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York Region

October 23, 2009

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NORTH YORK CIVIC CENTRE

Ms. Ulli S. Watkiss
City Clerk
City of Toronto
City Hall, 100 Queen St. W.
1st Floor E.
Toronto, Ontario M5H 2N2

Dear Ms. Watkiss:

Re: 2008 Travel Time Study Results and Future Study Participation

Regional Council, at its meeting held on Thursday, October 22, 2009, adopted the following recommendations of the Transportation Services Committee regarding the report entitled "2008 Travel Time Study Results and Future Study Participation":

1. Regional Council authorize the participation of York Region in future editions of the biennial Ontario Ministry of Transportation Travel Time Study and authorize staff to enter into the appropriate agreements with the Ontario Ministry of Transportation.

2. The Regional Clerk forward copies of this report to the Clerks of the local municipalities, Ontario Ministry of Transportation, Durham Region, Peel Region, and the City of Toronto.

A copy of Clause No. 2, Report No. 2 of the Transportation Services Committee, is enclosed for your information.

Please contact Vi Bui, Transportation Planner, 905-830-4444, ext. 1585 or Loy Cheah, Manager, Infrastructure Planning at ext. 5024, if you have any questions with respect to this matter.

Sincerely,

Denis Kelly
Regional Clerk

B. Bridle
Attachment

Copy to: Kathleen Llewellyn-Thomas, Commissioner of Transportation Services
Bryan Tuckey, Commissioner of Planning and Development Services
Vi Bui, Transportation Planner
Loy Cheah, Manager, Infrastructure Planning

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York Region

Clause No. 2 in Report No. 2 of the Transportation Services Committee was adopted, without amendment, by the Council of The Regional Municipality of York at its meeting on October 22, 2009.

2
2008 TRAVEL TIME STUDY RESULTS AND FUTURE STUDY PARTICIPATION

The Transportation Services Committee recommends:

1. **Receipt of the presentation by Loy Cheah, Manager, Transportation Planning, Planning and Development Services Department; and**

2. **Adoption of the recommendations contained in the following report dated September 24, 2009, from the Commissioner of Transportation Services and the Commissioner of Planning and Development Services.**

1. RECOMMENDATIONS

It is recommended that:

1. Regional Council authorize the participation of York Region in future editions of the biennial Ontario Ministry of Transportation Travel Time Study and authorize staff to enter into the appropriate agreements with the Ontario Ministry of Transportation.

2. The Regional Clerk forward copies of this report to the Clerks of the local municipalities, Ontario Ministry of Transportation, Durham Region, Peel Region, and the City of Toronto.

2. PURPOSE

This report has been prepared to outline and highlight the findings of the 2008 Ontario Ministry of Transportation (MTO) Travel Time Study, a comprehensive survey of travel time, speed, and delay across the Greater Toronto Area (GTA) and surrounding areas, conducted by the Ontario Ministry of Transportation.

This report also seeks Regional Council's authorization of York Region's participation in all future editions of the Travel Time Study and to enter into an agreement with the Ontario Ministry of Transportation as a participating municipality.

3. BACKGROUND

Travel times and speeds are roadway performance measures and are indicators of traffic congestion

The travel time measure has been adopted by many agencies as a useful performance measure on highways and major roadways. MTO has undertaken a biennial travel time survey of major provincial roadways in the GTA since 1996. The results of the studies provide metrics for assessing facility performance and identifying critical road sections to be considered in future road and transit improvement projects, and traffic management strategies.

2008 Travel Time Study was added to the Region's comprehensive transportation monitoring program

At its meeting of March 27, 2008, Regional Council adopted the recommendations of Clause 3 of Report No. 3 of the Planning and Economic Development Committee which authorized York Region's participation in the 2008 Travel Time Survey. In addition to the Travel Time Survey, the Region's comprehensive transportation monitoring program includes the Annual Average Daily Traffic Volumes Program and the Cordon Count Program. These programs monitor traffic volumes and traffic types on specific roads in the Region. However, they do not measure travel speeds and travel times which have become primary indicators for traffic congestion.

It should be noted that this is the first year that York Region participated in the biennial Travel Time Study. As such, historical data is not available for trend analysis. However, York Region's continuing participation will allow for this.

Other GTA municipalities are also participating in MTO's Travel Time Study

In 2008, the travel time survey included 13 major 400-series highways and 92 arterials for a total of approximately 4,270 km covering both directions. The participating municipalities were the City of Toronto, the Regional Municipalities of Peel, Durham, and York.

York Region's arterial analysis was new for the 2008 Travel Time study and included 16 major routes covering approximately 550 kilometres of roads such as Yonge Street, Dufferin Street, Highway 9/Davis Drive and the Rutherford Road/Carrville Road/16th Avenue corridor, among others. The 2008 Travel Time Study covered approximately 340 kilometres of MTO 400-series highways within York Region such as Highway 404, Highway 400, Highway 427, and Highway 407.

4. ANALYSIS AND OPTIONS

Council Attachment 1 summarizes the 2008 Travel Time Study findings for 400-series highways in York Region and Greater Toronto Area, while *Council Attachment 2* summarizes the findings for arterial roads surveyed in York Region.

The study highlights key York Region arterials that are congested during peak periods

Levels of Service which are based on travel speeds are used to measure the performance of arterial roads. Level of Service A indicates that motorists are traveling above or at the posted speed limit with no congestion. Motorists start to experience some congestion at Levels of Service B and C, and significant congestion conditions occur at Levels of Service D and E. Level of Service F is the lowest measurement of efficiency for a road's speed performance. Motorists traveling in this condition would experience extreme congestion with constant slowing and stopping.

For York Region's arterial road analysis, the 2008 Travel Time Study found that:

- 33% of arterial corridors surveyed within York Region are operating at Level of Service D, and 10% operating at Level of Service E during the afternoon peak period. The afternoon peak period was found to be more congested than the morning peak period. This is also consistent with the findings for the other participating jurisdictions.

- The midday peak is nearly as congested as the morning peak period on the surveyed arterial roads.

- *Tables 1 and 2* list the slowest five segments of arterial roads that have travel speeds of about half of the posted speed limit during the morning and afternoon peak periods:

Table 1
Morning Peak Period Slowest Five Segments – Based on Travel Speed

Route	Begins At	Ends At	Speed Limit (km/h)	Surveyed Speed (km/h)
Yonge St SB	Gamble Rd	Steeles Ave	50 to 60	31
Dufferin St SB	Teston Rd	Steeles Ave	60 to 80	32
Bayview Ave SB	Elgin Mills Rd	Steeles Ave	40 to 60	32
Weston Rd SB	Major Mackenzie Dr	Steeles Ave	60 to 70	34
Leslie St SB	Major Mackenzie Dr	Steeles Ave	50 to 70	36

Table 2
Afternoon Peak Period Slowest Five Segments – Based on Travel Speed

Route	Begins At	Ends At	Speed Limit (km/h)	Surveyed Speed (km/h)
Kennedy Rd NB	Steeles Ave	Major Mackenzie Dr	60 to 70	26
Davis Dr WB	Hwy 404	Bathurst St	50 to 80	28
Yonge St NB	Steeles Ave	Gamble Rd/19th Ave	50 to 60	31
Bayview Ave NB	Steeles Ave	Elgin Mills Rd	40 to 60	31
Warden Ave NB	Highway 7	Steeles Ave	60 to 70	31

New performance measures provide easier understanding of road congestion

In the 2008 Travel Time Study, two new performance measures were introduced to track the performance of 400-series highways and arterial roads. These two measures are:

- Travel Time Index (TTI) – Compares peak period and free-flow travel conditions to provide an indication of the additional time required in peak flow conditions (e.g., a TTI of 1.4 indicates a motorist's trip will take 1.4 times longer during the peak period than at posted speed or free-flow travel conditions).

- Buffer Time Index (BTI) – A measure of travel time reliability, the BTI represents the extra travel time (or buffer) that a motorist needs to consistently arrive on time with a high degree of confidence (e.g., a BTI of 24% means a motorist should allow 24% more time than the free-flow travel time for a trip, to arrive on-time for 19 out of 20 trips, or with a 95% level of confidence).

In terms of reliability and consistency of travel times based on the two measures noted above, the 2008 Travel Time Study found that:

- On average, the afternoon peak period is the most unreliable period for travel in York Region. The least reliable arterial road require motorists to allot an additional 60% more time than their trip would normally take, in order to avoid being late.

- The least reliable arterial segments tend to be the Southbound, towards Toronto, in the morning peak, and the Northbound, from Toronto, in the afternoon peak.

- The most reliable arterials tend to be in the northern part of York Region, north of Green Lane.

- Travel on many specific arterial road segments can take twice as long during the peak periods as compared to free-flow conditions. These arterial road segments include:

For the Morning Peak Period:

- Dufferin Street Southbound (from Teston Rd to Steeles Ave)
- Weston Road Southbound (from Major Mackenzie Dr to Steeles Ave)

For the Afternoon Peak Period:

- Kennedy Road Northbound (from Steeles Ave to Major Mackenzie Dr)
- Highway 9/Davis Drive Westbound (Highway 404 to Bathurst St)
- Warden Avenue Northbound (from Steeles Ave to Highway 7)
- Warden Avenue Southbound (from Highway 7 to Steeles Ave)
- Weston Road Northbound (from Steeles Ave to Major Mackenzie Dr)

York Region's road network performs better than Toronto and Peel Region

Based on the survey data, travel speeds on York Region's arterials are faster than those in the Region of Peel and City of Toronto, but slower than the Region of Durham during all peak periods. This is based on the aggregate Travel Time Index (TTI).

York Region's arterials are more reliable than all other participating municipalities during both the AM and PM peak periods. This is based on aggregate Buffer Time Index (BTI).

Trips on 400-series highways in York Region can take twice as long during the peak periods as compared to free-flow conditions

The analysis of the 400-series highways in York Region indicates that:

- Motorists should expect a 400-series highway trip in York Region and Simcoe County to be consistently slower than in previous years. Drivers need to budget at least 20% more time to avoid being late, as compared to 18% more time in 2006.

- 400-series highway travel times in York Region increased by about 15% (or take 15% longer to travel) during both the morning and afternoon peak periods in 2008, after dropping off in 2006. When the 2008 data is compared with the 2002 and 2004 data, a trend of slower travel speed or congestion becomes apparent.

- The slowest 400-series highway speeds in the GTA are found on Highways 404 and 400. In particular, Highway 404 southbound from 16th Avenue to Highway 401 is the slowest 400-series highway segment in the GTA during the morning peak period.

- High Occupancy Vehicle (HOV) lanes on 400-series highways are typically moving faster than the General Purpose Lane (GPL) during all periods. For example on Highway 404 southbound, the HOV lane is nearly 10 minutes faster than GPL lanes between 16th Avenue and Highway 401 during the morning peak period. For the northbound direction, the HOV lane is nearly two minutes faster during the afternoon peak period.

- Trips on many 400-series highway segments can take twice as long during the morning peak period and 1.5 times longer during the afternoon peak period as compared to the free-flow speeds.

Truck speeds are typically 10 – 20 km/h slower than private car under free-flow conditions

Truck speed data analysis was included in the 2008 Travel Time Study. About one million trip samples were collected on truck speed by Turnpike Global Technologies during the Fall 2008. The analysis indicated that truck speeds on highways are considerably lower (10 to 20 km/h) than car speeds under free-flow conditions (or no traffic congestion).

Analysis to establish a relationship between the parallel arterials and 400-series highways was inconclusive

In addition to the above surveys, a number of 400-series highways and arterials were surveyed in parallel. The objective of this exercise was to determine whether there is any transfer of traffic from the 400-series highway to arterial corridors as a result of congestion. By using the current methodologies, the analysis indicates that the data collected only shows 'normal' conditions for the parallel routes. This study recommended that future studies use different survey methodologies and analyses to examine the relationship between parallel arterials and 400-series highways.

York Region should participate in all future editions of the biennial Travel Time Study

To better monitor and assess congestion levels and trends within the Region, staff recommend York Region's participation in the 2010 Travel Time Study and all future editions of the biennial survey with MTO as the proponent. The 2010 participating municipalities include the City of Toronto, Regional Municipalities of Durham, Peel, and potentially Regional Municipality of Halton.

Historical time-series speed data is a tool to assess traffic congestion and the impact of transportation improvements

The Travel Time Studies provide an important set of transportation indicators to monitor the Region's effectiveness in managing and balancing existing and future growth. It will provide reliable historical data on travel speeds and delays that can be used for transportation planning as well as traffic operational planning in York Region to effectively manage traffic congestion under both existing and future conditions.

The Studies will also provide consistent data collection methodologies across the GTA that can be used to compare road performance among participated jurisdictions. The data set can also be used to identify any potential improvements on the inter-connections between municipalities and the province to effectively move people and goods, and to maintain economic growth and prosperity of York Region and the GTA.

5. FINANCIAL IMPLICATIONS

Study budget requirements subject to capital budget approval process

York Region's share of the 2008 Travel Time Study was approximately $42,000 out of a total study cost of approximately $300,000. It is anticipated that future studies will be similar in scope and costs. York Region's participation in this traffic monitoring program will require a budget in the order of $45,000 on a biennial basis and will be submitted as part of the annual roads capital budget review and approval process.

6. LOCAL MUNICIPAL IMPACT

The 2008 Travel Time Study data and the final report are available to local area municipalities, stakeholders, and other Regional departments. Local municipalities can use the data to assist in their transportation planning and traffic operational activities and achieve a better understanding of traffic congestion and road network performance in their communities.

7. CONCLUSION

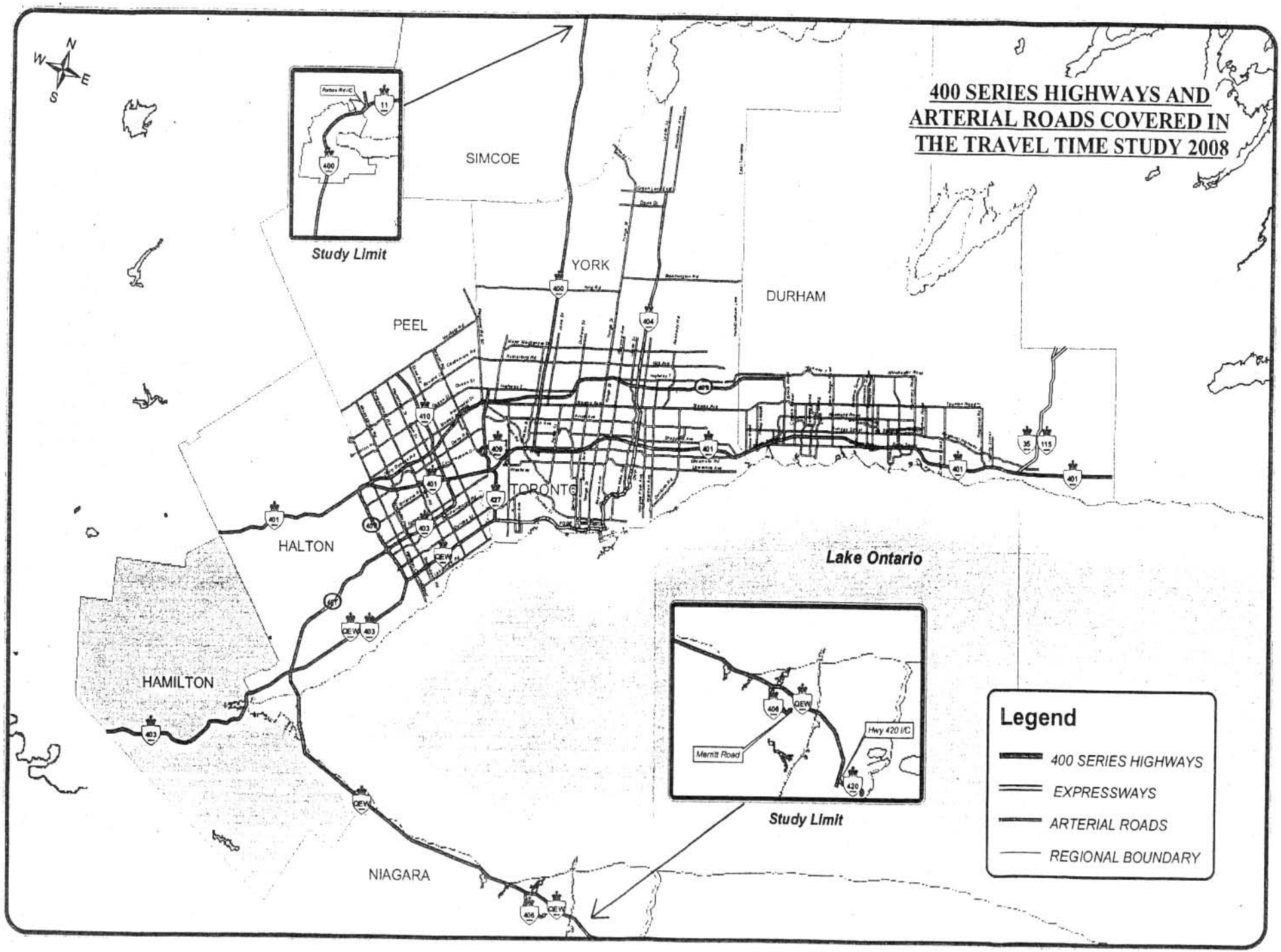
The 2008 Travel Time Study provides useful information related to peak period travel times, arterial road levels of service, areas of significant congestion, and travel speed performance measures on major roads within York Region. This information will assist staff in implementing and monitoring traffic management strategies and transportation initiatives in major congested travel corridors of the Region.

It is important for York Region to continue to participate in future editions of the biennial survey to be conducted by MTO. The coordinated data collection and consistent criteria will allow for comparisons across participating jurisdictions in the GTA. Staff can also use the data to establish future travel trends and road performance.

For more information on this report, please contact Vi Bui, Transportation Planner at 905-830-4444, Ext. 1585 or Loy Cheah, Manager, Infrastructure Planning at Ext. 5024.

The Senior Management Group has reviewed this report.

(The two attachments referred to in this clause are attached to this report).



COUNCIL ATTACHMENT 1

MTO AND GENERAL EXECUTIVE SUMMARY

The Ministry of Transportation, Ontario (MTO) has undertaken a biennial travel time survey of major provincial roadways in the Greater Toronto Area (GTA) since 1996. The results of the studies provide metrics for assessing facility performance and identifying critical road sections to be considered in future improvement projects and traffic management strategies.

In 2008, the travel time surveys included 13 major 400-Series highways and 92 arterials (refer to attached map of study area) for a total of approximately 4,270 km covering both directions. The Labour Day recreational survey included four 400-Series highways and six provincial highways. The weekend survey included five 400-Series highways. Thirty-one ramps between 400-Series highways were also surveyed. Survey vehicles covered a total of over 141,000 km to obtain all data at the confidence level required for this assignment. This report outlines the results of the survey of travel times on principal 400-Series highways, highways and arterials in the GTA for the fall season of 2008. The following additional elements were added or returned to the 2008 study:

- Expanded survey and analysis of travel time and delay on principal arterials under the jurisdiction of the City of Toronto, Region of Peel, Region of Durham, and Region of York.
- Weekend travel time analysis on 400-Series highways;
- Analysis of ramps between 400-Series highways (first done in 2004; excluded from 2006 study);
- Expanded survey and analysis of MTO High Occupancy Vehicle (HOV) lane corridors to reflect new HOV facilities; and
- Analysis of parallel 400-Series highway/arterial routes.

The primary results of this study are highlighted below. More details on each major component of the report are provided in the following subsections.

- ► *The majority of mainline 400-Series highways did not experience a statistically significant change in speeds in 2008 compared to 2006, although speeds were generally found to be slower;*
- ► *Network-wide average peak speeds are slower in 2008, after relative stability between 2000 and 2006. Congestion continues to be a significant issue in the core of the GTA, but outlying areas are beginning to become more congested as well;*
- ► *The majority of segments with statistically significant changes from 2006 to 2008 experienced deterioration in speed;*
- ► *Travel Times on 400-Series highway HOV lanes were found to be as much as 43% lower than on the general purpose lanes in the AM peak period, on both eastbound Highway 403 and southbound Highway 404;*
- ► *Operational improvement projects for the QEW, Highway 401, Highway 406 and Highway 407 have resulted in increased average speeds on adjacent sections since 2006;*
- ► *Overall, results of the Labour Day recreational survey indicated that traffic conditions were worse than typical weekday PM peak period travel. This is in contrast to the 2006 findings and is likely due to good weather over the holiday weekend;*

- *Weekend surveys on 400-Series highways were introduced for the first time in 2008. Based on the mean speeds, it would appear that sufficient 400-Series highway capacity exists for MTO to implement longer lane closures for weekend construction and maintenance activities;*
- *MTO should continue to compare data from GPS equipped truck probes with passenger car probes. The use of these data as a supplemental data source has potential and should be investigated further with respect to methodology and calibration issues;*
- *The results of the survey of ramps between 400-Series highways indicate that the travel time on ramps cannot be reliably predicted by simply summing travel times on mainline sections of the adjacent highways. Furthermore, truck probes do not appear to provide a reliable surrogate for passenger car data on ramps between 400-Series highways. If MTO wishes to accurately assess car travel times on these ramps, the current dataset suggests that passenger car surveys on the ramps themselves are required; and*
- *The regional municipalities should continue to participate in future studies to monitor the status of the road network in the peak periods so that a broader picture can be provided regarding congestion in the GTA during peak periods.*

Methodology

All data were collected using a fleet of GPS equipped passenger cars as probe vehicles. The average car technique required the surveyor to operate the vehicle in any available general travel lane at a speed that was, in the opinion of the driver, the average speed of the traffic stream.

For all 400-Series highway, City of Toronto expressway and municipal arterial segments, surveys were conducted during the AM peak, midday, and PM peak periods of three distinct weekdays. For the Labour Day weekend, surveys were conducted on 400-Series highways and provincial highways during the outbound period on the Friday and an inbound period on the Monday. Weekend surveys were conducted on select 400-Series highways during the midday hours and into the afternoon. The sampling times of surveys were deliberately varied within each survey period to capture the temporal variability of travel times inherent to each section of road.

Areas of Significant Congestion on 400-Series Highways

400-Series highway sections were sorted by their mean speeds in ascending order to identify critical sections. The rankings of 400-Series highway sections were conducted separately for the AM and PM peak periods. The five slowest 400-Series highway segments for the AM and PM peak periods are shown below. The 2006 Travel Time Study rankings and mean speeds are also listed for these 400-Series highway sections as a means for general comparisons.

The main congestion areas remain:

- Highway 404 GPL southbound between 16th Avenue and the DVP in the AM peak period;
- Highway 401 Express/Collector eastbound between Mississauga Road and Dixie Road in the AM peak period, eastbound between Highway 410 and Highway 404 in the PM peak period, and westbound west of Highway 410 in the PM peak period; and
- QEW eastbound between Erin Mills Parkway and Highway 427 in the AM peak period.

One congested area that did not appear in the 2006 study is Highway 410 southbound between Bovaird Drive and Highway 403/401. In this year's study it was the second slowest AM segment, with a mean speed of 38 km/h. This speed compares to 71 km/h in the 2006 study.

Slowest MTO 400-Series Highway Segments

Period	Dir	Route	Begins At	Ends At	2008		2006	
					Rank	Mean Speed (km/h)	Rank	Mean Speed (km/h)
AM	SB	Hwy 404 GPL	16th Ave.	Hwy 401	1	31	1	44
	SB	Hwy 410	Bovaird Dr.	Hwy 403	2	38	14	71
	EB	Hwy 401 Coll	Mississauga Rd.	Dixie Rd.	3	50	37	95
	EB	Hwy 401 Express	Mississauga Rd.	Dixie Rd.	4	51	2	45
	Toronto Bound	QEW	Erin Mills Pkwy	Hwy 427	5	52	5	48
PM	WB	Hwy 401 Express	Dixie Rd.	Mississauga Rd.	1	33	2	40
	EB	Hwy 401 Express	Dixie Rd.	Hwy 400	2	37	5	46
	WB	Hwy 401 Coll	Dixie Rd.	Mississauga Rd.	3	37	10	51
	Niagara Bound	QEW	Royal Windsor Dr.	Fairview St.	4	43	13	55
	EB	Hwy 401 Coll	Hwy 400	Hwy 404	5	44	3	41

Changes in Performance from Previous Study (2006 to 2008)

SPEED PERFORMANCE

A fundamental component of the data analysis was a statistical comparison of the 2008 mean speed and speed variance (a surrogate measure of travel time reliability) to those found in previous studies. A summary of the comparisons is provided below in terms of "No Change", "Deterioration", "Effective Improvement" (change from a congested speed condition to a non-congested speed condition, using the MTO ATMS threshold of 75 km/h), and "Not Effective Improvement".

Comparison of 400-Series Highway Segments 2006 to 2008 (All Peak Periods)

Change		Mean Speed			Speed Variance		
		# of Segments	% of Segments	% of Distance	# of Segments	% of Segments	% of Distance
No Statistically Significant Change		282	61%	61%	343	74%	75%
Statistically Significant Difference	**Not Effective** Improvement	17	4%	3%	---	---	---
	Effective Improvement	12	3%	3%	48	10%	7%
	Deterioration	151	32%	33%	71	16%	17%
Total 400-Series Highway Segments		**462**	**100%**	**100%**	**462**	**100%**	**100%**

From the summary of the comparative analysis, the following observations were made regarding changes to mean speed and speed variance:

- **Mean Speed** – The results show that the majority of segments (282 of 462) experienced no statistically significant change from 2006 to 2008. Twenty-nine segments showed improvements in speed, but only 12 of those achieved an effective improvement; however, 151 segments exhibited deterioration in mean speed from 2006; and

- **Speed Variance** – The changes in speed variance exhibit a similar pattern to mean speed. The majority of 400-Series highway segments exhibited no change, while more segments deteriorated (increased variance) than improved (reduced variance).

These speed performance results suggest that the overall mainline 400-Series highway system is slower and slightly less stable than it was in 2006.

Among the locations where highway speeds improved over 2006 *with statistical significance* include:

- Toronto Bound QEW between Thorold Stone Road and Glendale Avenue (AM peak) (result of widening);

- Highway 401 westbound Express between Highway 404 and Highway 400 (AM and PM peak) (result of downstream widening between the basket weave and Weston Road);

- Both directions of Highway 406 between Beaverdams Road and Merrit Road (result of widening);

- Eastbound Highway 407 between Highway 401 and Highway 410, and between Highway 404 and Markham Road (result of widening); and

- Northbound Highway 427 between Highway 401 and Highway 7 (no specific reasons evident).

CONGESTION MEASURES

The 2008 study collected data for two performance measures that are used to track trends in 400-Series highway congestion performance over time. These two measurements are:

- **Travel Time Index (TTI)** – Compares peak period and free-flow travel conditions to provide an indication of the additional time required in peak flow conditions (e.g., a TTI of 1.4 indicates a motorist's trip will take 1.4 times longer on average than at the posted speed limit). For consistency, free-flow speed was assumed to be represented by posted speed limits; and

- **Buffer Time Index (BTI)** – A measure of travel time reliability, the BTI represents the extra travel time (or buffer) that a motorist needs to allow to consistently arrive on time with a high degree of confidence (e.g., a BTI of 24% means a motorist should allow 24% more time than the average travel time for a trip, to arrive on-time for 19 out of 20 trips, or with a 95% level of confidence).

The Travel Time Index and Buffer Time Index values calculated for the entire GTA 400-Series highway network since 2002 are shown below. Although 2008 exhibits the highest TTI of all compared years, which is consistent with the slower travel times encountered in this year's study, such system-wide aggregate calculations need to be interpreted cautiously, as the index does not

indicate a predominant trend for any peak period over time for the mainline 400-Series highway network. What the findings show is that a trip in 2008 could be expected to take 13 to 24 percent longer than the same trip in 2002, but this cannot be identified as a trend until future studies are undertaken, as the 2006 TTI was generally equal to or less than the 2002 TTI.

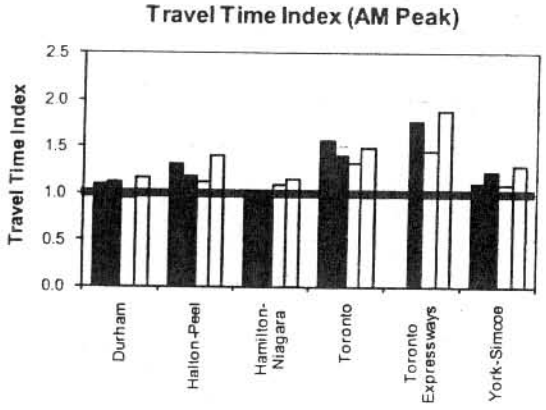
400-Series Highway Network Aggregate Travel Time and Buffer Time Indices Since 2002

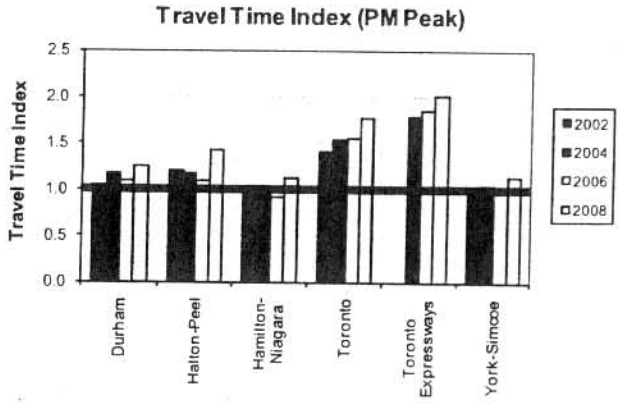
	Travel Time Index				Buffer Time Index			
Period	**2002**	**2004**	**2006**	**2008**	**2002**	**2004**	**2006**	**2008**
AM	1.20	1.19	1.13	1.33	20%	26%	24%	22%
MID	0.97	0.97	0.90	1.10	7%	12%	5%	5%
PM	1.12	1.19	1.14	1.36	20%	28%	19%	21%

The BTI has varied from one study year to the next and no clear network-wide trend can be identified. In both cases, the use of the study data to develop new congestion-related performance measures for MTO will need to be considered further. The aggregated TTI and BTI values do suggest that, in general, traffic conditions are more congested and more reliable today than in 2006, i.e. indicating that longer travel times are becoming the rule, rather than the exception.

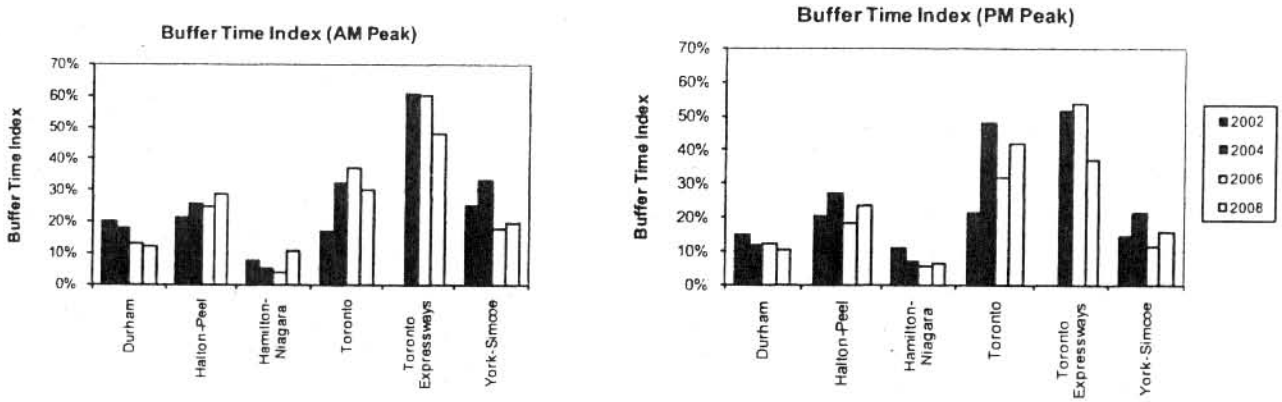
To assess TTI and BTI values from a different perspective, the indices are presented on a regional level in the following charts, for the AM and PM peak periods. The bold line indicates a TTI of 1.0, above which travel times are greater than they would be at the posted speed limit. One interesting observation is that while BTI values increased throughout the suburban regions, they decreased in the City of Toronto, both on expressways and 400-Series highway segments during the AM peak period, and on expressways during the PM peak period. The decrease accompanied an increase in TTI. What the results indicate is that travel through the City of Toronto is taking longer than it took in 2006 (and somewhat comparable to 2004 findings), but the variability in travel time is decreasing.

TTI Values by Region and Year





BTI Values by Region and Year



Impact of Operational Improvements

Since the 2006 Travel Time Study, a number of operational improvement projects were completed on 400-Series highway sections throughout the Greater Toronto Area. The impacts of these improvements were assessed by examining the change in mean speed from 2006 to 2008 for 400-Series highway segments adjacent to where the improvement work was completed for 11 projects. Improvements in mean speed were identified for the following improvement projects in some or all of the peak periods:

- QEW (Thorold Stone Road to Glendale Road);
- Highway 401 (Highway 400 to Highway 404);
- Highway 406 (Beaverdams Road to Port Robinson Road); and
- Highway 407 (Highway 404 to Markham Road, Highway 427 to Highway 410 and Highway 410 to Highway 401).

Labour Day Recreational Survey

The recreational surveys for the Labour Day weekend were conducted on Friday, August 29 and Monday, September 1, 2008. When comparing 2008 with 2006, the majority of the highway travel speeds remained relatively stable in the Friday and Monday peak travel periods. Based on percentage of distance, it appears that Friday outbound travel speeds improved more than they deteriorated between 2006 and 2008. However on Monday, while a greater number of segments showed improvements between 2006 and 2008, the percentage of distance was equal for both improved and deteriorated segments.

FRIDAY, AUGUST 29, 2008

During the Friday of the Labour Day weekend, both directions of Highway 401 exhibited the most heavily congested road segments. These congested sections of Highway 401 would have serviced recreational travellers destined for northbound Highway 400, and areas to the east and west of the GTA via Highway 401, in addition to commuter traffic. The slowest segment was the westbound

Highway 401 Collectors between Dixie Road and Mississauga Road, with a mean speed of 34 km/h.

In comparison to the Friday surveys of the 2006 Labour Day weekend, the majority of road sections exhibited no statistically significant change in mean speed. However, notable changes were:

- Slower 2008 speeds on all studied sections of northbound Highway 400;
- Faster 2008 speeds on all studied sections of eastbound Highway 407; and
- Various segments of two-lane highways experienced statistically significant changes in travel speed; however, no specific reasons have been identified.

The 2008 Labour Day survey speeds were also compared to 2008 travel time survey speeds. Evidence appears to suggest that the 400-Series highway system was more congested during the Labour Day Friday than during regular PM peak periods in 2008. This is in contrast to 2006, when study findings indicated that the 400-Series highway system appeared to be no more congested than during a typical PM peak period.

MONDAY, SEPTEMBER 1, 2008

During the Monday of the Labour Day weekend, the mean speeds were considerably higher than for the Friday. The slowest road sections were found on westbound Highway 401 through Durham Region; southbound Highway 400 through Simcoe County and northern York Region. Mean speeds on these segments ranged between 65 km/h and 90 km/h.

In comparison to the Monday surveys of the 2006 Labour Day weekend, some highway segments exhibited statistically significant higher speeds in 2006, particularly southbound Highway 400 south of Highway 9, westbound Highway 401 between Highway 12 and Highway 404 and southbound Highway 48 between the south junction of Highway 12 and 16th Avenue. It was hypothesized in the 2006 study that poor weather may have caused some travellers to return home earlier than usual, whereas the weather on Labour Day 2008 was good.

Results of HOV Corridor Analysis

Surveys of HOV facilities were again undertaken for the 2008 Travel Time Study. The objective of these surveys was to quantify the travel time benefits of travelling in an HOV lane versus its corresponding general purpose lanes (GPL). The analysis of the HOV and GPL data aimed to determine if the difference between the mean speeds of the HOV and GPL facilities was statistically significant at a 95% level of confidence.

Since the 2006 Travel Time Study was conducted, MTO has constructed a new HOV facility on northbound Highway 404 between the Highway 401 interchange and 16th Avenue. This is in addition to the previously constructed southbound HOV lane on this same section of Highway 404, and in both directions of Highway 403 between Winston Churchill Boulevard and Highway 401. The analysis revealed the following statistically significant results:

- On Highway 403 eastbound, the HOV is over 6 minutes faster, on average, in the AM peak period than the GPL between Winston Churchill Boulevard and Highway 401. This represents nearly a 43% reduction in travel time; this is almost the same as in 2006;

- On Highway 403 westbound, the HOV lane is over 4 minutes faster, on average, in the PM peak period than the GPL between Highway 401 and Winston Churchill Boulevard. This represents a 34% reduction in travel time, or double the time savings that was found in 2006;

- On Highway 404 southbound, the HOV lane is nearly 10 minutes faster, on average, in the AM peak period than the GPL between 16th Avenue and Highway 401 (survey vehicles split between DVP and both directions of Highway 401). This represents a 43% reduction in travel time. The southbound HOV lane provided a time savings of over 1 minute during the PM peak period; and

- On Highway 404 northbound, the HOV lane is nearly 2 minutes faster, on average, in the PM peak period than the GPL between 16th Avenue and Highway 401 (survey vehicles split between DVP and both directions of Highway 401). This represents a 17% reduction in travel time.

For all other surveyed directions of travel and peak periods, either a statistically significant difference was not identified between the HOV travel time and the GPL travel time, or the time savings represented by the statistically significant result was minimal.

The analysis indicates that the existing HOV facilities do reduce travel time in the peak travel direction, most noticeably on southbound Highway 404, where the HOV lane not only allows traffic to travel at a higher speed than the adjacent general purpose lanes, but perhaps more importantly, it allows motorists to bypass a series of interchanges and lane drops as Highway 404 passes Finch Avenue and Sheppard Avenue and approaches the interchange with Highway 401 and the Don Valley Parkway. Time savings are still present, but less obvious, in the northbound direction, where the combination of lighter traffic (annual Highway 404 traffic at Highway 7 is currently about half of the volume at Highway 401) and the lack of a merge allow general purpose traffic to move more freely than in the southbound direction.

Truck Probe Data

Truck probe data were generated from the Turnpike Global Technologies (TGT) fleet management GPS devices presently installed on their customers' trucks. Data were collected during the fall of 2008. A total of over 960,000 section samples were obtained. The truck probe data were processed by MTO in a manner to represent a technique similar to the technique used for the 2008 Travel Time Study in processing the passenger car probe data. The aggregate performance results were delivered for all road segments in this assignment, including mean speed, speed variation, and sample size.

The mean speeds of truck probe data were compared to those calculated from passenger car probe data. The comparative analysis indicated that on the majority of 400-Series highway segments, passenger cars exhibited higher speeds and lower speed variance than truck probes. The higher speeds of passenger cars were primarily observed during less congested conditions. On arterials, the difference between passenger car and truck probe data was more prominent in the 2008 Travel Time Study than it was in 2006.

Ramps between 400-Series Highways

A series of ramps between 400-Series highways were surveyed in the 2008 Travel Time Study. The objective of the ramp surveys was two-fold:

1. MTO wishes to determine if ramp analysis is required in future Travel Time Studies, or if simply summing travel times on the adjacent mainline sections is sufficient; and

2. MTO wishes to assess the use of truck probe data as a passenger car surrogate. By comparing ramps where both passenger car and truck probe data was collected, the objective was to develop a factor or series of factors by which passenger car travel times could be estimated from the truck probe data.

The results of the ramp survey indicate that the travel time on ramps cannot be reliably predicted by simply summing travel times on mainline sections of the adjacent highways. No patterns or trends were evident based on ramp type, location or geometry. If MTO wishes to accurately assess the travel time required to transfer from one 400-Series highway to another, e.g. in the analysis of origin-destination pairs, ramp surveys will be required.

Furthermore, truck probes do not appear to provide a reliable surrogate for passenger car data on ramps between 400-Series highways. Two types of recorded truck speeds (GPS and engine control module) were compared to the recorded passenger car GPS speeds. No patterns or trends were evident from the collected data. Passenger car speeds were faster than both types of truck speeds on some ramps, and slower than both types on other ramps, with no correlation to ramp type, location or geometry. If MTO wishes to accurately assess passenger car travel times on these ramps, it will either need to collect more passenger car speeds on more ramps to determine if such surrogate factors can be developed, or it will need to continue to rely on passenger car probes.

Weekend Surveys

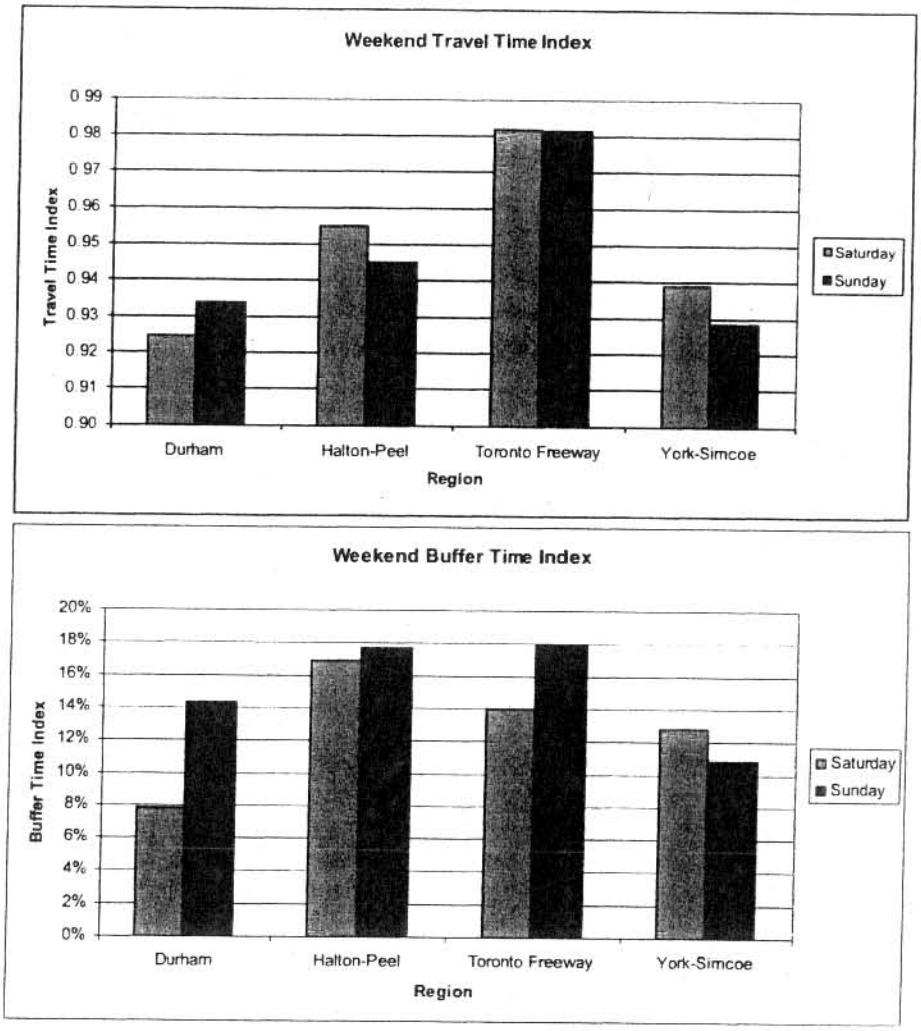
The 2008 Travel Time Study was the first to incorporate weekend travel time and speed analysis. The stated objective of MTO is to assess whether typical weekend traffic operations will support longer lane closures during weekend maintenance and construction activities. Weekend speed data was collected on selected 400-Series highways including the QEW and Highways 400, 401, 404 and 427. Data was collected during September and October 2008, for two Saturdays (10:00 AM – 5:00 PM) and two Sundays (11:00 AM – 5:00 PM) in each month. Nearly 600 km of highways were surveyed on weekends, and surveyors collected nearly 26,000 km of data.

Weekend speeds were noticeably higher than even midday weekday speeds. The slowest speeds were found on southbound Highway 427 between Highway 401 and the QEW (84 km/h Saturday; 77 km/h Sunday). When this segment is excluded due to ongoing construction activities at the time of data collection, and other segments featuring construction on the QEW are also excluded, the slowest and the segments were both found on westbound Highway 401, between Highway 400 and Dixie Road:

- Saturday: average speeds on the westbound express lanes were 95 km/h; and
- Sunday: average speeds on the westbound collector lanes were 93 km/h.

Many highways on both days featured TTI values less than 1.00, indicating the average trip on these days would take less time than it would at the posted speed. As shown below, 400-Series highway sections in the City of Toronto featured the highest TTI values, but even they aggregated to less than 1.00 on both days. Based on the available data, it would appear that sufficient 400-Series highway capacity exists for MTO to implement longer lane closures for weekend construction and maintenance activities.

Weekend TTI and BTI Values by Region



Highway 7 and Dundas Street

As was done in the 2006 Travel Time Study, Highway 7 was surveyed independently from other arterials. This year's Travel Time Study also added Dundas Street as an independent, inter-municipal corridor.

HIGHWAY 7

The Highway 7 corridor was analyzed as one continuous route within the Regions of Peel, York and Durham between Mississauga Road in the Region of Peel and Harmony Road in the Region of Durham. The corridor is known by various names along its length, including Queen Street (Peel) and Winchester Road (Durham). The corridor is approximately 88 km in length.

During any of the peak periods a minimum 65% of segments operate at LOS C or better (PM peak period). The slowest segment in all peak periods was found to be in the Region of Peel between Main Street and Highway 410. Highway 7 operates as Queen Street in this vicinity and passes

through downtown Brampton, where development and general urban characteristics contribute to the low speed. Slow mean speeds were found throughout the Region of York, with the three defined segments between Highway 50 and Donald Cousens Parkway ranking in the top five slowest sections in all peak periods. This area of Highway 7 features large areas of development, particularly between Pine Valley Drive and Keele Street, as well as east of Leslie Street and into Markham.

The Highway 7 Travel Time Index was found to be at least 1.37 for all periods in either direction, meaning a typical trip should be expected to take 37 percent longer than it would under free-flow conditions. This increases to 1.50, or 50% longer, during the PM peak period only.

DUNDAS STREET

The Dundas Street corridor was analyzed as one continuous route within the Region of Peel and the City of Toronto between 9th Line in the Region of Peel and Kingston Road in the City of Toronto. The corridor is approximately 41 km in length.

During any of the peak periods, a minimum 64% of segments operate at LOS C or better (PM peak period); however, 11% of segments are failing (LOS F) during the PM peak period. The slowest eastbound segment in either the AM or the PM peak period is in the western part of Toronto, from the Peel boundary to Yonge Street. This segment is nearly 18 km in length and features average speeds of 29 km/h in the AM peak hour and 23 km/h in the PM peak period. Given the variation in development and roadway geometry along this section of Dundas Street, it can be surmised that some sections are operating much faster than this average, and others are operating much slower. In particular, the sections through downtown Toronto, Chinatown and other adjacent neighbourhoods feature TTC streetcars, intensive land uses, considerable on-street activity, illegal parking and loading during peak hours, and other factors that negatively influence operating conditions.

In the westbound direction, the segment between Kingston Road and Yonge Street was found to be slowest during the AM peak hour. This section is used by east end commuters and features residential land uses, on-street parking in sections and urban development closer to downtown. During the PM peak, the slowest westbound section was found in the Region of Halton, between Winston Churchill Boulevard and 9th Line. This segment is influenced heavily by the interchange with southbound Highway 403, which is typically slow at this point as it merges with the westbound QEW. The second slowest was in the Region of Peel between Cawthra Road and Hurontario Street, which is influenced by traffic leaving Mississauga headed for the QEW.

Assessment of Study Elements

PARALLEL ROUTE ANALYSIS

The methodology prescribed by the terms of reference required termination of surveys in the event of an incident. Therefore, the data collected only shows 'normal' conditions for the parallel routes. It is assumed that the desired effects of the methodology are not captured since data collection was stopped on all parallel routes. However, the parallel survey requirements did help to ensure that data was collected for adjacent roadways during common timeframes. It is recommended that the parallel survey requirement remain in future Travel Time Studies.

The survey termination requirements often led to scheduling difficulties on other corridors not associated with the parallel routes. In future studies, it is recommended that flexibility be introduced to reduce the makeup requirements such that all associated parallel routes are not terminated when

an incident occurs on a single corridor. Provided that surveyors continue to maintain good incident logs and they are cross-referenced against MTO/municipal incident logs, this approach will better capture congestion-related traffic transfer, because data will continue to be collected when known incidents have occurred on parallel routes.

EXPANSION OF DATA COLLECTION PROGRAM

Arterial corridors in the Regions of Durham and York were surveyed for the first time in the 2008 Travel Time Study, along with expanded networks in the Region of Peel and City of Toronto. The 2008 study also introduced weekend surveys for the first time and saw the return of surveys on ramps between 400-Series highways. The addition of new municipal partners and the expansion of the data collection program help to create a richer dataset and present a more complete picture of traffic operations in the GTA.

The additional study elements presented new challenges in survey scheduling and data collection, processing and analysis. In particular were the challenges associated with mobilizing enough surveyors to complete the scheduled activities on a given day, especially when the time during which data could be collected remained fixed. As with previous studies, all data was to be collected between Labour Day and mid-November, at which point poor weather concerns made continued data collection either impractical or infeasible.

It is recommended that if any components of the Travel Time Study are to expand significantly in future studies, e.g. in the event that additional municipalities elect to participate, that MTO consider allowing data collection to continue in the spring, after suspending data collection through the winter months. MTO could still require an interim deliverable to ensure that data was collected, processed and analyzed during the fall months, but the additional time—during which traffic operations are very similar to the current data collection period—would ensure that all program elements are completed to the requirements of the Terms of Reference and help to alleviate any concerns that may exist over small percentages of data that do not satisfy the statistical requirements.

ARTERIAL DATA COLLECTION

The 2008 Travel Time Study introduced an automated methodology for collecting travel time and speed data on arterial corridors, eliminating much of the need for the manual process first used in 2006. The methodology was verified by comparing the collected data with the findings of the 2006 study on common corridors and observing similar results. Eliminating or reducing the previous mouse-click methodology is especially important in light of recent legislation that prohibits motorists from using mobile phones or other similar devices while driving. The manual process is still available in the event of known or suspected loss of GPS signal, but the current methodology allowed surveyors to focus on operating the survey vehicle.

Signal delay was measured directly from observed traffic conditions; however the measure of congestion delay was dependent on the selection of free-flow speed for each arterial. In this study, some jurisdictions asked if 85th percentile speed would be a better method of determining free-flow speed. Any data that reduces the need for estimation is beneficial to the study. Therefore, it is recommended that data from spot speed studies (i.e. 85th percentile speeds) be incorporated in future arterial studies wherever possible to more accurately estimate congestion delay.

TRUCK PROBE DATA

The continued incorporation of truck probe data in 2008 provided an opportunity to further refine a data processing methodology for raw commercial probe data. In the future, truck probe data is

expected to continue to be a more integral component of the facility performance analyses in future travel time surveys. In particular, truck probe data may offer an advantage for some measures due to its generally large sample sizes. The comparison of truck probe performance and passenger car performance should be investigated on a more disaggregated level (e.g. runs from the same days and times) to examine the differences under various flow conditions and determine the impacts of any differences in data collection methodologies.

REGION OF YORK EXECUTIVE SUMMARY

The 2008 Travel Time Study covered approximately 340 km of MTO 400-Series highways within the Region of York and 16 arterial corridors covering approximately 550 km. Region of York arterial analysis was new for the 2008 Travel Time study and included major routes such as Yonge Street, Dufferin Street, Highway 9/Davis Drive and the Rutherford Road/Carrville Road/16th Avenue corridor, among others.

The primary Region of York findings are highlighted below. More details on each major component of the report are provided in the following subsections.

- *Arterials in the PM peak period experience lower speeds, and are therefore more congested, than the AM peak period. This is consistent with the findings from the other jurisdictions. The midday peak is nearly as congested as the AM peak.*
- *The slowest AM arterial routes carry southbound traffic, and four of the five slowest PM routes carry northbound traffic.*
- *The slowest 400-Series highway speeds are found on Highway 404 and Highway 400.*
- *400-Series highway travel times in the Region of York increased in 2008, after dropping off in 2006. When the 2008 data is compared with the 2002 and 2004 data, a trend of increasing congestion becomes apparent. The 2008 aggregate BTI rebounded from 2006, and no trends are evident since 2002. When combined with the higher TTI, the BTI indicates that not only should motorists expect a 400-Series highway trip in Peel and Halton to take somewhat longer than in previous years, they should budget more time to avoid being late than was required in 2006, but not as much as was required in 2004.*

Arterial Analysis

All data were collected using a fleet of GPS equipped passenger cars as probe vehicles. The average car technique required the surveyor to operate the vehicle in any available general travel lane at a speed that was, in the opinion of the driver, the average speed of the traffic stream.

Arterials were assessed on the basis of mean speed, Travel Time Index, Buffer Time Index and delay (signal delay and congestion delay). The table below identifies the five slowest Region of York arterial segments for the AM and PM peak periods, along with their associated mean speeds and average signal delay per signal.

The results of the speed ranking for Region of York arterials indicate that the PM peak period experiences lower speeds, and is therefore more congested, than the AM peak period. This is consistent with the findings from the other jurisdictions.

It can be seen that all five of the slowest AM peak period segments and four of the slowest PM peak period segments feature Steeles Avenue as one of the boundaries. While this is partially a function of the longer segments selected by the Region of York as compared to other participating jurisdictions, it also highlights both the amount of development in southern York Region, as well as the number of people commuting between the Region of York and the City of Toronto. This is further substantiated by the fact that the slowest AM routes all carry southbound traffic, and four of the five slowest PM routes carry northbound traffic.

Slowest Arterial Segments within the Region of York

Period	Dir	Route	From	To	Length (km)	Space Mean Speed (km/h)	Average Signal Delay Per Signal (sec)
AM	SB	Yonge St.	Gamble Rd. / 19th Ave.	Steeles Ave.	12.4	31	13
	SB	Dufferin St.	Teston Rd.	Steeles Ave. W	10.4	32	10
	SB	Bayview Ave.	Elgin Mills Rd.	Steeles Ave. E	10.2	32	9
	SB	Weston Rd.	Major Mackenzie Dr. W	Steeles Ave. W	8.4	34	15
	SB	Leslie St. S	Elgin Mills Rd. E	Steeles Ave. E	10.5	36	10
PM	NB	Kennedy Rd.	Steeles Ave./ Kennedy Rd.	Major Mackenzie Dr.	13.6	26	7
	WB	Hwy 9 / Davis Dr.	Hwy 404	Bathurst St.	7.4	28	12
	NB	Yonge St.	Steeles Ave.	Gamble Rd. / 19th Ave.	12.4	31	14
	NB	Bayview Ave.	Steeles Ave. E	Elgin Mills Rd.	10.2	31	12
	NB	Warden Ave.	Steeles Ave. E	Hwy 7	4.1	31	16

MTO 400-Series Highways within the Region of York

Approximately 340 km of MTO 400-Series highways were surveyed within the Region of York. The five slowest segments for the AM and PM periods are shown below. It should be noted that wherever 400-Series highway segments cross municipal boundaries, they have been assigned for ranking purposes to the jurisdictions noted in the project terms of reference.

Slowest MTO Segments within the Region of York

Period	Dir	Route	Begins At	Ends At	Segment Length (km)	Mean Speed (km/h)
AM	SB	Hwy 404 GPL	16th Ave.	Hwy 401	11.6	31
	SB	Hwy 404 HOV	16th Ave.	Hwy 401	11.6	55
	SB	Hwy 404	Green Lane	16th Ave.	25.1	55
	WB	Hwy 407	York Durham Line	Markham Road	6.7	81
	SB	Hwy 400	Hwy 9	York Rd. 11	12.3	82
PM	NB	Hwy 404 GPL	Hwy 401	16th Ave.	11.6	67
	NB	Hwy 404 HOV	Hwy 401	16th Ave.	11.6	70
	NB	Hwy 400	Langstaff Rd.	York Rd. 11	12.5	76
	SB	Hwy 404 GPL	16th Ave.	Hwy 401	11.6	82
	EB	Hwy 407	Hwy 404	Markham Road	9.4	91

Travel Time and Buffer Time Indices

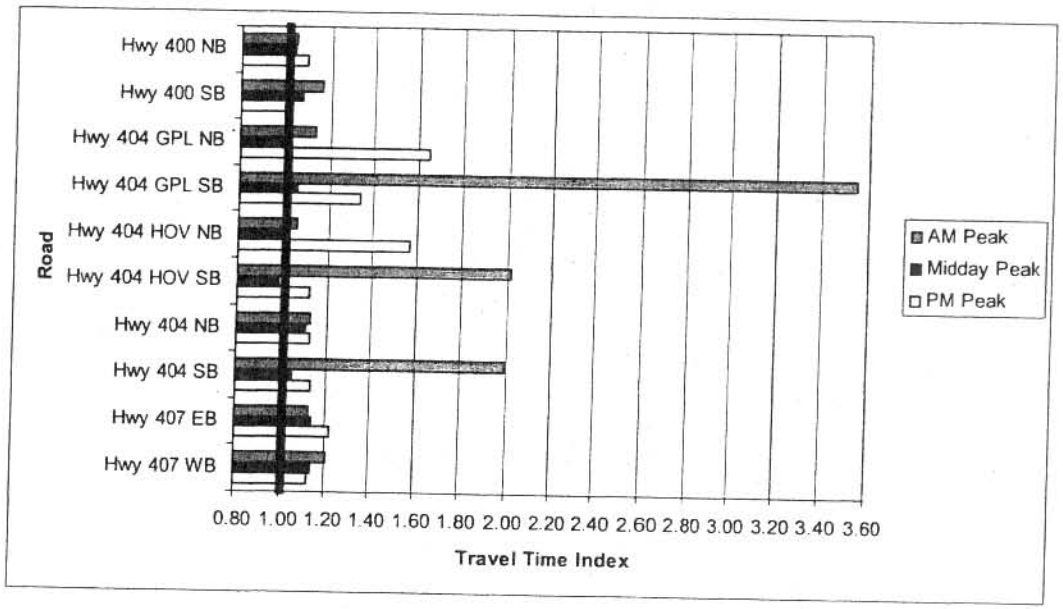
The 2008 study collected data for two performance measures that are used to track trends in congestion performance over time. These two measurements are:

- **Travel Time Index (TTI)** – Compares peak period and free-flow travel conditions to provide an indication of the additional time required in peak flow conditions (e.g., a TTI of 1.4 indicates a motorist's trip will take 1.4 times longer on average than at the posted speed limit). For consistency, free-flow speed was assumed to be represented by posted speed limits; and

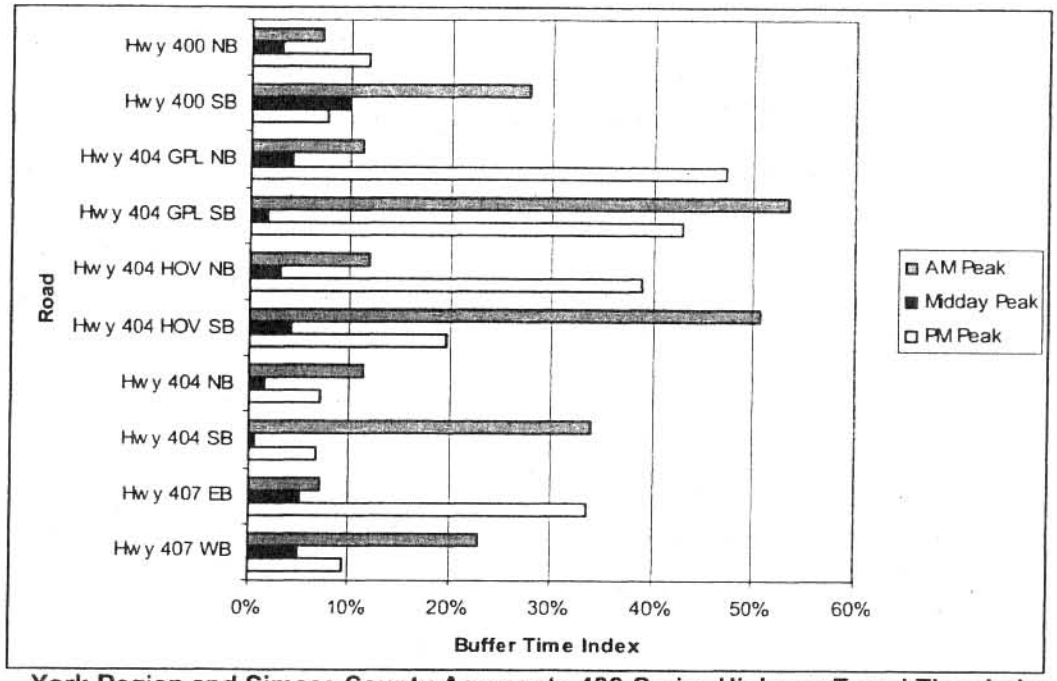
- **Buffer Time Index (BTI)** – A measure of travel time reliability, the BTI represents the extra travel time (or buffer) that a motorist needs to allow to consistently arrive on time with a high degree of confidence (e.g., a BTI of 24% means a motorist should allow 24% more time than the average travel time for a trip, to arrive on-time for 19 out of 20 trips, or with a 95% level of confidence).

The following charts show the Travel Time Index and Buffer Time Index at various levels of aggregation for MTO 400-Series highways through York Region (and Simcoe County) and for York Region arterials. For TTI, the bold line indicates a value of 1.0, above which travel times are longer than they would be at the posted speed limit. The charts are useful to illustrate the directional peaks of MTO 400-Series highways and expressways. It should be noted that wherever 400-Series highway segments cross municipal boundaries, they have been assigned for TTI/BTI purposes to the jurisdictions noted in the project terms of reference.

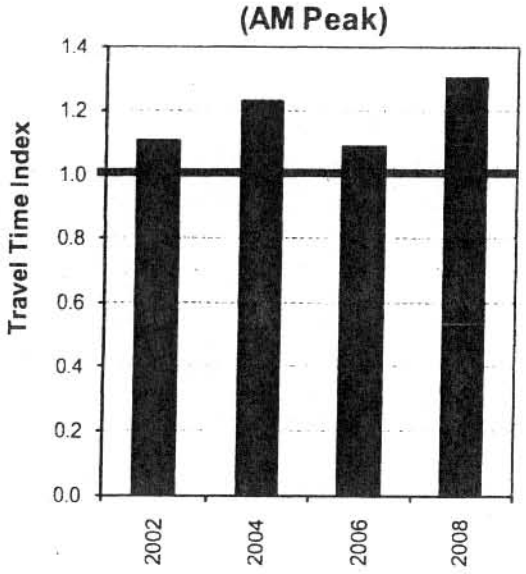
2008 Travel Time Index: MTO 400-Series Highways within York Region and Simcoe County

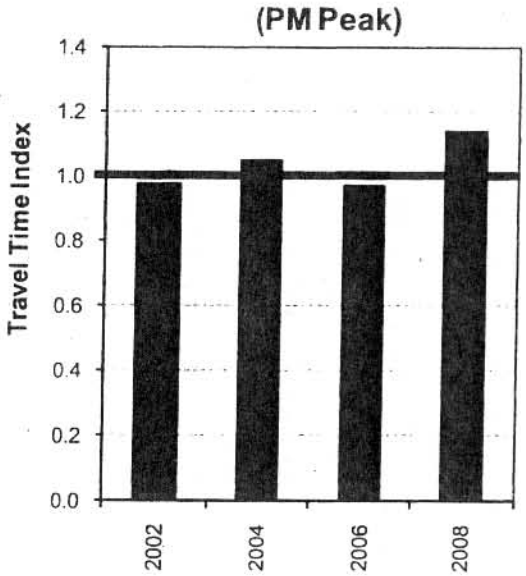


2008 Buffer Time Index: MTO 400-Series Highways within York Region and Simcoe County

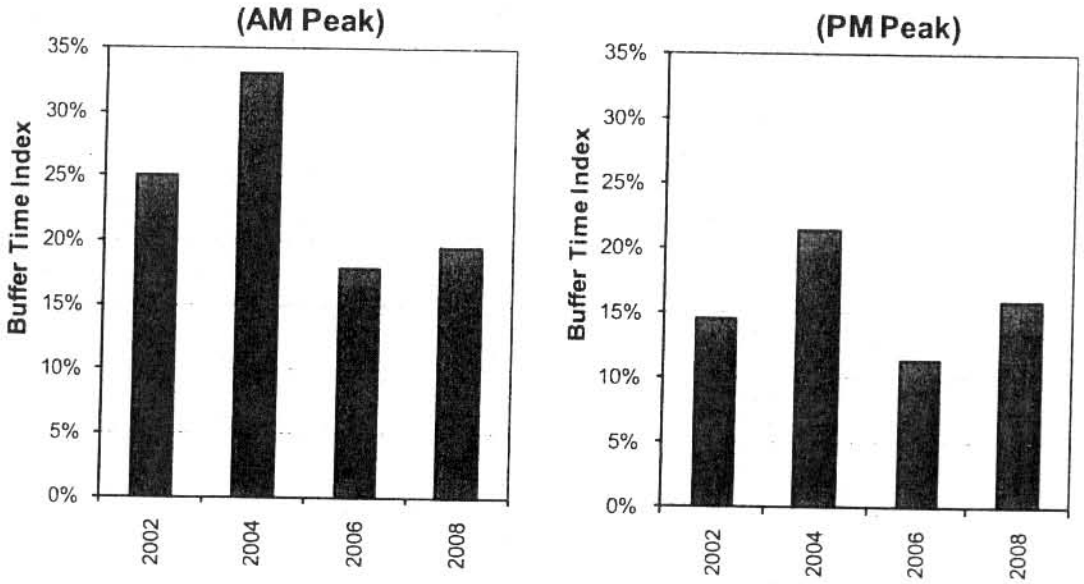


York Region and Simcoe County Aggregate 400-Series Highway Travel Time Index



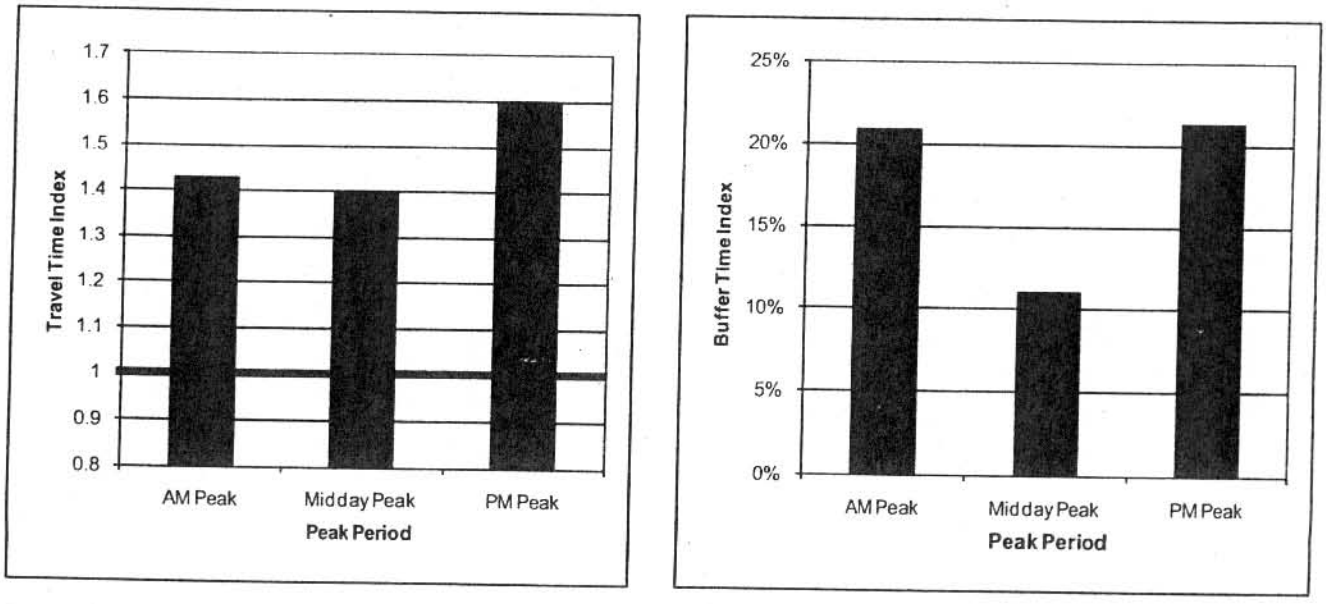


York Region and Simcoe County Aggregate 400-Series Highway Buffer Time Index



From the aggregate 400-Series highway and expressway TTI, it can be seen that 400-Series highway travel times in the Region of York and Simcoe County have increased in 2008, after dropping off in 2006. When the 2008 data is compared with the 2002 and 2004 data, a trend of increasing TTI becomes apparent, with 2006 appearing as an outlier. The 2008 aggregate BTI rebounded from 2006, and no trends are evident since 2002. When combined with the higher TTI, the BTI indicates that not only should motorists expect a 400-Series highway trip in The Region of York and Simcoe County to take somewhat longer than in previous years, they should budget more time to avoid being late than was required in 2006, but not as much as was required in 2004.

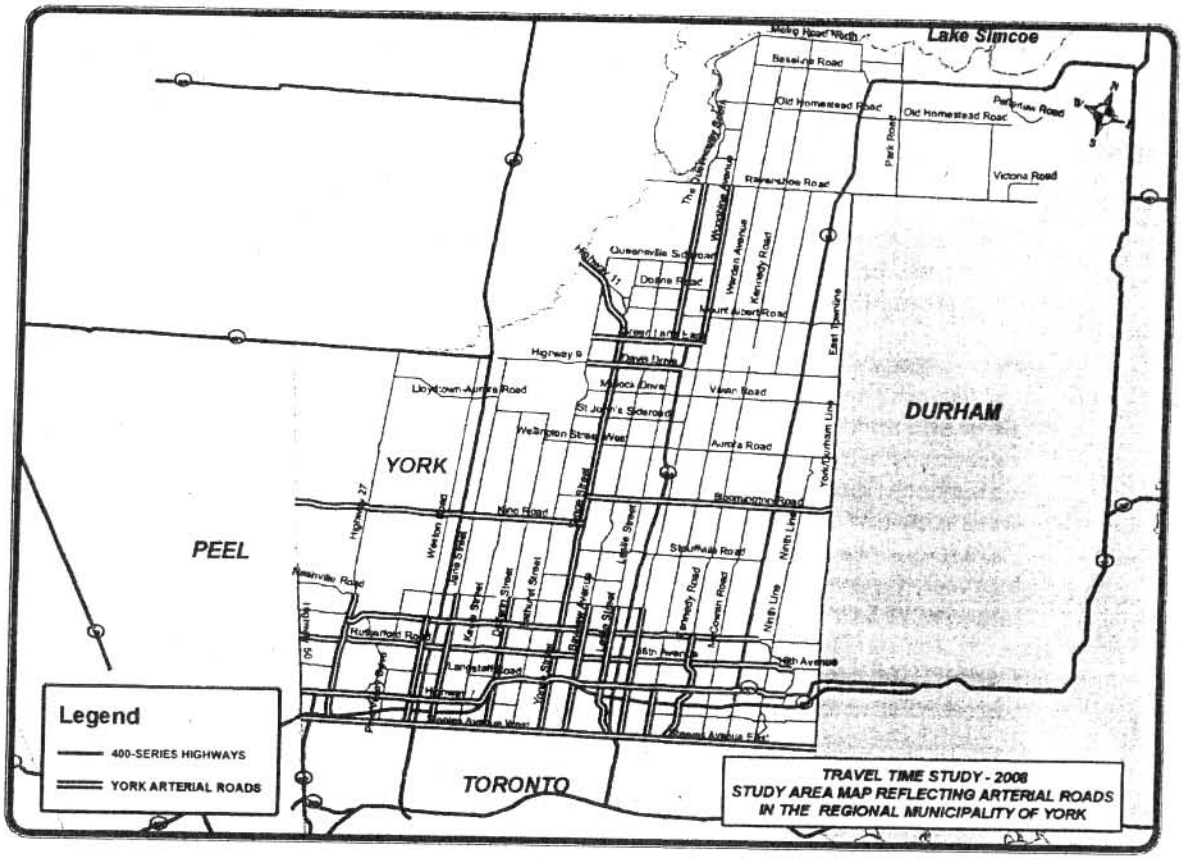
2008 Region of York Aggregate Travel Time Index and Buffer Time Index for Arterials



For arterials within the Region of York, it can be seen that the PM peak period is more congested than the AM peak. Also of interest is the fact that the midday peak is nearly as congested as the AM peak, on the studied arterials. The buffer time index is roughly the same for AM and PM, and indicates that motorists should allow an additional 21-22% travel time to ensure that they will arrive on time 19 out of 20 trips.

5.5 York Region Arterial Analysis

York Region arterial analysis was new for the 2008 Travel Time study. Sixteen arterial corridors were surveyed in York Region, covering approximately 550 km. The following sections describe the findings of the York Region arterial survey.



5.5.1 STATISTICAL VALIDITY OF SAMPLE SIZES

Due to the number of segments, the summary of the required number of runs and the actual runs performed for all arterial segments under the jurisdiction of York Region is provided in **Appendix G1**. The data that were collected satisfied minimum sample size requirements for 96%, 98% and 100% of the arterial segments for the AM, midday and PM peaks, respectively, at a 95% level of confidence.

The samples that did not meet the required confidence levels were on King Road between Yonge Street and Highway 400. Neither direction satisfied 95th percent confidence during the AM peak, nor did westbound satisfy the requirements during the midday peak.

The times of sampling of arterial surveys were varied throughout each peak period to obtain a representative sample of the entire period. The distribution of sample sizes within each period for York Region is presented in **Appendix G1**. Of all available one-hour periods, 89% contained at least one survey.

Survey drivers drove approximately 13,150 km on York Region arterials.

5.5.2 GENERAL PERFORMANCE MEASURES

5.5.2.1 Speed and Travel Time Statistics

The designations of urban street class for each arterial were based on an assumption of free-flow speed. Through discussions with the Region of York, it was determined that the estimated free-flow speed would be equivalent to the posted speed limit plus 10 km/h.

York Region provided a breakdown of speed limits for the arterials being studied. Because speed limits typically change within the boundaries of a single route, a weighted average speed limit was calculated for each route using the distances over which different speed limits apply. Using these weighted segment speed limits, urban street classes were assigned as follows:

- Class II – Yonge Street between Steeles Avenue and 19th Avenue, and between Industrial Parkway and Green Lane; Bayview Avenue; the Rutherford Road/Carrville Road/16th Avenue corridor between Highway 400 and Highway 404; and
- Class I – All other Region of York arterials.

It is important to remember that for this exercise, the road class is determined by the free-flow speed of the analyzed segment, as shown in **Exhibit 5-1**, and the free-flow speed is determined by a weighted average of the various speed limits and distances thereof within an analyzed segment. In the case of York Region, the starting point for free-flow speed was posted speed plus 10 km/h. Therefore, once the weighting process is completed, it can be surmised that any resulting Class II arterials have sufficient sections posted at 50 km/h that the resulting weighted average falls between 55 km/h and 70 km/h.

Exhibit 5-41 summarizes the AM, midday and PM levels of service for York Region arterials. It can be seen that no segments operated at LOS E or F during the AM peak period, and only two percent of roadway segments operated at LOS E midday period. PM operations were found to be worse than the other peaks, with 10% of segments operating at LOS E, but still no segments operating at LOS F. The selection of longer road segments by York Region, as compared to other municipalities in this study, resulted in no segments identified as operating at LOS F. If these longer segments were broken down into smaller segments, one could expect to find road segments operating at LOS F.

Exhibit 5-41: Levels of Service for York Region Arterials

Level of Service	AM Peak Period	Midday Peak Period	PM Peak Period
A	4%	6%	4%
B	21%	33%	19%
C	54%	49%	34%
D	21%	12%	33%
E	0%	2%	10%
F	0%	0%	0%

Summaries of the average travel time, space mean speed and level of service for York Region arterials are provided in **Appendix G1**. Refer to **Appendix G1** for a complete summary of the calculated arterial performance statistics for all periods. Colour-coded maps displaying the arterial mean speed ranges are also provided in **Appendix G1**.

5.5.3 IDENTIFICATION OF SLOWEST ARTERIAL SEGMENTS

The arterial segments were ranked by mean speed to identify locations of poorest performance. The ten slowest York Region arterial segments are shown in **Exhibit 5-42** and **Exhibit 5-43** for the AM and PM peak periods, respectively.

Exhibit 5-42: York Region Arterials – Ten Slowest Arterial Segments (AM Peak Period)

Route	Begins At	Ends At	Segment Length (km)	Space Mean Speed (km/h)
Yonge St. SB	Gamble Rd. / 19th Ave.	Steeles Ave.	12.4	31
Dufferin St. SB	Teston Rd.	Steeles Ave. W	10.4	32
Bayview Ave. SB	Elgin Mills Rd.	Steeles Ave. E	10.2	32
Weston Rd. SB	Major Mackenzie Dr. W	Steeles Ave. W	8.4	34
Leslie St. S SB	Elgin Mills Rd. E	Steeles Ave. E	10.5	36
Rutherford-Carville-16th EB	Hwy 400 NB Exit Ramp	Hwy 404 NB Exit Ramp	14.4	36
Kennedy Rd. SB	Major Mackenzie Dr.	Steeles Ave./ Kennedy Rd.	8.9	37
Hwy 9 / Davis Dr. WB	Hwy 404	Bathurst St.	7.4	39
Woodbine Ave. S SB	Elgin Mills Rd.	Steeles Ave.	10.2	39
Weston Rd. NB	Steeles Ave. W	Major Mackenzie Dr. W	8.5	40

Exhibit 5-43: York Region Arterials – Ten Slowest Arterial Segments (PM Peak Period)

Route	Begins At	Ends At	Segment Length (km)	Space Mean Speed (km/h)
Kennedy Rd. NB	Steeles Ave./ Kennedy Rd.	Major Mackenzie Dr.	13.6	26
Hwy 9 / Davis Dr. WB	Hwy 404	Bathurst St.	7.4	28
Yonge St. NB	Steeles Ave.	Gamble Rd. / 19th Ave.	12.4	31
Bayview Ave. NB	Steeles Ave. E	Elgin Mills Rd.	10.2	31
Warden Ave. NB	Steeles Ave. E	Hwy 7	4.1	31
Warden Ave. SB	Hwy 7	Steeles Ave. E	4.1	32
Hwy 9 / Davis Dr. EB	Bathurst St.	Hwy 404	7.4	32
Rutherford-Carville-16th WB	Hwy 404 NB Exit Ramp	Hwy 400 NB Exit Ramp	14.4	32
Yonge St. SB	Gamble Rd. / 19th Ave.	Steeles Ave.	12.4	33
Weston Rd. NB	Steeles Ave. W	Major Mackenzie Dr. W	8.5	34

The results of the speed ranking for York Region arterials indicate that the PM peak period experiences lower speeds, and is therefore more congested, than the AM peak period. This is consistent with the findings from the other jurisdictions. It can be seen that eight of the slowest AM peak period segments and seven of the slowest PM peak period segments feature Steeles Avenue as one of the boundaries. While this is partially a function of the longer segments selected by York Region as compared to other participating jurisdictions, it also highlights both the amount of development in southern York Region, as well as the number of people commuting between York

Region and the City of Toronto. This is further substantiated by the fact that the slowest AM routes all carry southbound traffic, and four of the five slowest PM routes carry northbound traffic.

5.5.3.1 Travel Time and Buffer Time Indices

Travel Time and Buffer Time Indices were calculated for all arterial road segments during the three peak periods. Refer to **Section 3.2.3** for further details of these performance measures and their formulae. The Travel Time and Buffer Time Indices are summarized for York Region arterial corridors in **Exhibit 5-44** through **Exhibit 5-47**. Refer to **Appendix G1** for tabulated values of the Travel Time Index and Buffer Time Index for all individual arterial segments in each peak period.

Exhibit 5-44: York Region AM Peak TTI Values by Arterial Corridor

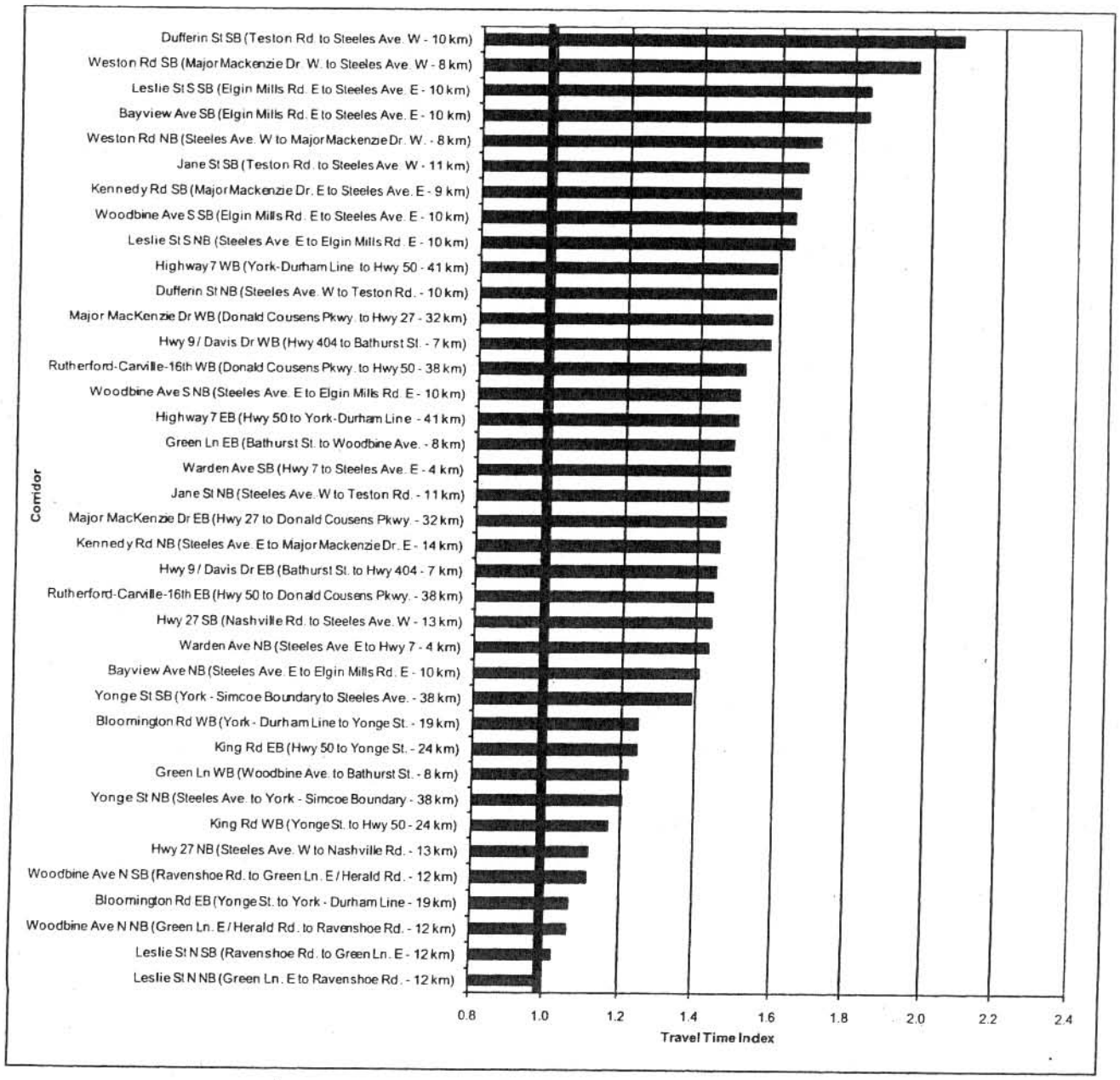


Exhibit 5-45: York Region PM Peak TTI Values by Arterial Corridor

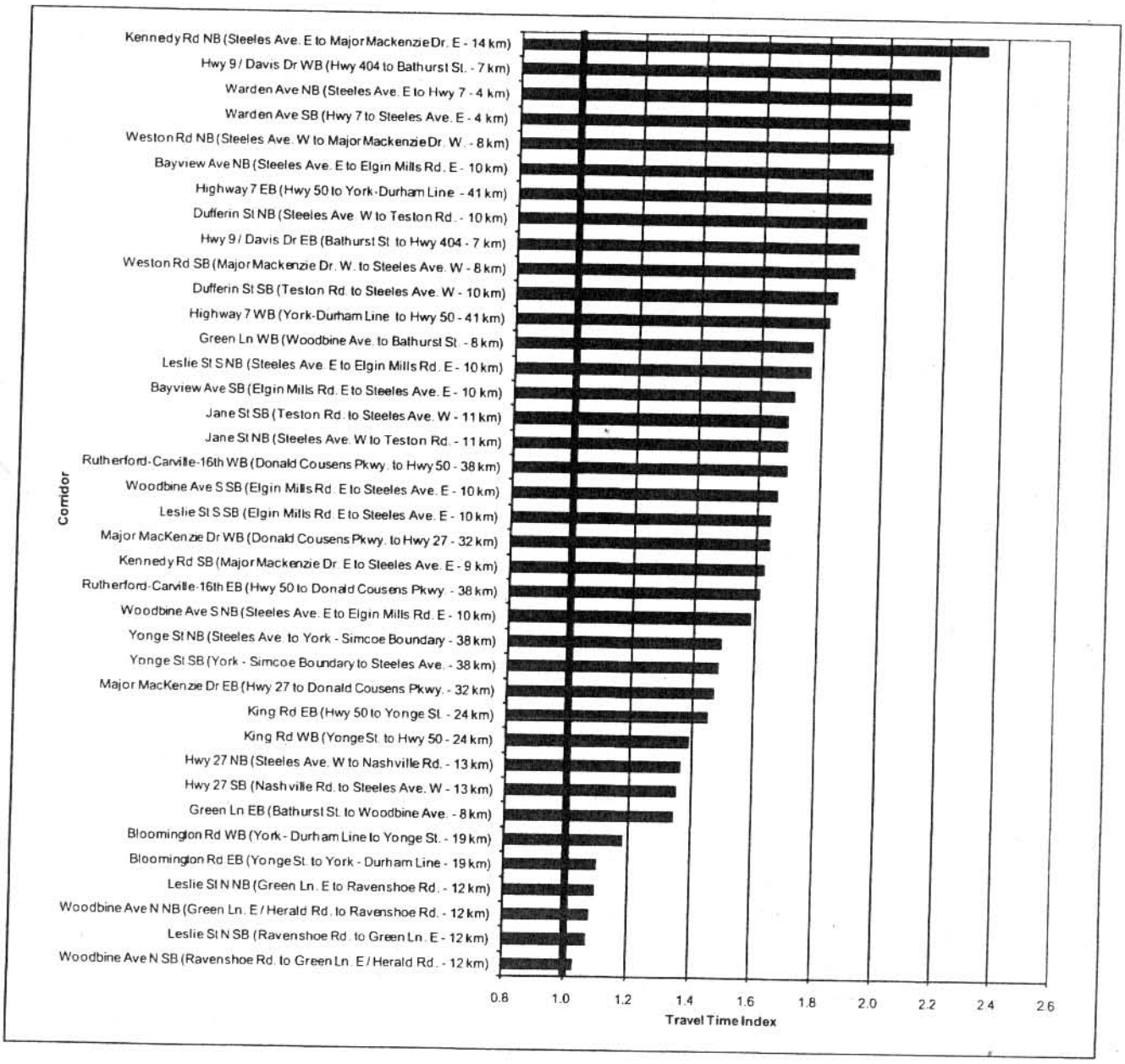


Exhibit 5-46: York Region AM Peak BTI Values by Arterial Corridor

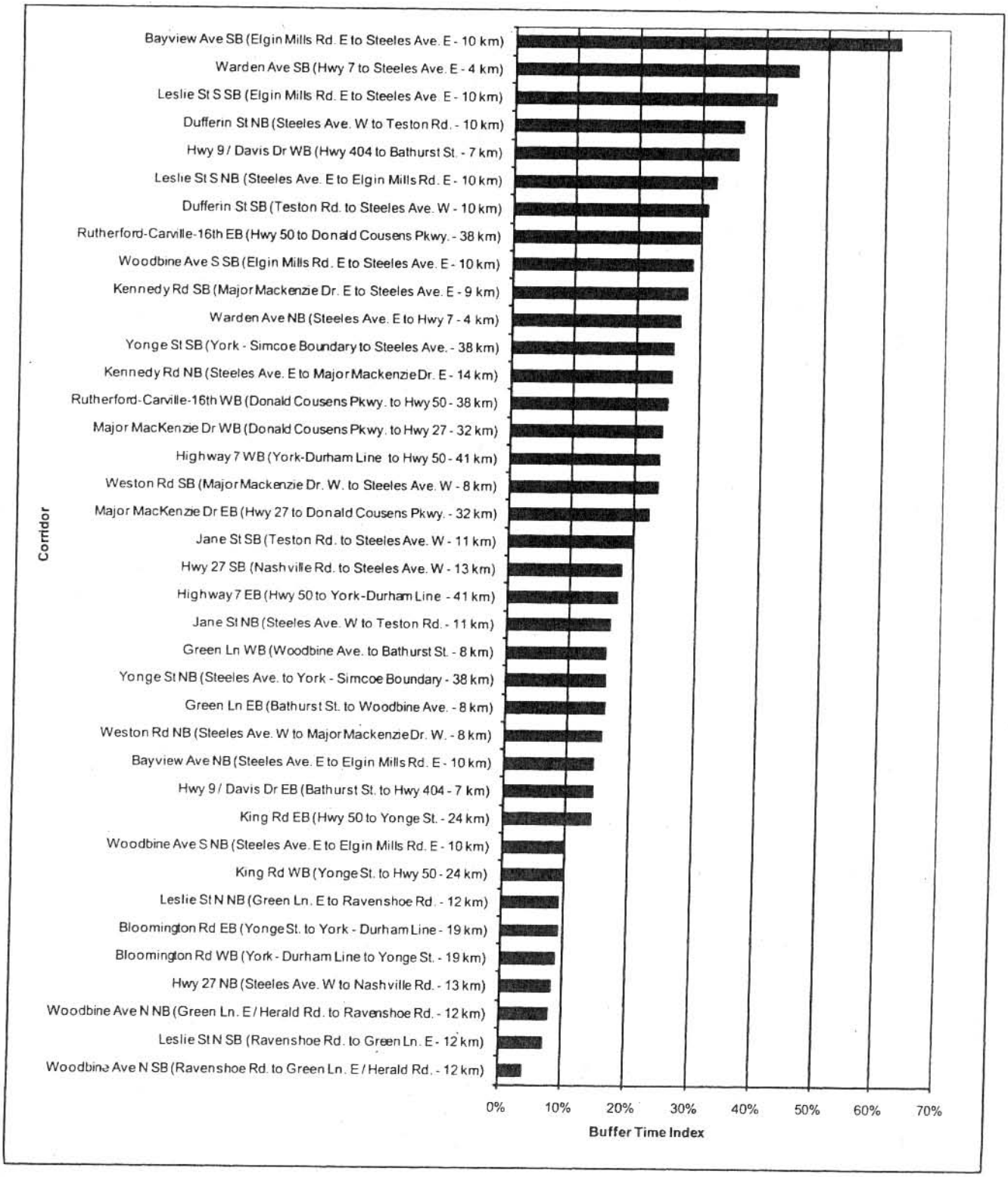
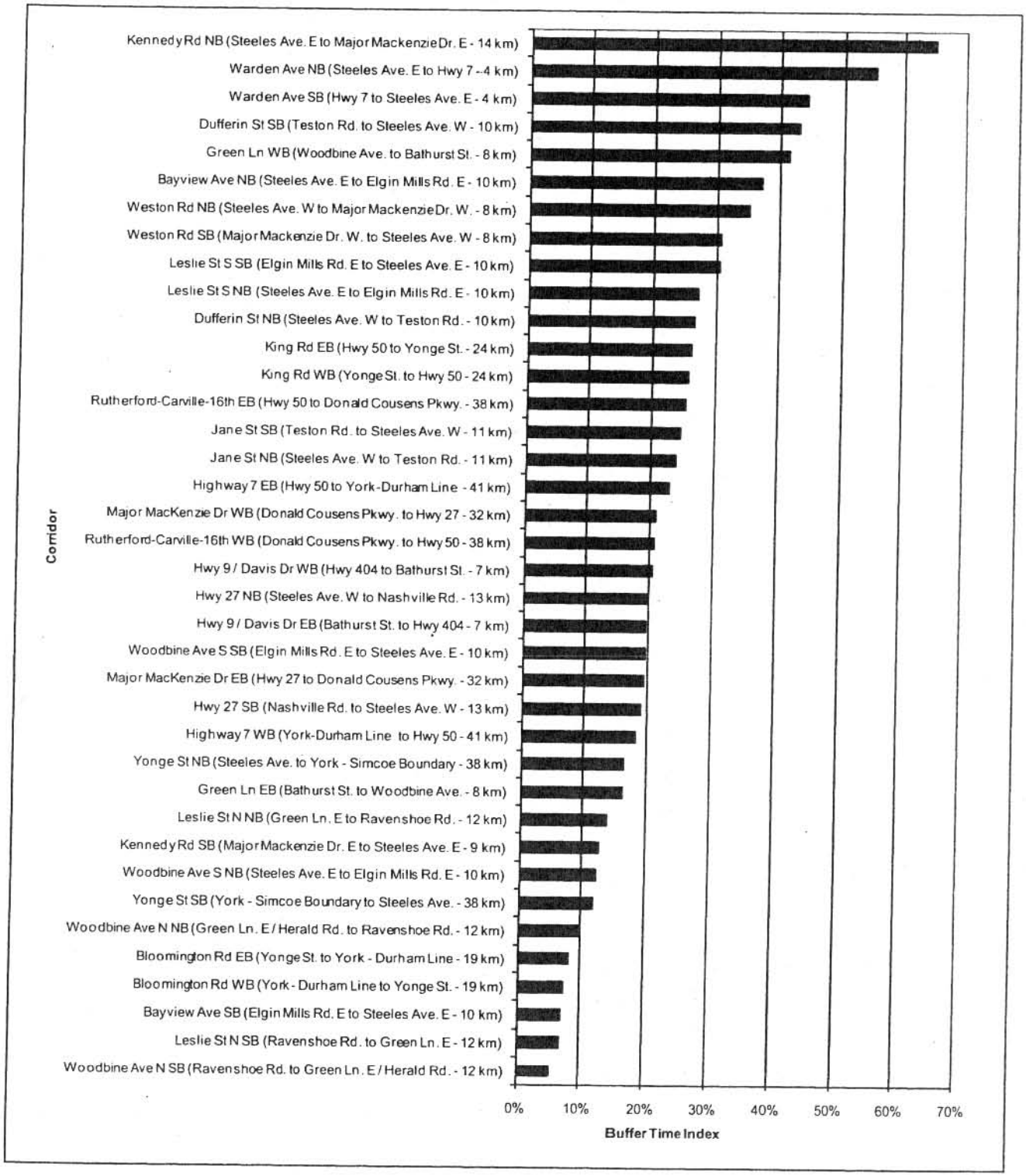


Exhibit 5-47: York Region PM Peak BTI Values by Arterial Corridor



The following observations can be made from the arterial corridor Travel Time and Buffer Time Indices:

- As noted above, PM operations are slower than AM. This is apparent when comparing the AM and PM TTI. In the AM, 39% of arterials have a TTI value of 1.5 or greater. In the afternoon, 61% of arterials have such a TTI. A TTI of 1.5 means that a peak period trip will take 50% longer than it would under the assumed free-flow speed.
- Southbound Dufferin Street is approximately 10% more congested during the AM peak period than northbound Dufferin Street is during the PM peak period;
- During the each peak period, trips on several arterials can be expected to take at least twice as long as they would at the assumed free-flow speeds;
- The least reliable arterials with respect to travel time were found to have BTI values over 60%. This means that motorists should allow themselves an extra 60% travel time to avoid being late on 19 of 20 trips.

5.5.4 MEASURES OF ARTERIAL DELAY

The results of the arterial delay analysis are presented in **Exhibit 5-48** and **Exhibit 5-49** for York Region arterials. Note that these delay results have been normalized to represent delay in terms of delay per traffic signal. Full summaries of arterial delay are provided in **Appendix G1**. Colour coded maps of arterial signal delay are also provided in **Appendix G1**.

Exhibit 5-48: York Region Arterials – Average Delay per Signal – AM Peak Period

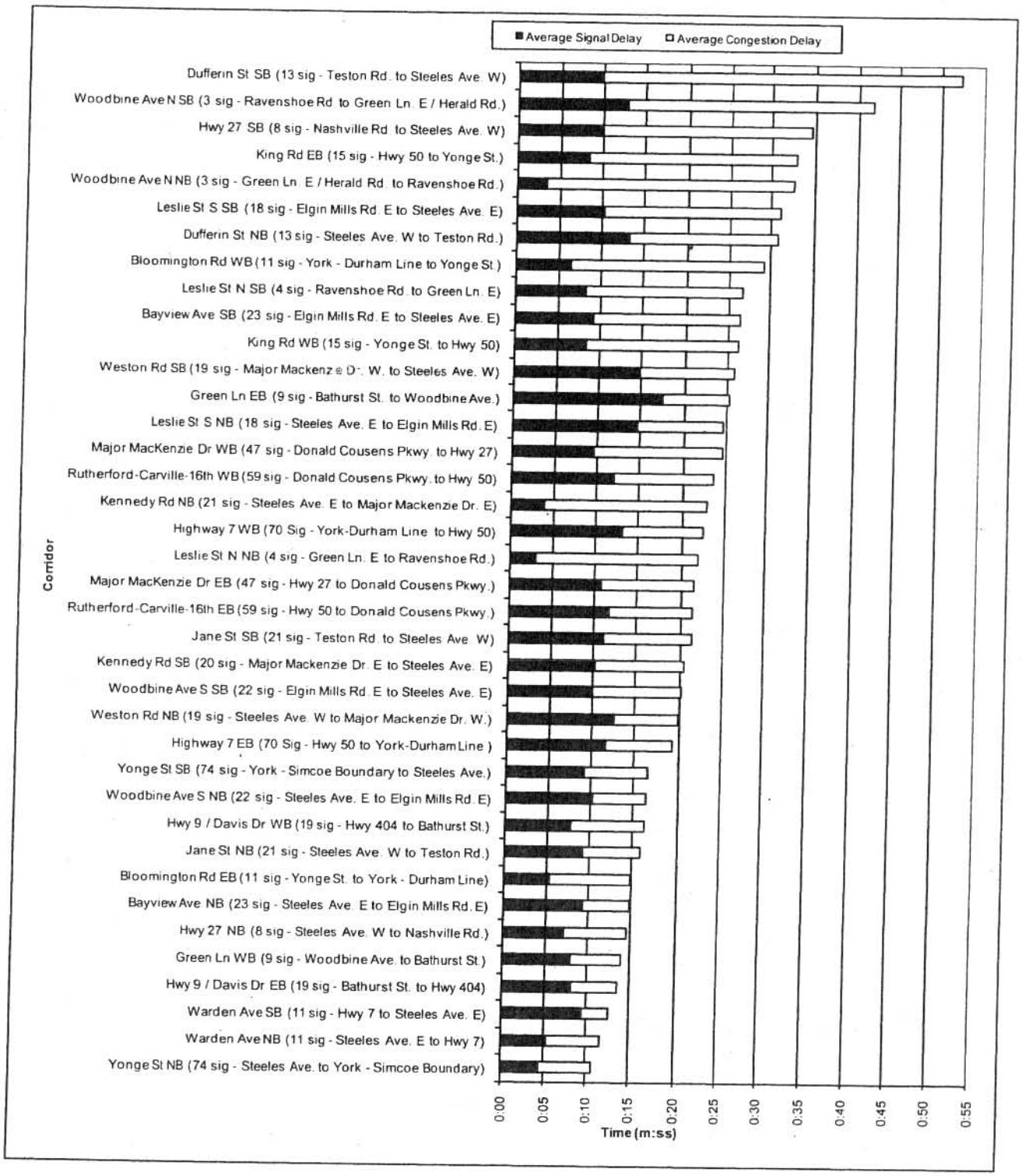
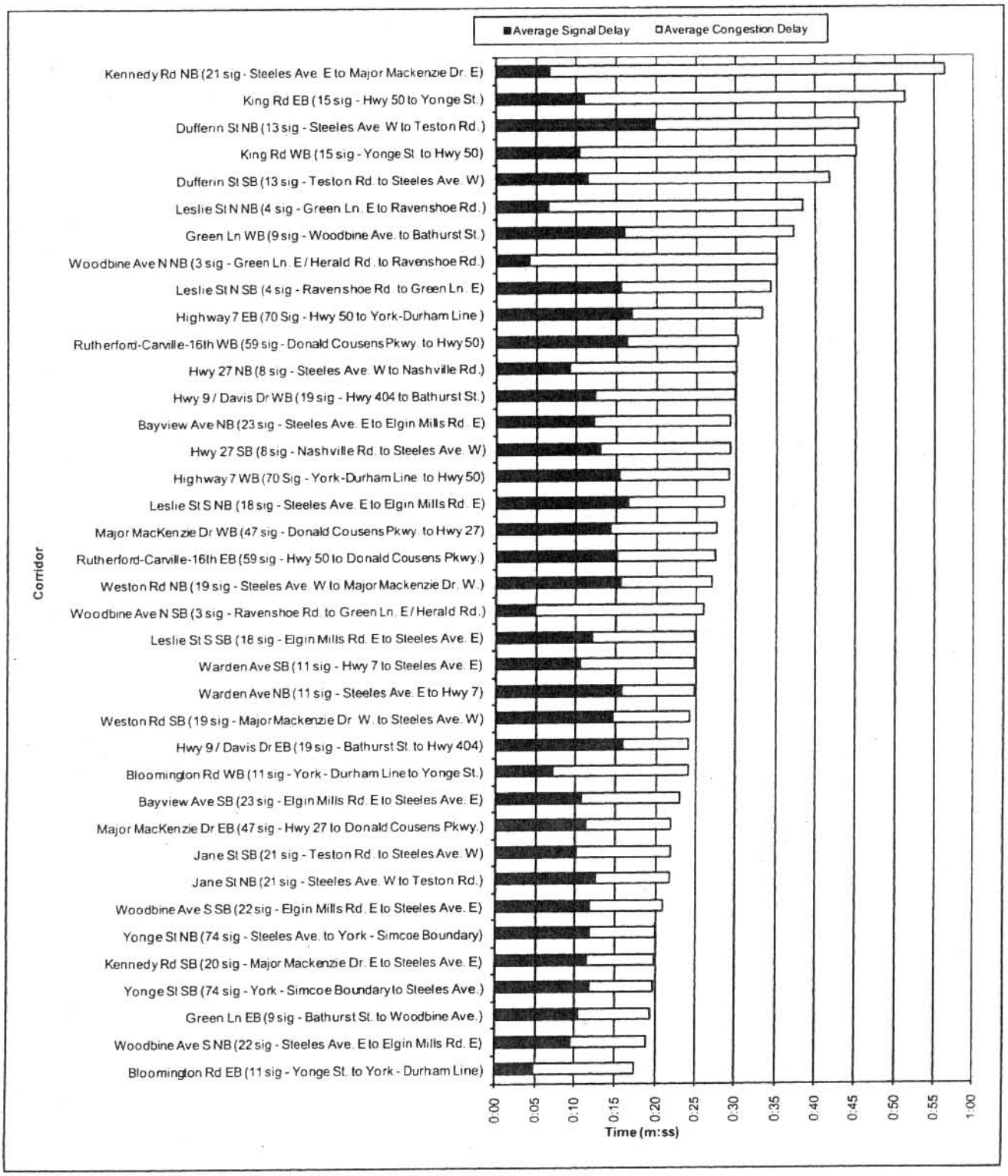


Exhibit 5-49: York Region Arterials – Average Delay per Signal – PM Peak Period



The following observations can be made from investigation of the results for arterial delay:

- Congestion delay is considerably greater than signal delay for York Region arterials, most noticeably southbound Dufferin Street and northbound Kennedy Road and Leslie Street during the AM peak hour and northbound Kennedy Road during the PM peak hour[17];
- Both directions of Dufferin Street experience considerable delay during each peak period; and
- There appears to be no correlation between the number of traffic signals on a corridor and the amount of signal or congestion delay for these studied arterials.

[17] Recall that congestion delay is a function of the assumed free-flow travel time. The high levels of congestion on these corridors may be due, in part, to an overestimation of the free-flow speed on each corridor.