips from Toronto (see Figure 19).

2.3.12 Over the 1986 to 2006 period, the vast majority of workers destined for Vaughan's employment areas travelled by auto (see Figure 19). In 1986, about 10% of work trips to Vaughan employment areas were made by transit, dropping to about 6% in 2006.

Figure 17 – Origins of AM Peak Period Trips to Vaughan (Total Trip Distribution)

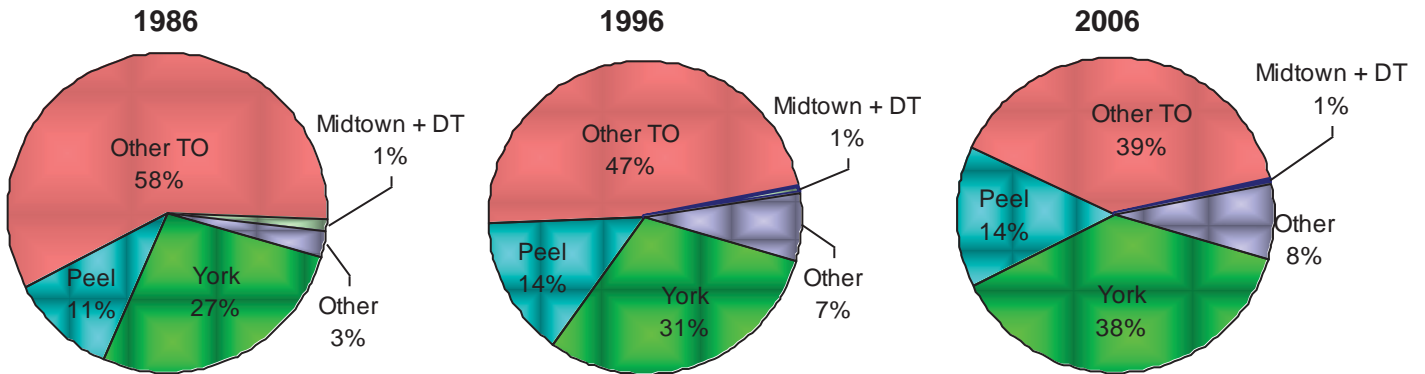


Figure 18 –Origins of AM Peak Trips to Vaughan (Transit Trip Distribution)

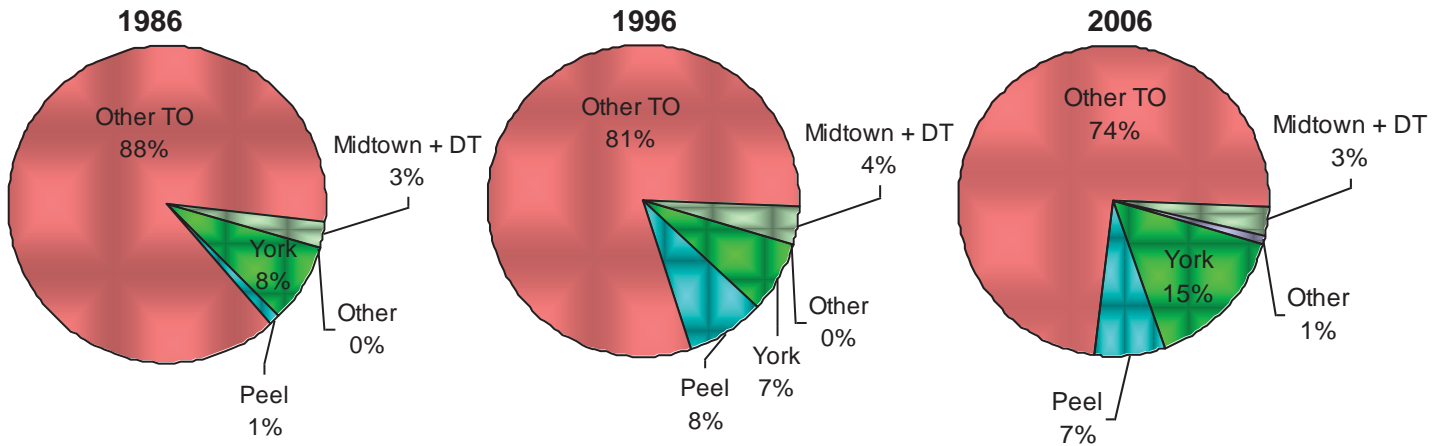
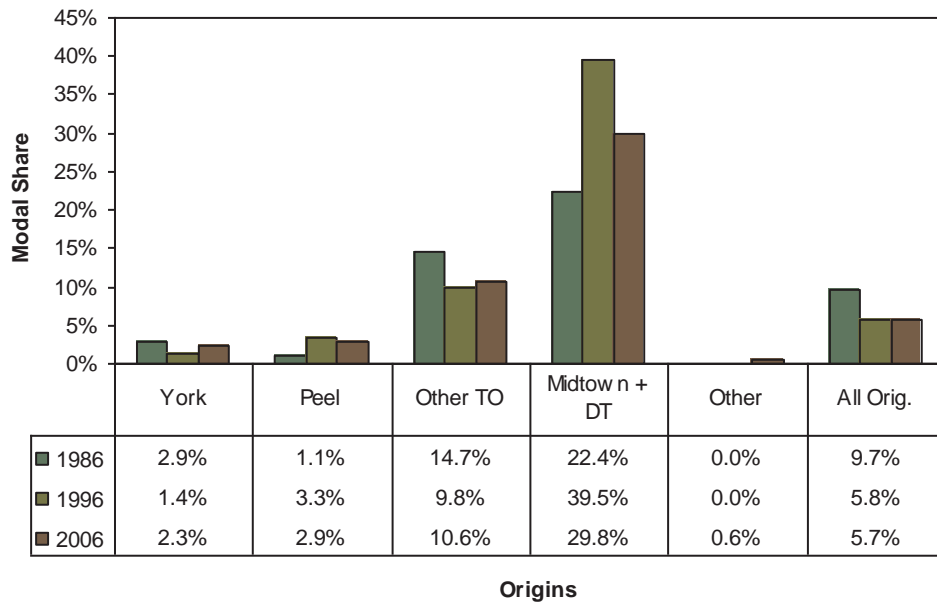


Figure 19 – Modal Share Trends for Vaughan-destined Work Trips by Origin (AM Peak Period)



2.3.13

Figure 20 is a breakdown of work trips that originate from York Region and are destined for Vaughan's employment areas. The majority of employment in Vaughan is increasingly filled by local residents, growing from 33% of all York Region-based trips in 1986 to 57% in 2006. This increase in internalized trips is mostly auto-oriented however, as the transit modal share for trips to the City of Vaughan remains low at less than 4% during the 1986 to 2006 period (see Figure 20).

Figure 20 - AM Peak Period Work Trips to Vaughan from York Region (Total Trip Distribution)

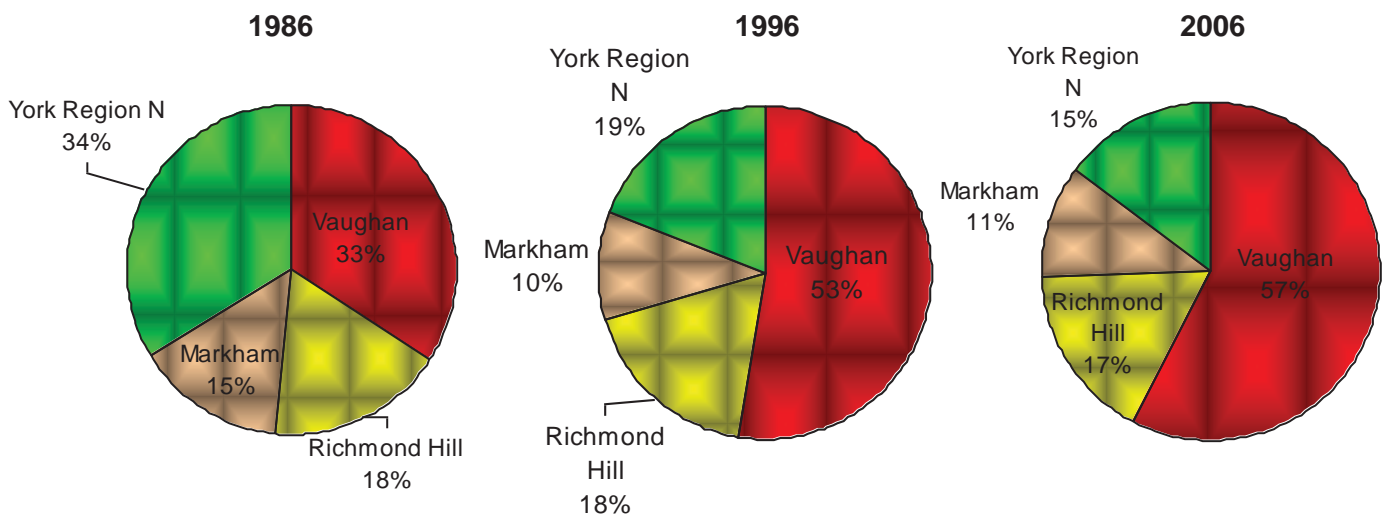
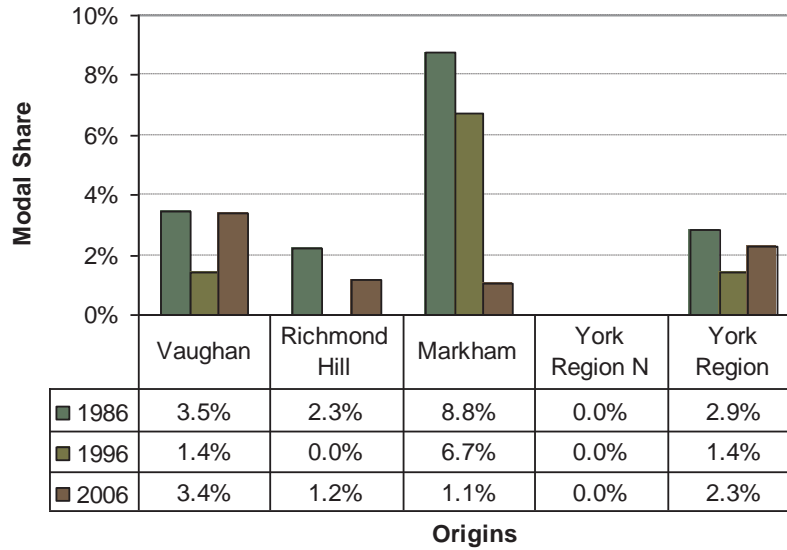


Figure 21 – Modal Share for Vaughan-destined Work Trips to Vaughan from York Region (AM Peak Period)



School Trips

2.3.14 Trips to and from secondary and post-secondary institutions are the second largest market for public transit in the GTHA. Between 1986 and 2006, York Region has consistently attracted the significant majority (slightly more than 70%) of Vaughan-based school trips (see **Figure 22**) due to local high school trip making. The remaining 30% are mostly travelling to post-secondary institutions such as York University, Humber College, Seneca College, etc. in other Toronto areas, rather than to Downtown Toronto (University of Toronto/Ryerson).

2.3.15 This balance is reversed in terms of transit modal share, however, with transit accounting for less than 6% of school trips to York Region in 2006 and for more than 80% of school trips to the Downtown Toronto-based destinations. The contrast in terms of mode share between other Toronto areas and Vaughan and York Region can be seen in **Figure 23**.

Figure 22 – AM Peak Period School Trips from Vaughan to Key Destinations

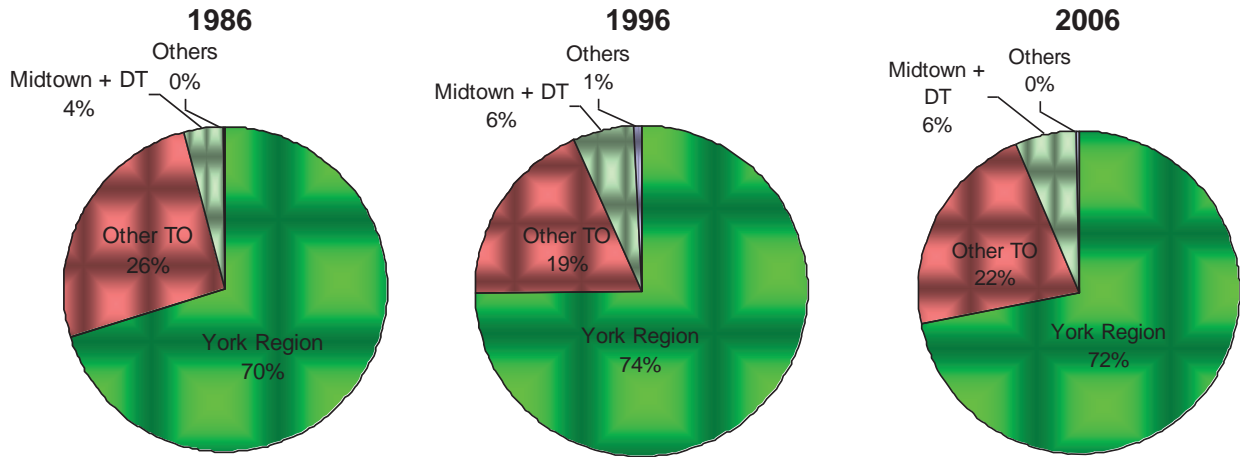
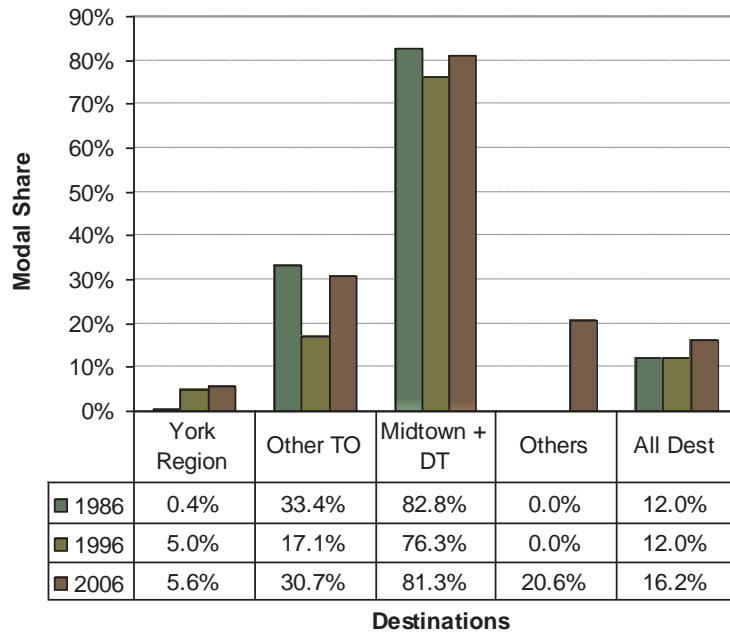


Figure 23 – Modal Share Trends for School Trips from Vaughan to Key Destinations (AM Peak Period)



2.4 General Trends

2.4.1 Between 1986 and 2006, transit played a significant role in moving Vaughan residents to Toronto-based jobs/schools and in moving Toronto residents to Vaughan’s employment areas. The trend for origin and destination trips has been shifting with the “other Toronto” area’s share of trips decreasing and Vaughan’s (as well as York Region’s) share of trips increasing. However, this increased self-containment has not translated into significant increases in transit travel to or from Vaughan. Overall, the share of total work trips to

Vaughan by transit declined from approximately 10% in 1986 to 6% in 1996 and 2006 (see **Figure 19** of **Section 2.3**). During this period, transit's role in serving Vaughan-based origin/destination trips has remained small compared to trips to Toronto jobs and from Toronto residential areas.

2.4.2 Transit's current role, and its failure to capture an increased share of local travel despite substantial improvements in local transit services since 1996, reflects the high auto availability of local residents (compared to Toronto residents) and poor competitive position of transit in Vaughan's suburban environment. Whereas 26% of Toronto households do not own a private vehicle, fewer than 4% of Vaughan households are carless and most of Vaughan's potential transit riders have a license to drive and access to a car⁴.

2.4.3 Toronto residents have access to an extensive and integrated network of buses, subways and streetcars that link homes to jobs and schools in locations where transit is competitive with the auto in terms of convenience and cost (e.g. parking). In contrast, Vaughan residents and workers have to walk further to access less frequent and extensive bus services. In addition, most residents have access to a car and to free parking at work, therefore, transit has not been able to compete effectively against the automobile.

⁴ 2006 TTS tabulations.
Doc No Rev: Date: April 2009

3 Transit's Potential Future Role in Vaughan

3.1 Introduction

- 3.1.1 Given the preceding analysis of transit use trends, this chapter assesses transit's potential role in serving the future travel needs of Vaughan residents, employees and others, based on benchmarking of experience in the North York City Centre (NYCC) and York University that may serve as models for future transit-oriented development in Vaughan.

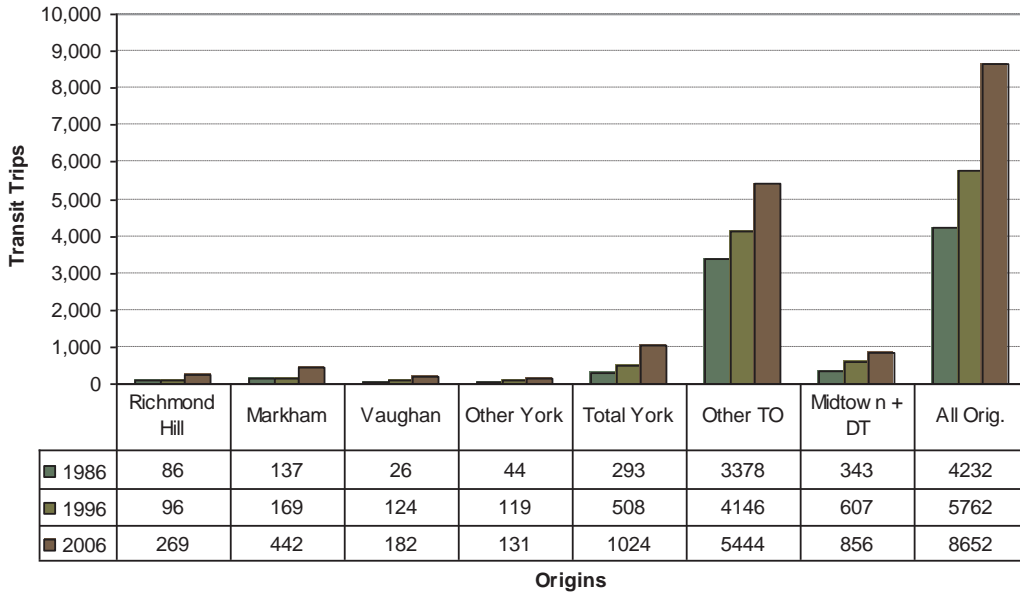
3.2 North York City Centre

- 3.2.1 In the context of the Metrolinx Regional Transportation Plan, multi-modal, mixed use activity centres will become increasingly important in the next 15 to 25 year. These centres, dubbed "mobility hubs", are to incorporate key land use and transportation elements, i.e. density, employment concentration, strategic parking structure, accessibility, etc.⁵ The NYCC is an early example of a mobility hub, with well-integrated transit (RT and bus), limited parking supply, high density, and a mix of uses. The NYCC demonstrates what can be achieved in transforming an auto-oriented suburban location of single family homes and small businesses into a major, transit-oriented mixed use centre.
- 3.2.2 Similar to the NYCC, the VCC has been dubbed as a future mobility hub candidate and growth centre, with a series of RT initiatives planned for the next 15 to 25 years, e.g. Spadina subway extension to the VCC via York University, Highway 7 and Highway 407 BRT, Jane Street RT. These major investments can be expected to significantly impact the land use composition and transit ridership levels in the long term. With planned land use and supportive policies, the VCC has immense potential as a focal point of growth and as a key destination and origin point in the GTHA.
- 3.2.3 Prior to the extension of the Yonge subway north of Eglinton station, the area was a typical suburb, with low density, single uses, large parking lots, low concentration of employment and population, etc. Over the past twenty years, the NYCC has emerged as a major work and transit destination within the GTHA, attracting an increasing number of auto and transit trips from York Region. As shown in **Figure 24** below, the number of AM peak transit trips coming from York Region and City of Toronto into the NYCC has grown consistently between 1986 and 2006. York Region-based transit trips grew by almost four times between 1986 and 2006 to 1,024 trips while Toronto-based transit trips doubled to 6,300. A breakdown of the modal shares in **Figure 25** display a similar trend, with York Region's

⁵ "Mobility Hubs" Green Paper #2. Metrolinx. February, 2008.
Doc No Rev: Date: April 2009

transit modal share to NYCC increasing from 13% in 1986 to 17% in 2006 and “other Toronto” based modal share saw a slightly higher increase from 31% to 41%.

Figure 24 – Transit Work Trips from Key Origins to NYCC (AM Peak Period)

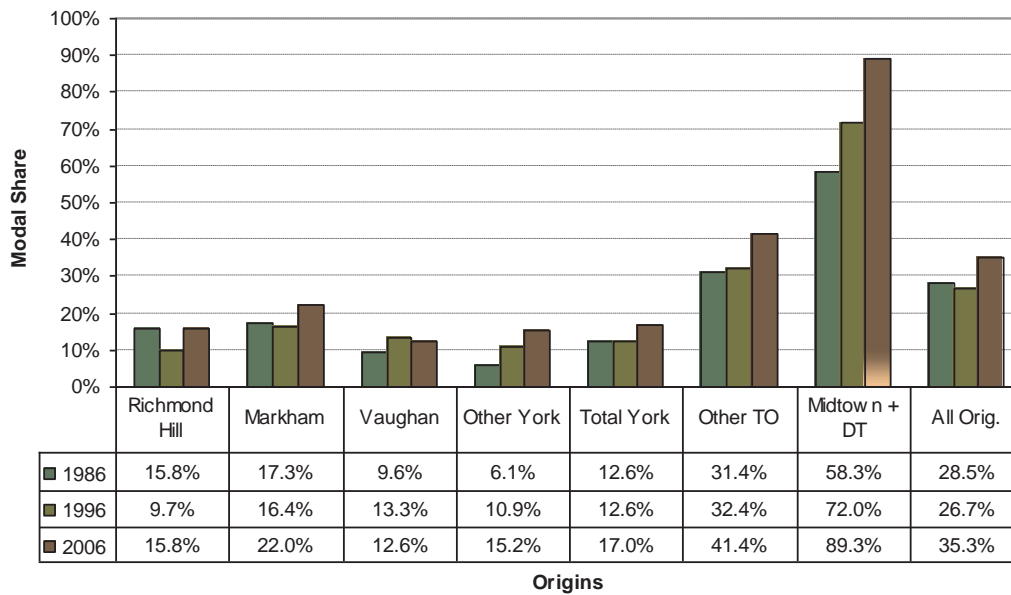


3.2.4

Considering NYCC as a destination, the overall transit modal share for trips has grown from 29% in 1986 to 35% by 2031. The modal shares for trips to NYCC from Downtown Toronto (Downtown Core and Mid-Town) jumped from 58% to 89%, whereas the Vaughan-based transit modal share to NYCC increased from 9.6% in 1986 to 12.6% in 2006. Although the City of Vaughan has become an increasingly important employment destination, its transit modal share for inbound trips is low, having decreased from 10% in 1986 to 6% in 2006 (as shown in **Figure 19** of **Section 2.3**). Based on the NYCC experience, the development of the VCC into a “mobility hub” (a more transit oriented destination) can be expected to increase its transit potential from a destination modal share of about 4 % (observed in 2006⁶) to the modal share as high as 29% to 35% as observed for the NYCC.

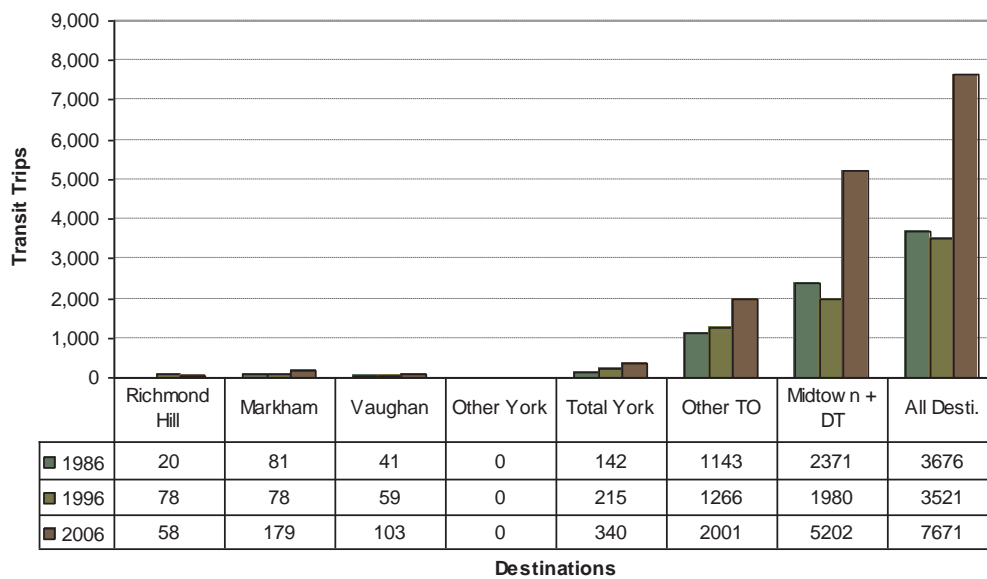
⁶ Based on 2006 TTS tabulation
Doc No Rev: Date: April 2009

Figure 25 – Modal Share of Work Trips from Key Origins to NYCC (AM Peak Period)



3.2.5 The outbound trip pattern during the AM peak period is shown in **Figure 26**. NYCC-based transit users are most likely to work in the midtown and downtown core of Toronto and in “other Toronto” area. In addition, many NYCC residents walk to local jobs.

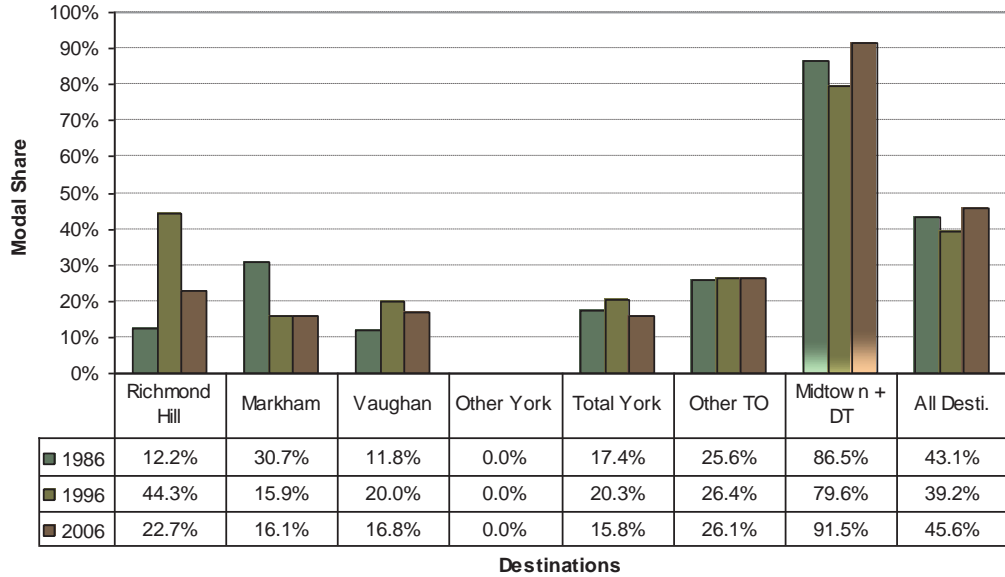
Figure 26 – Transit Work Trips from NYCC to Key Destinations (AM Peak Period)



3.2.6 Between 1986 and 2006, the modal shares for trips from NYCC to York Region are notably higher than the modal share for trips from Vaughan to York Region (see **Figure 27** below and **Figure 13** of **Section 2.3**). For instance, trips from NYCC to York Region had a modal share of 16% in 2006 versus 3% for trips from Vaughan to York Region. This illustrates the

higher transit ridership by NYCC area residents compared to other suburban populations for travel to dispersed suburban destinations in York Region. NYCC residents are more likely to use transit because a high proportion of area households live without a car or with only one car. Similarly, future residents of the VCC can be expected to own fewer cars and, therefore, be more likely to use transit for trips to both Toronto and Vaughan/York Region destinations.

Figure 27 - Modal Share of Work Trips from NYCC to Key Destinations (AM Peak Period)



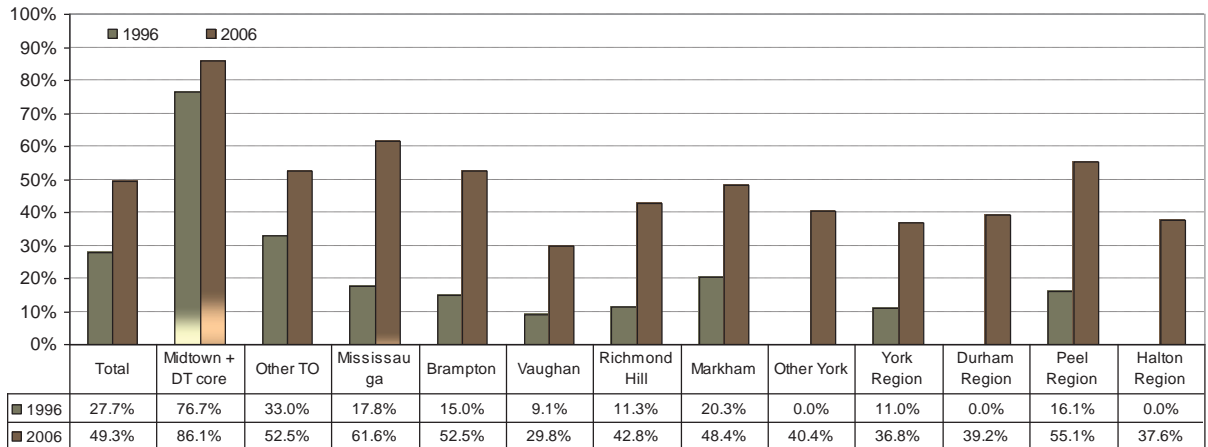
3.2.7

The combination of factors such as density, urban form, land use mix, and transit availability and accessibility contributed to the success of NYCC as a major transit node with a high transit modal share for inbound and outbound trips. Limited parking availability and parking pricing also played a role in reducing auto trips into the NYCC, especially for Toronto-based commuters that have direct transit access to the Yonge subway line. However, this is not the case for Vaughan residents (with the exception of those in Thornhill), who currently do not have direct transit access to Finch and North York Centre subway stations. Car ownership is also an important factor. Whereas 26% of Toronto households do not have access to a personal use vehicle, in the area of North York within 2 km of the Yonge Subway, 19% of households do not have a car, compared to 4% in Vaughan. The average number of cars/household for Toronto in 2006 was 1.07 and the average for the NYCC is 1.16, compared to 1.88 for Vaughan. Even the section of the Yonge corridor within Thornhill (Steeles to Highway 407), which has benefited from improved transit services on Yonge Street since 1986, saw zero car households increase from 5% of all households to 9% in 2006 and the average cars/household ratio declined from 1.72 to 1.60 by 2006. The NYCC provides a useful model of the impacts of transit oriented redevelopment on auto ownership and transit modal share.

3.3 *York University*

- 3.3.1 Universities are unique trip generators in the magnitude of daily and peak trips and the transit ridership they attract. The case of York University serves to illustrate the key factors in improving/maintaining transit modal share, in a suburban yet transit-oriented development node. Today, York University features a limited and expensive parking supply and a high level of transit accessibility (TTC, GO, YRT, and VIVA) that enables transit to compete with the automobile. Continued improvements in suburban transit services from York Region and the Greater Toronto Area (including the GO Highway 407 “BRT” services) greatly improved regional transit access over the 1996-2006 period. As shown in **Figure 28**, AM peak trips to York University have an overall transit modal share of 50% in 2006, compared to 28% in 1996. Toronto downtown core and midtown have the highest modal shares. This is to be expected given the accessibility and convenience of existing TTC transit servicing York University and the modal choice of most university students. The largest changes in transit market shares for AM peak travel to York occurred in various suburban travel markets, including Mississauga, Brampton, Vaughan and Richmond Hill.
- 3.3.2 Transit ridership from the City of Mississauga exhibited remarkable growth from 1996 to 2006, with the modal share more than tripling to 62% in 2006 (compared to 18% in 1996). Similar proportional increases were also observed from travel to York from Brampton and Vaughan and an even larger increase in transit’s market share was observed for Richmond Hill, although all these origins achieved a lower transit market share than Mississauga. All of these markets benefited from new BRT services during this period – the VIVA buses serve Vaughan and Richmond Hill while the GO 407 Express buses serve Mississauga and Brampton.
- 3.3.3 While recognizing the unique characteristics of universities as trip generators, the interaction between the City of Mississauga and York University demonstrates the potential impact of a major transit-oriented centre served by enhanced transit services (not necessarily rail rapid transit) on transit ridership in the City of Vaughan. The viability of a suburban university as a major transit destination also illustrates the importance of strategic parking supply and pricing to mode choice within planned transit destinations/growth centres in Vaughan.

Figure 28 – Modal Share of Trips to York University (AM Peak Period)



3.3.4 Overcoming auto-dependency and low transit ridership in suburban locations requires a multi-faceted approach, involving land use and transit planning, parking strategy, urban design elements, etc. As demonstrated by the experience of NYCC and York University, transit can play a significant role in Vaughan’s future. Whereas York Region and Vaughan employment areas have transit modal shares of 2% to 3% (based on 2006 TTS data), a jobs within the VCC might be expected to generate transit modal share of 12% to 17% or more, based on the NYCC experience. Given its geographic proximity to the City of Toronto, the VCC is well-situated to capture inter-regional transit trips.

4 Realizing Transit's Potential in Vaughan

4.1 *Overview*

- 4.1.1 High auto ownership and dependency along with low transit ridership are not uncommon in North American suburbs and the suburban municipalities around Toronto are no exception. Transit's potential, even in communities with high levels of transit service, such as the original Toronto suburbs of Etobicoke, North York, and Scarborough, is limited by land use factors at major travel destinations outside the downtown, and by socio-demographic realities such as high car ownership. Conversely, an appropriate set of policies aimed at altering land use and car ownership can positively influence transit, even in a typical suburban setting like the City of Vaughan, as evidenced by the North York City Centre and York University examples.
- 4.1.2 The availability and accessibility of inter-regional and local transit service in Vaughan can influence future land use patterns and car ownership trends. The extension of the TTC subway to the VCC area and the continued development of the VIVA BRT service in the Highway 7 corridor (including bus-only lanes offering true "rapid transit" performance) will create Transit Oriented Development (TOD) opportunities along the Highway 7 corridor and particularly in the VCC for both non-residential and residential uses. The provision of GO BRT service along Highway 407 from Highway 427 to Markham Road (Markham) will help to provide regional access to the VCC and support the development of this location as a major destination. Improvements to the Barrie GO Transit line peak service (and new off peak service) will support future modal shifts to transit for both inbound and outbound commuters while offering improved regional access to Vaughan.
- 4.1.3 Improving both transit service connectivity and accessibility must be a long term priority for the City of Vaughan. Once the Vaughan TMP is completed, the City is encouraged to identify and address outstanding issues related to connectivity and accessibility working with the Region and YRT/VIVA. At a citywide level, the City should work with the Region and YRT in improving the transit feeder system within Vaughan to provide better connections between existing/new subdivisions, the rapid transit lines and a limited number of major transit destinations (starting with Vaughan Metropolitan Centre). At a more local level, the identification and implementation of a midblock collector road system, including the crossing of major highways or arterials to support transit and create a more complete transportation network for pedestrians, cyclists and transit users should also be explored in conjunction with the Region.

4.2 *The City's Role and Potential Strategies*

4.2.1 This chapter discusses the best ways for the City to support increased transit use, recognizing recent trends in transit markets shares for the relevant Vaughan travel markets and the transit modal split targets for various markets (and major destinations within Vaughan). Over the next twenty years, population and employment will continue to grow in the City of Vaughan (as shown in **Table 6**). While transit is now a Regional responsibility, the City should be playing an increasingly important role in determining whether or not residents and employees will have convenient access to planned rapid transit and bus services in carrying out its planning and urban design responsibilities.

Table 6 – Population and Employment Forecasts for 2016 and 2031

Yr	Existing	Forecast		Abs. Diff		CAGR	
	2006	2016*	2031**	06-'16	16-'31	06-'16	16-'31
Pop.	248,800	281,000	418,800	32,200	137,800	1.2%	2.7%
Employ.	162,200	188,000	275,900	25,800	87,900	1.5%	2.6%

* "York Region population and employment forecast". Planning Services, York Region.

** "Population and employment forecast". Economic & Technology Development Department. City of Vaughan

4.2.2 In order to increase transit's role in Vaughan, it will be necessary to create strategic urban nodes or "mobility hubs" (i.e. major destinations like the Vaughan Metropolitan Centre where transit can be competitive), as well as medium to high density residential communities that are accessible to high quality transit services. Achieving this transformation will require continued transit infrastructure investments, in combination with more transit oriented development supported by coordination of land use, urban design, and transportation/transit planning policies, as well as TDM measures (including parking pricing near major transit oriented destinations).

4.2.3 Transit oriented residential developments in the Highway 7 Corridor/VCC areas can be expected to attract more zero car households and also to have lower overall car ownership. The 1986 and 2006 TTS data for NYCC and for locations in the Yonge Corridor within Thornhill and Richmond Hill (to Elgin Mills) shows declining auto ownership over time in these areas and an increase in zero car households. In the case of Planning District 11, which includes NYCC, an area accessible to the TTC subway, the percentage of zero car households went from 13% in 1986 to 19% by 2006 and average cars/household went from 1.40 to 1.16. To the extent that Vaughan attracts more households with zero or only one car, transit can be expected to play an even bigger role for those trips that are destined to jobs within transit oriented areas in York Region and suburban Toronto (like NYCC and York University).

4.2.4 The walking distance to transit stations is an important factor since most transit trips begin or end with a walk trip. Where improved transit services are accessible within convenient walking distances to residents, local jobs and other opportunities, people no longer require a car to live and the numbers of local residents who do not drive will increase, as will average auto ownership. Persons who do not drive tend to locate themselves closer to good transit

service (e.g. Alshalalfah and Shalaby – June 2007 show that 66% of transit users in Toronto who did not have a car available lived within 300m of their usual transit route whereas those with one and two or more cars available tended to live farther from transit service)⁷. It will be important for the City to maximize the share of residents and workers who will be located within a convenient walk of transit (generally within 400m). Furthermore, it is important that residential, retail, and employment areas as well as local streets be designed to make walking and cycling more convenient and competitive by providing direct walking routes and pedestrian/cyclist amenities. It is recommended that the following policy should be included in the City's Official Plan

- a) "Sidewalks should be provided on both sides of collector roads and at least on one side on local roads in new subdivisions to provide accessibility to transit and to facilitate walking and cycling."

4.3 *Vaughan Metropolitan Centre*

4.3.1 As a result of the planned Spadina subway line extension, the Vaughan Metropolitan Centre (VMC) has been designated as an important urban growth centre/mobility hub by the Metrolinx Regional Transportation Plan. Formerly known as the Vaughan Corporate Centre, the VMC has been designated by the City as a future downtown development, a major urban centre in York Region and a key gateway in the Province of Ontario. Improved opportunities to live and work in neighbourhoods near the Vaughan Metropolitan Centre and other future transit hubs, and zoning by-laws supportive of mixed use and pedestrian/cyclist-friendly developments can further reduce dependence on the auto and have substantial impacts on the vitality of Vaughan's urbanized areas.

4.4 *Parking Policy and other Travel Demand Management (TDM) Measures*

4.4.1 Downtown Toronto, North York City Centre, and York University all demonstrate the importance of parking policy/pricing and urban design in influencing mode choice. Parking pricing is the most important single example of travel demand management (TDM) that can influence mode choice. This is an example of types of travel disincentives that make transit the preferred modal choice to travel to downtown Toronto.

4.4.2 Other measures have yielded positive results elsewhere in the York Region and cities of similar size throughout Canada. The City can facilitate improved transportation choices by using travel incentives and disincentives as well as educational/promotional campaigns to further reduce auto-dependence. Given the prevalence of auto-oriented workplaces in the City, car and van-pooling programs can reduce peak hour vehicles by increasing vehicle occupancies, thus accommodating the same number of person trips in fewer vehicles. Workplace-based measures such as preferential carpool parking, flexible working hours,

⁷ Alshalalfah, B. and Shalaby, A. "Case Study: Relationship of Walk Access Distance to Transit with Service, Travel, and Personal Characteristics". *Journal of Urban Planning and Development*, Vol. 133, No. 2, June 2007, pp. 114-118
Doc No Rev: Date: April 2009

subsidized transit passes, and dedicated lunch hour shuttle can also be effective in reducing auto use.

- 4.4.3 On a broader scale, commute assistance service centres also bring tangible benefits to individuals choosing to reduce their auto-dependence. For instance, city-wide trip-planning and ride matching programs, guaranteed ride home programs and up-to-date traveller information services can all be a part of a “smart commute” package offered by the City.
- 4.4.4 School-based programs such as discounted transit passes, the creation and maintenance of safe and walkable routes to schools can also encourage students to adopt more active/transit-oriented options. When children live within walking/bicycling distance to their schools, walking school buses can be implemented whereby one or more adults supervise students as they walk to school. Recognition and awards can be used to encourage continued TDM leadership and success by employers, institutions, or interest groups.
- 4.4.5 In achieving transit’s potential role in Vaughan, the City can combine land use/zoning and transportation policies to create transit-oriented destinations, as well as to intensify land use at key nodes and along central corridors. For instance, the new Vaughan TMP or OP should include a new policy which encourages/requires site development to provide for pedestrian/cycling links as well as the various TDM measures discussed. The VMC is a prime example of an area where the transit-oriented development coupled with existing and planned transit infrastructure and enhanced bus services can create a cost effective transit node in the City. Specifically, transit, pedestrian/cycling policies, as well as transit-oriented urban design should be used to support transit and other TDM measures in the VMC. Currently the VMC is envisioned as a downtown that will accommodate significant population and employment growth and will also function as a commercial/transport gateway in the provincial context⁸. Opportunities exist for other major centres to replicate and/or complement the VMC. The completion of the TMP will help to identify these locations as well as the types of policies (land use/zoning) that the City should develop to be consistent with the phasing of development, infrastructure, and transit network plans. Through transportation/transit planning, these destinations should be made accessible to commuters (especially during the AM peak) via transit service (BRT/Subway or Commuter rail). Equally important, the City should focus on providing access to commuters’ ultimate destinations, i.e. a short, secure walkable route or a convenient bus ride from the main transit station. This means that consideration must be given to density, size, and urban design aspects of planned or existing developments and that most development in the VMC should be within 400 m of the subway and the rest should be within 400 m of the various feeder services including BRT on Highway 7. Parking must be limited and priced to support local business (encourage visitors/shoppers) and not long-term parkers so as to provide a strong disincentive for car use for commuting. Residential developments should be oriented towards transit so that a much higher proportion of local residents are able to live within 400m of rapid transit (BRT/subway) or local bus routes offering direct connections to rapid transit or the VMC. The creation of these residential opportunities will attract more residents who live without a car or have fewer cars. In addition to this set of strategies and policies, the City should implement TDM measures to further reduce ownership and encourage a modal shift to transit.

⁸ “The Vaughan Metropolitan Centre” City of Vaughan. 2009. Available Online
<http://www.city.vaughan.on.ca/images/stories/business/pdf/VaughanMetropolitanCentre_web.pdf>
Doc No Rev: Date: April 2009



D4. Safety and Traffic Calming

City of Vaughan

Vaughan Transportation Master Plan Task 8: Vaughan's Safety and Traffic Calming – Discussion Paper

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1. Overview

The City of Vaughan is currently developing its New Official Plan (OP), and as part of this process it is required to undertake a Transportation Master Plan (TMP) Study to support the policies and principles of the New OP. The TMP will provide the City with not only the long term strategic direction and vision required, but also supply the overall implementation strategy, staging plans, and actions necessary to begin the immediate shift to a more livable City less dependent on the automobile.

The objectives of this paper are to conduct a review of Vaughan's current road safety and traffic calming policies and provide recommendation on programs that could be adopted as the City moves forward with its New Official Plan.

2. Road Safety

The life cycle of a roadway consists of a number of stages as shown in Figure 1.

There is a need to consider safety early and often throughout the roadway life cycle. Interventions to improve safety are possible at any stage in the road system life cycle. However; an early assessment of safety implications offers the greatest opportunity for potential safety improvement. This discussion paper will focus on the safety considerations of the following three stages of the roadway lifecycle:

- Planning;
- Design; and
- Operations.



Figure 1. Road System Lifecycle

2.1 Safety Consideration in Planning

Traditional road safety management programs have been very effective in identifying and treating hazardous locations. However, this reactive approach is expensive and requires a significant collision data history before any action can be taken. Such programs are, of course, too late for those involved in the collisions that generated the data. Several research studies have argued that the reactive safety management program is perhaps not the best method to address road safety effectively. There is a need for a more proactive analytical approach in order to prevent such unsafe situations from arising in the first place.

To address this problem, the “safety planning” process is introduced to complement the traditional or reactive methods. Safety planning is a proactive approach that incorporates road safety at the planning stage. The purpose is to prevent occurrence of unsafe situations, such as traffic collisions, in the first place. The safety planning strategy addresses a range of activities, including:

- programming safety improvements to address roadway “hotspots” or collision-prone locations;
- introducing multi-disciplinary programs (i.e. integrating engineering, enforcement and educational activities);

- reflecting road safety considerations as a key decision-making parameter in evaluating projects and programming expenditures; and
- establishing inherently safe transportation networks or safety conscious planning (SCP).

Road safety should be explicitly considered in the planning process, but that is usually not the case. Traditionally, road safety practitioners have had a reactive approach to dealing with safety problems on their road network as opposed to considering it at the planning stages. A fatal collision at a location or a series of collisions in a particular area may come to the attention of the transportation engineer, who will diagnose the problem and seek to correct it through the application of countermeasures and improvements.

The downfall of this approach is the fact that it is reactive. It only addresses a safety concern after collisions have happened. The approach is particularly problematic with respect to new infrastructure. By definition, those locations have no collision history to examine and, therefore, it is not possible to evaluate their impact using traditional reactive approaches. A proactive approach, one that considers the potential safety impact of a new infrastructure will result in the future, is the necessary approach for their evaluation.

Evaluation of safety in a proactive manner has gained significant attention in recent years. Enhancements in the methodologies used to evaluate collision statistics have improved the ability to use that information in a predictive rather than reactive manner.

One way to address to consider road safety in the early stages of planning is to incorporate a process for assessing the road safety impacts of a proposed development within the developmental process. A Safety Impact Study (SIS), as described in the following section, could complement traffic impact analyses by identifying and examining opportunities to mitigate the undesirable safety impacts, considering both the site itself and the adjacent public road network.

2.1.1 Safety Impact Study

In the evaluation of proposed developments, municipalities regularly call for the provision of a Traffic Impact Study (TIS) in order to assist in obtaining sufficient information to make a decision. The purpose of a Traffic Impact Study is to assess the potential effects of traffic caused by a proposed development. A TIS identifies improvements that may be required to the roadway network in order to ensure that the roadway system will operate at an acceptable level of service upon completion of the proposed development.

Safety is an important part of any transportation system. The performance of a roadway with respect to safety is as important as the operational performance. Agencies are also moving from addressing safety in a reactive mode, taking actions at locations where collisions have occurred, to a proactive one, evaluating roadways for their potential to operate safely and, ideally, making modifications to prevent collisions before they occur.

Where new developments are proposed the undertaking of a Safety Impact Study (SIS) is a new approach that can provide the required information to a road authority to allow them to assess proposed developments from a safety perspective. While examining safety of proposed developments is, of course, not new, it is usually done in an ad hoc manner, where road authorities have carried out safety reviews to help address these issues. These studies have typically been carried out when it was found that TIS reports submitted failed to provide an evaluation of the potential safety implications of proposed developments. While individual reports were adequate in addressing specific locations, guidelines to provide standardization to the approach undertaken in conducting safety impact studies are not widely available. Only a few jurisdictions have developed SIS guidelines, such as the Halton and Niagara Regions.

2.1.1.1 Private Development and Safety

While proactive approaches to road safety have been widely discussed, reported on and embraced by road safety practitioners as being a superior approach to the older reactive methods, until now little has been done to apply proactive methods to evaluating safety with regard to proposed developments.

Traditionally, when development is being considered at a particular location, the municipality requests that a traffic impact study be carried out, if the development meets a particular specific set of criteria. Guidelines for carrying out a traffic impact study are often provided ensuring that the report provides definitive answers as to how the proposed development is going to impact capacity on the neighbouring road network and/or parking.

As with traffic impact studies, there is a need for guidelines for safety impact studies so that proposed developments can be evaluated on a common basis. Safety Impact Studies are a new approach to examining the impact of proposed developments, and guidelines for their completion are not very common.

The development of guidelines for the preparation of a Safety Impact Study will assist the City of Vaughan to call for their preparation in conjunction with development submissions and ensure that sufficient information of acceptable quality will be provided to allow for an evaluation of the safety impacts on proposed developments.

2.1.1.2 Safety Impact Study requirements

Scope and Function of a Safety Impact Study

Safety Impact Studies (SIS) are intended to be applicable both on site and off site. The scope would include all modes of transportation including cycling, transit (including buses and other high occupancy vehicles) and pedestrians.

The following are some of the things that need to be considered when developing SIS guidelines:

On-site Considerations

- Pedestrian - Often time's large developments create large parking areas but do not consider pedestrians that must travel from the storefront or office building to the parked car. The major collisions types most often associated with pedestrian involvement are:
 - Pedestrians darting out mid-block in front of a vehicle.
 - Running from one side of the intersection to the other.
 - A vehicle turning from one street onto another.
 - Pedestrian crossing a multi-lane street.
 - Vehicles backing up.
 - In parking lots where pedestrians supposedly have the right-of-way but many motorists do not yield for pedestrians.
- Transit - Transit agencies do not typically like routing buses on site. However, consideration should be given to safe walking to and from a transit stop relative to the bus coming on site and reducing the walking risk. Transit operations should be evaluated if service is intended to come on site, even if it is a possibility for future consideration.
- Cycling - In a similar fashion, cycling should be considered on site as well. Considerations should include the potential cyclist paths, conflict points with other transport modes, location of parking facilities, illumination, etc
- Vehicles - When reviewing vehicular movements it is important to review all aspects of operations including internal circulation, queuing on site and potential spill into the adjacent streets, turning movements, loading areas, pick up and drop off activities, emergency access, etc.

Off-Site Considerations

- Continuous pedestrian and cyclist links between adjacent street and on site development.
- Specific treatments at conflicting points between different road users.
- Impact of expected traffic mix (e.g. proposed residential development adjacent to important heavy vehicle traffic generator, proposed elementary school on arterial roadway, etc.)
- Degree of illumination, lane addition, signage and marking, appropriate intersection control devices, etc.

Decision Criteria for Carrying Out a Safety Impact Study

Making the decision as to which developments are required to undertake a safety impact study and the personnel required to undertake the study is the first step of the process.

Qualifications to Conduct a Safety Impact Study

It is the proponent's responsibility to retain a qualified traffic safety consultant experienced in traffic safety and traffic engineering.

Study Area

If one is being carried out, the study area used for a Traffic Impact Study will define the limits of the Safety Impact Study. If a Traffic Impact Study is not being completed, the Safety Impact Study should extend to areas directly influenced by the proposed development.

2.1.1.3 Safety Analysis Methods

In general, the safety impacts of a development can be estimated in two different ways. The first one is a quantitative approach using statistical estimates based on collision data where available. Such an assessment may be carried out if collision and volume data exist within the study area. The proposed process also allows for the prediction of collision performance for the development using collision modification factors. Comparison of the pre-existing collision history to the predicted collision performance upon completion of the development can then be undertaken. Based on this, a change in collision experience because of the development can be predicted.

A qualitative approach may also be taken. This approach identifies issues and problems, which may adversely affect the safety of road users, and estimates the road travel risk level associated with them. The identification of the issues and problems are based on the driver, vehicle, road/infrastructure, environment and temporal characteristics of the study area. A scoring system using a series of checklists would be developed to assess the safety of the development in a more qualitative approach.

2.1.1.4 Reporting and Format of SIS

A Safety Impact Study should be referenced in a report format. The report should include, but not be limited, to the following:

- Description of the proposed development.
- Need and justification for a Safety Impact Study.
- Reference to all background material, data and the Traffic Impact Study relating to this study.
- Reference to appropriate plans indicating dimensions and standards.
- Documentation of all site visits and findings.

- Completed safety impact study checklists.
- Summary comments relating to all elements reviewed.
- Analysis of areas of concern with identified mitigating actions.
- Supporting material and justification to the analysis.

These steps give the City of Vaughan an overview of what would be required if SIS guidelines were to be developed and incorporated into the City's development application process.

2.1.2 Multi-Disciplinary Programs

York Region has a good example of a multi-disciplinary approach to road safety. The Region, through its Traffic Safety Strategy Committee (TSSC), developed the "Save-a-Life"¹ program which brings together three key components, namely engineering, enforcement, and education. The objective of the program is to improve public safety on the roadways. This program requires involvement from the following three departments:

- Region of York Transportation and Works Department – responsible for the technical analysis;
- York Regional Police Traffic Bureau – conducts strict, fair, and highly visible enforcement on the sections of regional roadways identified by the Transportation and Works Department;
- Region of York's Health Department - provides educational messages on information bulletin that are disseminated during Media Blitzes, during the issuing of an offence notice or warning, and during the R.I.D.E. Program.

It would be valuable to the City of Vaughan to implement a similar program to the Region's for its City roads.

2.2 Safety Considerations in Design

All roads open to traffic pose some degree of risk to their users. Road safety is therefore a relative measure and design choices may result in comparatively safer or less safe performance. There is number of safety evaluation methods, techniques and tools that can be used in transportation planning and design projects, some of these are even available as off-the-shelf software packages, such as the Interactive *Highway Safety Design Module* (IHSDM)², while others are under development and are expected to be available soon, such as *SafetyAnalyst*³ and the *Highway Safety Manual*⁴.

2.2.1 Safety Performance of Proposed Transportation Infrastructure

The City of Vaughan should consider implementing a procedure that would take into account road safety during the planning and preliminary design stages of a transportation facility. A framework has been established by Tonkonojenkov et al.⁵, where available quantitative and qualitative safety evaluation techniques can be incorporated in transportation corridor planning and preliminary design projects.

1. <http://www.york.ca/Services/Roads/SaveALife.htm>

2. Federal Highway Administration (FHWA), *Interactive Highway Safety Design Model (IHSDM) Manual*, <http://www.tfhr.gov/safety/ihsdm/ihsdm.htm>

3. Federal Highway Administration (FHWA), *SafetyAnalyst*, <http://www.safetyanalyst.org>

4. Transportation Research Board, *Highway Safety Manual*, <http://www.wsdot.wa.gov/partners/hsm/public/Home/Home.html>

5. Tonkonojenkov, O., Hadayeghi, A., Malone, B., *Incorporating Safety Considerations in Transportation Corridor Planning and Preliminary Design*, August 2007. (To be published in the ITE Journal in August 2009)

The framework for incorporating road safety at the planning stages of a transportation corridor planning is outlined below:

- General collision analysis;
- Identification of collision-prone locations;
- Field visit;
- Providing high-level recommendations for road safety improvements;
- Documenting road safety analysis;
- Qualitative road safety evaluation of the generated detailed planning alternatives;
- Providing recommendations to improve alternatives and generate new ones;
- Documenting road safety evaluation of the generated detailed planning alternatives;
- Conducting road safety audit of the preferred detailed planning design alternative(s); and
- Preparing road safety audit report.

The framework for incorporating road safety at the preliminary design stages of a transportation corridor planning project is outlined below:

- Safety evaluation of design exceptions;
- Quantitative road safety evaluation of preliminary design alternatives;
- Documenting road safety evaluation of preliminary design alternatives;
- Advanced road safety analysis of the selected (preferred) preliminary design alternative and development of safety improvements;
- Preparing report "Road Safety Analysis and Improvement of the Selected Alternative";
- Conducting road safety audit of the preferred planning design alternative(s); and
- Preparing road safety audit report.

This framework could be used by project owners as a template that could be readily incorporated in Requests for Proposals for corridor planning and preliminary design projects.

2.2.2 Road Safety Audits

A road safety audit (RSA) is a formal safety performance examination of an existing or future road or intersection by an independent audit team.

Conducting a RSA in the early stages of a project, such as the preliminary design stage, can result in less implementation costs than when conducted at a later stage, such as the detailed design or construction stages.

The US Federal Highway Administration (FHWA) has developed road safety guidelines⁶ that presents basic road safety audit principles based on experiences gained in the US and other Countries. The guidelines are meant to encourage public agencies to implement road safety audits as part of their everyday practice. The guidelines are divided into three sections. The first section includes general information on RSA, information on how to implement a RSA program, and an overview of the RSA process. The second section contains detailed steps on how to conduct a RSA and types of audits including preliminary design, detailed design, construction, pre-opening, and road safety audits of existing roads. The last section consist of a tool which includes a number of "prompt lists" with the purpose of helping the RSA team identify safety issues and to ensure that important issues are not overlooked.

6. McGill, J., Malone, B., Tonkonojenkov, O, Sugget J.; Wemple, B., Freeman J. *Road Safety Audit Guidelines*. FHWA-SA -06-06, February 2005.

The City of Vaughan is growing rapidly and so is its road network with new road being constructed as part of new developments and road widenings as a result of the City's growth. It is important for the City to implement a road safety audit process that would be considered in the early stages of each project, so that safety issues can be identified and mitigated earlier in the process thereby reducing implementation costs later in the process, such as during detailed design or construction.

2.3 Safety Consideration in Operations

Safety considerations in the operations stage of a roadway cycle usually consists isolating the underlying causes of safety problems, and matching them with solutions which are innovative, effective, sustainable and practical.

2.3.1 Road Safety Management Programs

In general, road safety management programs are used to improve the understanding of the state of practice in road safety and consequently, improve the safety performance of the road component of a transportation network.

A safety management program for a transportation agency, in general, is comprised of four interrelated processes:

- **Black Spot Identification:** the main goal is to identify road locations that have poor safety performance and need safety investigation. The underlying assumption is that road design attributes often play a significant contributory role in collision occurrences. There are many methods to identify black spots in a transportation network.
- **Diagnosing Safety Problems:** this process examines the causes of safety problems at an identified black spot location.
- **Countermeasure Selection and Economic Appraisal:** this task involves selection of treatments deemed necessary for potential safety improvement of a black spot following diagnosis.
- **Monitoring:** this step involves monitoring implemented improvements to assess the safety effectiveness.

The identification of sites that require investigation for safety treatments is the first step taken by a transportation agency in its safety management program. However, identifying and conducting detailed engineering studies of candidate improvement sites is very expensive and time consuming. Also, the process of identifying road locations that have the greatest potential for safety improvements at the network level is often impossible since results in one road group are not directly comparable to the others. There is a need to provide a quantitative traffic safety approach to identifying problem locations, assessing the merits of potential solutions and ranking candidate projects.

As indicated above, to ensure that resources are spent on the locations with the highest potential for safety improvements, it is vital that a sound procedure be used to screen the road network in order to properly identify and rank black spots for diagnosis and treatment. A black spot or a location with promise is defined as any location that exhibits a collision potential that is significantly high when compared with some normal collision potential derived from a group of similar locations. Many road agencies describe the collision potential of a location using a measure of collision frequency, which is defined as the number of collisions occurring at a location during a specific time period. Typically between one and three years is used to minimize the effects of random fluctuations but still remain sensitive to changes over time.

Therefore, it is important for the City of Vaughan to develop a proactive, formalized and quantitative safety program for its entire road network in order to identify locations with the highest potential for safety improvements.

The four stages that form part of a road safety management program are described in the following sections.

2.3.1.1 Network Screening Program – “Black Spot” Identification

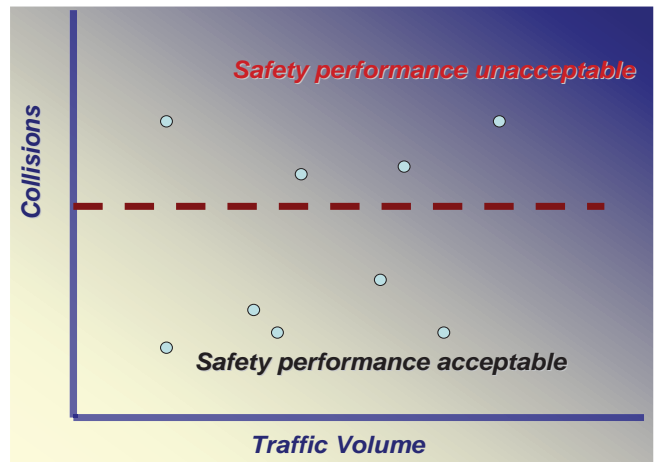
The objective of a network screening program is to identify and prioritize locations (road segments and intersections) that have the greatest potential for reduction in the severity or number of collisions. Therefore, “sites with promise” are identified based on their potential for safety improvement (PSI).

In general, most jurisdictions use conventional collision frequency or rates, described below, to identify locations with potential for safety improvements. However, research has shown that these methods are not suitable for identifying sites with promise because of the potential bias due to the phenomenon of regression to the mean. Because of regression to the mean, locations with a randomly high collision count can be incorrectly identified as being potential problem locations. Moreover, selection based on collision rate tends to wrongly identify sites with low volumes because of the nonlinear relationship that exists between traffic volume and collisions.

The advantages and disadvantages of using collision frequency and collision rates to assess the safety of a location are described below.

Collision Frequency Method

Collision frequency method examines the number of collisions at a site over a specified time. Locations can be compared to average collision frequencies. Generally, roadway segments and intersections are analyzed separately. Ideally, the most recent three to five years of crash data are used.



Advantages The method is simple to use, examining only collision counts.

Disadvantages A high collision frequency may be due to random occurrence or high levels of exposure. This common problem, failing to account for the regression-to-the-mean bias, is most prevalent when using short-term collision data. Examining data over a longer period can smooth out random fluctuations, but while examining a longer history can be beneficial, it is important to consider changes that may make past collision counts obsolete. This method does not take into account exposure to risk (traffic volume). It also does not account for differentials in collision severity, nor does it account for differentials between types of locations (e.g., intersections vs. roadway sections).

Collision Rate Method

This method is a measure of the relative rates of collision occurrence. The collision rate method simply divides the collision frequency by a measure of exposure, typically volume. For roadway sections, collision rate is typically computed as collisions per million vehicle-kms and for intersections as collisions per million vehicles entering. For roadway sections, the collision rate is computed as:

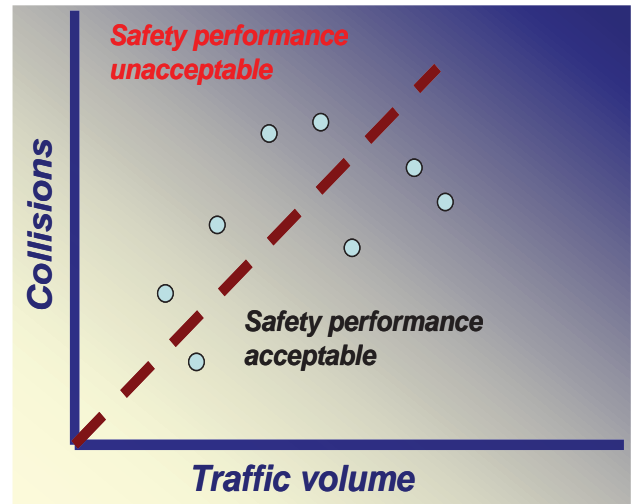
$$R = \frac{1,000,000 * A}{365 * N * V * L}$$

Where: R - is the collision rate (in collisions per million vehicle kilometres)
A- is the number of collisions
N - is the number of years of data

V - is the exposure-to-risk (traffic volume, e.g., AADT is commonly used)
L - is the length of the roadway section (kilometres)

- Advantages Using rates allows better comparison between different sites, since it takes into account variances in exposure.

- Disadvantages Since a collision rate depends on exposure, a site's deviation from average collision rate may simply indicate deviation from average traffic flow. Collision rates tend to focus on locations with low exposure. At low volume locations, where the number of collisions can also be expected to be low, significant historical data (five years or more) is needed to estimate collision rates with any degree of reliability. This method also does not account for the regression-to-the-mean bias. It also does not account for differentials in severity, nor does it account for differentials between types of locations (e.g., intersections vs. roadway sections).



To overcome the shortcomings of these two methods, the Empirical Bayes (EB) method can be applied for ranking “sites with promise”. The EB method was used in *The Science of Highway Safety* (1997)⁷ and is also part of *Highway Safety Manual* (HSM), which the interim document is expected to be released in the summer of 2009. The Highway Safety Manual is a document that will provide transportation professionals with information and tools to facilitate roadway design and operational decisions based on explicit consideration on their safety consequences.

The basic premise of the EB method is to rank sites by one or more measures based on a consideration of each site's collision history, traffic volume, and roadway characteristics. The PSI of a location in this method is the difference between its long-term safety performance and its expected safety performance. The advantage and disadvantages of this method are described below.

Empirical Bayes Methods

The Empirical Bayes (EB) methods estimate the expected collision frequency for a given location by combining observed and estimated collision counts. Expected counts are computed as a weighted function of the observed counts for the specific location and the estimated mean count for similar locations. The weighting smoothes out the randomness of collision occurrence. The equation for estimating the number of collisions that are expected to occur at a location is:

$$E(k|K) = w \cdot E(k) + (1-w) \cdot K$$

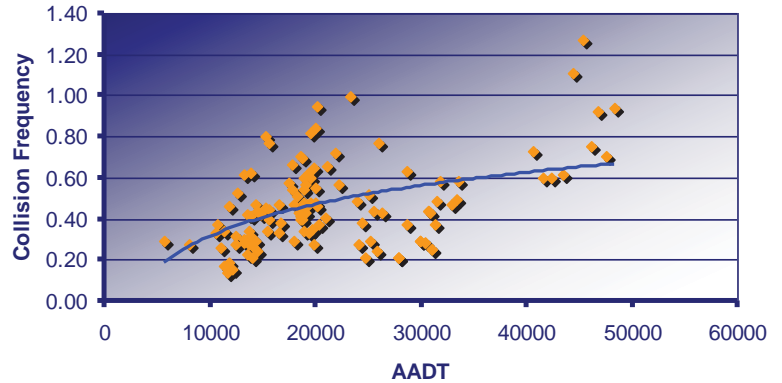
- Where: E(k) is the estimated mean collision count for locations with similar traits and characteristics
- K is the observed collision count for the location
- E(k|K) is the expected annual number of collisions over the 'long-term' for the location, a quantitative value between E(k) and K

7. *The Science of Highway Safety* (1997), Ontario Ministry of Transportation.

W is a weighting factor between 0 and 1
 k is a constant

Advantages

The EB methods are the most robust, statistically, in estimating expected collisions. They eliminate the potential regression-to-the-mean bias when estimating the expected 'long-term' collision counts for locations. The methodology permits the estimation of expected incident occurrences into the future.



Disadvantages

The methods are relatively complex. They are labour intensive and 'data hungry'. Determination of the estimated mean collision count for locations with similar traits and characteristics requires that Safety Performance Functions (SPFs) be developed. While some jurisdictions have developed SPFs, they are not readily available for all road authorities. Finally, EB methods do not compare the safety levels of different types of locations (e.g., off-ramps vs. intersections) on an equitable basis.

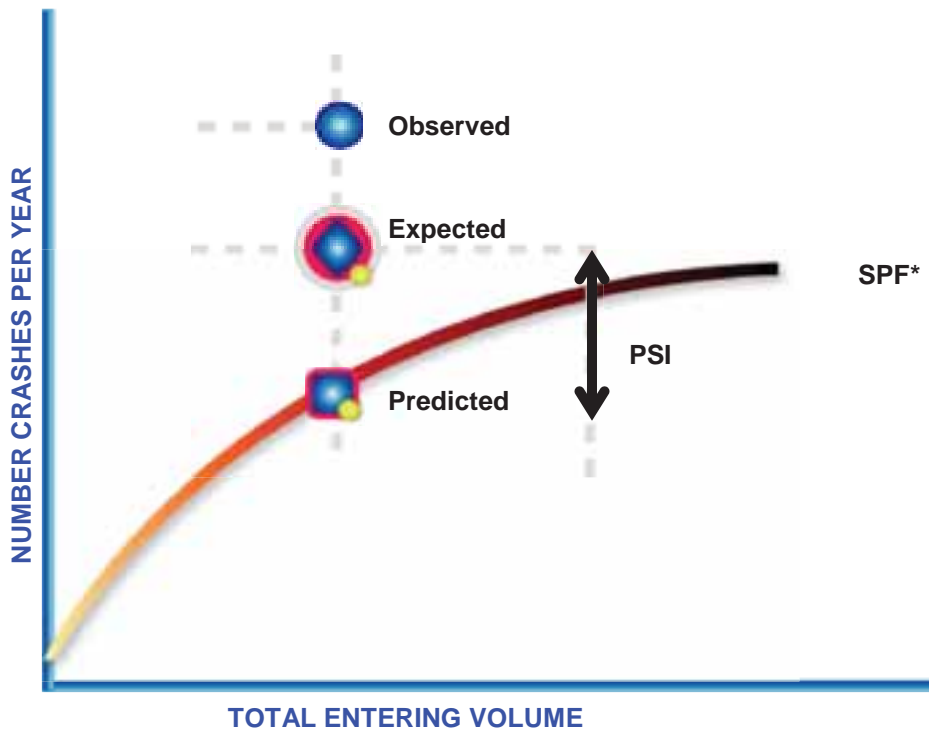
Screening Methodology

In order to screen the locations for potential for safety improvement, first it is necessary to develop Safety Performance Functions (SPFs) for road segments and intersections. SPFs are functions used to explore the relationship between the number of collisions and traffic flow and other road characteristics. The quantity and quality of the data used to calibrate accident prediction models or SPFs is very important to the success of these models. SPFs calibrated with limited data will not perform adequately in terms of predictive accuracy. Data identified in the previous section are needed to develop the SPFs.

Once the SPFs have been developed, they are used to calculate the number of **predicted** collisions per year at each location (i.e. road segment and intersection). The next step is to use the Empirical Bayes (EB) procedure to estimate the **expected** number of collisions, using the **predicted** number of collisions and the historical collision data for each of the City's road segments and intersections. The EB approach was originally formulated by Hauer⁸ and applied by Persaud et al.⁹, and Harwood et al.¹⁰. The difference between the **predicted** and the **expected** number of collisions is defined as the potential for safety improvement (PSI) index. This relationship is illustrated in Figure 2.

8. Hauer, E., (1997) *Observational Before-After Studies in Road Safety*. Pergamon Press, Elsevier Science Ltd., Oxford, England.
 9. Persaud, B. N., Retting, R. A., Garder, P. E., and Lord, D., *Safety Effects of Roundabout Conversion in the United States*. Transportation Research Record: Journal of Transportation Research Board, No. 1751, TRB, National Research Council, Washington, D.C., 2002, pp. 1-8
 10. Harwood, D. W., Bauer, K. W., Potts, I. B., Torbic, D. J., Richard, K. R., Kohlman Rabbani, E. R., Hauer, E., and Elefteriadou, I., *Safety Effectiveness of Intersection Left- and Right-Turn Lanes*. FHWA-RD-02-089. U.S. Department of Transportation, Washington, D.C., July 2002.

Figure 2. Relationship between Predicted and Expected Number of Collisions



* Safety Performance Function

Process for Identification of Problem Locations

The next step involves comparing the annual number of **predicted** collisions, as determined by intersection type and characteristic, to the statistically **expected** collision frequency at a given location, derived in conjunction with predicted and historical collision data. The total difference between predicted and expected collisions represents the potential for safety improvement (PSI) for a given year. A positive PSI value signifies that intersection safety is performing worse than estimated, which indicate an opportunity for safety improvement. The opposite is true when a negative PSI value is found, demonstrating that safety at the location is better than anticipated.

The locations should be ranked from the highest to the lowest PSI value, meaning the highest will have the greater potential for safety improvements.

2.3.1.2 Diagnosing Safety Problems

The second step in a road safety management program is to examine the causes of safety problems at an identified black spot location. To complete this task, a systematic methodology, known as “in-service road safety review”, should be conducted to ensure thoroughness and accuracy of analysis. The Transportation Association of Canada’s “Canadian Guide to In-Service Road Safety Reviews” should be followed for conducting this analysis.

To conduct them, the following two complementary tasks have to be performed:

- At least three years of historical collision data have to be collected and analyzed to identify over-represented clusters of particular collision types.

- Location-specific data, both physical and operational, are gathered and analyzed, accompanied by some consultation with local road agencies, enquiries on site traits, and observations of driver characteristics.

2.3.1.3 Countermeasure Selection and Economic Appraisal

The third step in a road safety management program is the selection of appropriate countermeasures for the problem location and the cost estimate associated with each countermeasure.

Once detailed analysis for the selected problem locations has been conducted and safety improvements have been identified, the proposed countermeasures or improvements should be quantified as to their cost and (societal) benefits, and integrated with other infrastructure improvements to be funded through capital and operating expenditures. In the course of this selection process, more than one countermeasure with the potential to remedy the problem is often identified. A subsequent economic appraisal will evaluate all options for all black spots in optimizing an improvement program for a given budget. A widely used economic evaluation method is the cost-benefit analysis.

The City of Vaughan should ensure that safety-driven improvements compete for funding on an equal basis with mobility and state-of-good repair initiatives. Similar to other jurisdictions, funding for implementing these countermeasures is usually limited; therefore, it is essential that funds are allocated to where it is needed most.

The funds allocated to road safety in the City's budget should focus on the safety improvements recommended through the road safety management program, where locations with the most potential for safety improvements should be selected. Through the in-service safety review, a more detailed analysis, as described in section 2.3.1.2, should be conducted for locations identified through the network screening process as having the highest potential for safety improvement (PSI).

The City's capital budget could be driven by the result of the detailed analysis. For example, top locations identified in the analysis can be allocated for safety improvements in the following year's capital budget.

2.3.1.4 Monitoring

The last step in a road safety management program involves monitoring implemented improvements to assess the safety effectiveness. For example, a before and after collision analysis could be conducted to evaluate the safety effectiveness of the implemented countermeasure.

2.3.2 Positive Guidance

There are instances when Municipalities will get complaints from residents about collisions that occurred in a specific location but there are no records of them, they are usually called "phantom crashes". These accidents may occur due to the lack of information of the roadway design and operation.

One way to handle this issue is through positive guidance. The principle of positive guidance is that motorists should be given enough information about roadway design and operation in advance in order to safely avoid a hazard. Positive guidance can be given through a combination of signs, object markers, and the view of the road ahead.¹¹

11. Russel, E.R. *Using Concepts of Driver Expectancy, Positive Guidance and Consistency for Improved Operation and Safety*. Transportation Conference Proceeding, 1998.

The Ontario Traffic Manual (OTM) Book 1 Appendix C¹² contains a toolkit that provides a procedure on how to provide positive guidance. The procedure consists of two phases, the first phase consists of project planning and data collection and the second consists of data analysis.

In Phase 1 of the procedure, data is collected, an office review, a site survey and an operation review area conducted. The procedure for data collection, office review and site survey is detailed in the OTM Book 1C.

In Phase 2 of the procedure, explained in detail in the OTM Book 1C, the following eight steps are conducted:

1. Identifying Hazards;
2. Determining Land Use and Hazardous Avoidance Manoeuvres;
3. Specifying Information Handling Zones;
4. Rating Hazard Visibility;
5. Determining Expectancy Violations;
6. Analyzing Information Loads;
7. Identifying Information Needs; and
8. Evaluating the Current Information System.

3. Data Requirements and Management

The following sections will assess the City's ability to achieve and implement safety management capabilities.

Sample data from the following sources were provided by the City of Vaughan and reviewed for this discussion paper.

- OnTRAC collision summary;
- TraxPro Automatic Traffic Recorder (ATR) Counts; and
- 2008 Traffic Study Inventory Listing (MS Excel file).

3.1 Assessment of Current Traffic Safety Policies

Currently that City of Vaughan does not contain any specific policy documents pertaining to road safety.

3.2 Assessment of Current Traffic Safety Data Availability

In order to develop a network screening process several pieces of data are required. This section will assess the type and quality of the currently available data.

3.2.1 Collision Data

Collision data for the City of Vaughan is stored in the "OnTRAC" software, a GIS based software that can collect, manage and analyze police-reported collision and traffic volume data. The most recent complete dataset available is for the year 2006. **Figure 3** shows an example of how the collision data is summarized.

¹² Ontario Traffic Manual - Book 1 Appendix C – Positive Guidance Toolkit. Ministry of Transportation, July 2001.

Figure 3. Collision Detail Summary

Collision Detail Summary										
OnTRAC Reporting System										FROM: 2005/01/01 TO: 2008/12/31
CONLEY ST & NEW WESTMINSTER DR 4 Collisions										
Municipality: Vaughan		Traffic Control:		Traffic signal						
COLLISION ID	DATE	ENVIRONMENT	LIGHT	CLASS	DIR	SURFACE CONDITION	VEHICLE MANOEUVRE	VEH TYPE	FIRST EVENT	
1	050013688	2005/01/23	Clear	Daylight	Non-fatal injury	V1 North	Dry	Going ahead	Automobile, station	N/A
						V2 West	Dry	Going ahead	Automobile, station	N/A
2	050177290	2005/09/16	Clear	Dark	Non-fatal injury	V1 North	Dry	Turning left	Automobile, station	N/A
						V2 South	Dry	Going ahead	Automobile, station	N/A
3	060123841	2006/06/05	Clear	Daylight	P D only	V1 North	Dry	Turning left	Automobile, station	N/A
						V2 South	N/A	Changing lanes	Automobile, station	N/A
4	060150985	2006/07/07	Clear	Daylight	P D only	V1 West	Dry	Going ahead	Passenger van	N/A
						V2 South	N/A	Going ahead	Automobile, station	N/A
Total: 4 Collisions										

3.2.2 Traffic Data

Traffic Volume data are available from the following two sources:

- Automatic Traffic Recorder (ATR) Counts, stored in the TRAXPro software, which is used for analyzing data collected with automatic traffic recorders. This data is not geo-coded.
- Turning Movement Counts (TMC) - This information is stored on the City's network year by year and alphabetically. An inventory of the locations available is kept by year.

3.2.3 Geometric Characteristics

The City of Vaughan does not keep road or intersection geometric characteristics data in a database format.

3.3 Data Management Program

In order to implement the different programs discussed in this paper, a comprehensive data management program must exist. The following sections will describe the different sets of data needed to develop a reliable road safety program.

3.3.1 Data Needs and Collection

3.3.1.1 Collision Data

Collision data should be collected from Motor Vehicle Accident (MVA) reports and summarized in a database every year so that any analysis is conducted with the most up to date information available. The database should be geo-coded to facilitate future data analysis. The collision database should contain at the very least the following information:

- severity (fatal, injury, property damage only);
- impact type (Rear-end, angle, side-swipe etc);

- location, time, and date;
- visibility;
- environmental condition (e.g. rain, snow, clear, etc);
- road surface condition (e.g. dry, wet, slush, ice, etc); and
- road alignment (horizontal and vertical) at the place of collision occurrence;

To achieve a reasonable level of statistical significance, a three to five year period is typically ideal for conducting a safety evaluation because of the random fluctuations in the data.

The format in which the City's collision data is currently collected and stored is appropriate for collision analysis purposes. It would be ideal to have more recent data available (2007 or later).

3.3.1.2 *Traffic Volume Data*

The traffic data should be collected in the form of Annual Average Daily Traffic (AADT) for both intersections and road segments. If AADT is not available, turning movement counts (TMC) and ATR can be used to estimate AADTs.

For statistical modelling purposes, the major and minor entering AADT volume is typically required to determine the potential safety improvement value for intersections. However, if entering AADT volume is not available, it is possible to estimate the volume based on the intersections' total AADTs.

The years of AADT data should correspond to the same period used for the collision data. Similarly a three to five year period is ideal for analysis. The AADT volumes should also be geo-coded to facilitate the integration of the different databases for analysis.

3.3.1.3 *Geometric Characteristics*

Geometric characteristics data for all road segments and intersections should be compiled for the City of Vaughan. The geometric characteristics database should preferably be geo-coded and include at the very least the following information:

- Road Segment Geometric Characteristics
 - Length of segment;
 - Road classification type; and
 - Number of lanes.
- Intersection Geometric Characteristics
 - Number of approaches;
 - Control type; and
 - Environment.

Currently the City does not maintain a geometric characteristics database.

3.4 **Data Management Options**

The City of Vaughan should consider using a data management system that can manage collision, traffic volume and road infrastructure data in one system so retrieval and analysis of data can be done more efficiently.

The City currently uses OnTRAC for collision data management. OnTRAC can collect, manage and analyze police-reported collision and traffic volume data. It includes a component that manages traffic volume data including the import of raw count data as well the derivation of count estimates for all links and nodes in a road network. The other component of this software provides the basic framework that provides end-users advanced network screening tools.

The Traffic Engineering Software (TES) is currently used by a number of jurisdictions in Ontario. The TES contains the Collision Management System, the Traffic Count Management System, Traffic Study Module, the Road Network Module, GIS Module and Safety Module. Each module can work as a stand-alone application or they can work together as one integrated system with one corporate ODBC compliant database including SQL and Oracle. The safety module is composed of two core functional areas: network screening and reports. The network screening functional area could be used to generate the potential for safety improvements (PSI) and determine collision class over-representation for all locations within the TES database. The reports functional area is used to perform analysis on the network screening data. Specifically, it can be used to generate reports to compare PSI values of various locations and to review any over representation information for locations.

4. Traffic Calming

Traffic calming is the implementation of physical or physiological changes to reduce traffic speeds and to help change driver's behaviours in order to improve safety and "quality of life" within a neighbourhood. Traffic calming installations are generally appropriate for local residential and minor collector roadways. Traffic calming techniques or strategies can also be applied to major collector and arterial roadways though the application of mainly physiological changes within the road right-of-way (e.g. landscaped boulevards, streetscaping, rural-to-urban gateway treatments, etc.) that do not affect the function of capacity of the roadway, but may change the driver's perception of the local environment. The advantage of traffic calming installations is that they are self enforcing and do not require regular police enforcement.

Traffic calming devices affect a driver's perception of the street, thereby influencing behaviour. Drivers will experience discomfort at inappropriate speeds and potential inconvenience to the point where they will then modify their driving habits and patterns. Traffic calming measures typically include one or several of the following features:

- Changes to a roadway's horizontal and/or vertical alignment;
- Roadway or lane narrowing;
- Changes to roadway surface texture and/or colour;
- Landscaping immediately adjacent to the roadway or within a median;
- Definition/separation of pedestrian/cycling facilities;
- Physical obstructions to prevent traffic movements;
- Streetscaping; and
- Gateway treatments.

Traffic calming measures can be grouped into Level I and Level II measures. Level I measures are those that involve only minor changes to the roadway. They are relatively straightforward to implement, low cost, have moderate effects on lowering traffic speeds, and are generally well received by residents and emergency services.

Level II measures are those that involve significant physical changes to the roadway, require more effort to implement, are high cost, have significant effects on traffic speeds and volumes, and are not always well received by some residents and emergency personnel.

Level I traffic calming measures include:

- Pavement markings;
- Textured pavement and crosswalks;
- Lane narrowing;
- Increased on-street parking; and
- Roadside improvements.

Level II traffic calming measures include:

- Raised crosswalks;
- Speed humps/tables;
- Centre median/pedestrian refuge;
- Curb radius reduction;
- Curb extensions;
- Traffic circle/Roundabout;
- Chicane;
- Road closure;
- Diagonal diverters;
- Breakaway barriers; and
- Bus only crossing / links.

There is a potential for Level III measures which would include electronic enforcement tools such as photo radar and red light cameras. These devices can be implemented in major roadways where other traffic calming measures are not viable.

The objectives of this section are to assess the existing traffic calming policies of the City of Vaughan and provide guidance on what other policies options could be implemented in Vaughan.

4.1 Assessment of Existing Traffic Calming Policies

The following documents were provided by the City of Vaughan and reviewed for this discussion paper.

- Neighbourhood Traffic Committee Policy and Procedure (revised June 2007)
- City of Vaughan Standard Drawings J1 to J-10 (Traffic Calming)

The City of Vaughan has put a procedure in place to conduct/review/develop a Neighbourhood Traffic Calming Plan (the "Plan") to address traffic calming issues, the policy and procedure are documented in the "Neighbourhood Traffic Committee Policy and Procedure" (revised June 2007).

The purpose of the policy is to prepare a Neighbourhood Traffic Calming Plan based on traffic calming, enforcement or regulatory measures to satisfy as much as practical the following objectives:

- Improve safety and convenience for pedestrian and cyclists;
- Reduce number and severity of collisions;
- Reduce the speed and volume of motorized vehicles;
- Reduce the volume of extraneous or non-local traffic;
- Minimize traffic impacts on adjacent local residential streets;
- Reduce motor vehicle emissions; and
- Maintain access for local traffic and emergency vehicles.

The procedure outlines the following six steps needed to develop and implement the Plan:

1. Establishing the Plan – a request for review of traffic calming needs to be made in writing to Councillor's office or the Engineering Services Department.
2. Developing the Plan – the petition will identify neighbourhood traffic concerns and various traffic calming measures in order to develop a Neighbourhood Traffic Calming Plan. The Engineering Services Department conducts supporting traffic studies as required. The Plan should incorporate traffic calming measures in accordance with the City's Warrant for the Use of Traffic Calming Measures, and as specified in the City of Vaughan Standard Drawings J1 to J-10 and the *Canadian Guide to Neighbourhood Traffic Calming* (Transportation Association of Canada, 1998). Variations in the design of these traffic calming measures may be incorporated into the Plan if approved by the Engineering Department. The Plan is submitted to Local Councillor for review and comment.
3. Community Meeting – a community meeting is organized by the Engineering Services Department to obtain public input on the Plan proposal.
4. Approving the Plan – the Plan will be submitted at a Committee of the Whole meeting. The report shall include comments on the feasibility, impacts and estimated costs of the Plan, and the concerns of other agencies. The Plan will need to be circulated to the following agencies:
 - City of Vaughan Fire Department;
 - City of Vaughan Public Works Department;
 - York Regional Police;
 - York Region EMS;
 - York Region Transit;
 - York Region Transportation and Works Department;
 - York District School Board; and
 - York Catholic District School Board.

The Committee of the Whole will make a recommendation to City Council.

5. Dealing with Additional Requests – request for additional traffic calming measures made after the Plan has been approved but before implementation will be reviewed by the Engineering Department which will make a decision on what area will be included in the petition. If major changes are requested, an additional community meeting needs to be held and Council approval is required.
6. Evaluating the Plan – one or two years after the implementation of the Plan, the Engineering Department will report to the Committee of the Whole on the effectiveness of the Plan and if changes may be required.

4.2 Policy Options

Based on the review of the City's current Neighbourhood Traffic Committee Policy and Procedure, and traffic calming literature, the City's policy and procedure are consistent with what is being implemented in other municipalities in Canada as they relates to existing neighbourhoods.

One additional step on the existing procedure would be the prioritization of the implementation of traffic calming measures. For example a ranking system could be developed based on a number of criteria such as speed, volume, collisions history, pedestrian and vulnerable road users (i.e. children, senior citizens, and disabled), coordination with

other road construction projects, and surrounding land uses. In addition, consideration should be given to staff resources and budget constraints.

As the City of Vaughan grows and new neighbourhoods are developed there is a need to take a more pro-active attitude toward traffic calming measures. This could be done in two ways. The first, City staff would review new development applications and identify opportunities to implement passive traffic calming measures within the new development. This option would rely heavily on City staff resources. The second option would be for the developer to be required to submit as part of their traffic impact study a traffic management plan that would take into consideration traffic calming measures.

4.3 Funding and Implementation

The City of Vaughan has limited budget for implementing traffic calming measures. Therefore, it is important to have a ranking system to prioritize the implementation of the approved Neighbourhood Traffic Calming Plans. In addition, effort should be made to coordinate the implementation of these plans with other infrastructure or urban design projects.

Funding for traffic calming measures could be secured through development charges or directly through development application for new neighbourhoods.

5. Recommendations

The following are recommendation as they relate to traffic safety and traffic calming measures that can be undertaken by the City as it continues to grow.

- Safety Considerations in Planning
 - Traffic Impact Studies (TIS) should be supplemented with Safety Impact Studies (SIS) to allow City staff to assess proposed developments from a safety perspective; and
 - A multi-disciplinary program should be developed where engineering, enforcement and educational activities are integrated for form a comprehensive program.
- Safety Considerations in Design
 - A procedure should be implemented that would take into account road safety during the planning and preliminary design stages of a transportation facility; and
 - The City of Vaughan should implement a road safety audit process that would be considered in the early stages of each project, so that safety issues can be identified and mitigated earlier in the process thereby reducing implementation costs later in the process, such as during detailed design or construction.
- Safety Considerations in Operations
 - A road safety management program should be developed so that road segments and intersections with the most potential for safety improvement can be identified and treated; and. A network screening program is very important for a transportation agency because it helps ensure that resources are spent on the locations with the highest potential for safety improvements. The soon to be published Highway Safety Manual (HSM) will be a valuable source of information. The HSM will contain state-of-the-art procedures to carry out such safety programs.
 - Positive Guidance should be taken into consideration when selecting possible countermeasures for problem locations.

- Data Requirements and Management
 - A data management system should be adopted, so that collision, traffic volume, and road characteristics data can be store in a system to facilitate the management, retrieval, and analysis of the data by City staff.
- Traffic Calming
 - A ranking system should be developed to prioritize the implementation of approved Neighbourhood Traffic Calming Plans;
 - Traffic calming measures should be taken into consideration in the review of new development applications; and
 - As per the Regional policy on Traffic Calming on Public Transit Routes, Level II and Level III traffic calming measures should not be implemented on any streets or corridors that have or may have transit service during part or all of the day.