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YONGE STREET TRAFFIC OPERATIONAL REVIEW

The Transportation Services Committee recommends:

- 1. Receipt of the presentation by Steven Kemp, Director, Traffic Management and Intelligent Transportation Systems; and**
- 2. Adoption of the recommendation contained in the following report dated May 15, 2012, from the Commissioner of Transportation and Community Planning.**

1. RECOMMENDATION

It is recommended that this report be received for information.

2. PURPOSE

This report provides information regarding traffic signal operational improvements carried out on Yonge Street between Finch Avenue and Highway 7 to reduce transit travel times for YRT/Viva in mixed traffic.

3. BACKGROUND

Yonge Street between the Finch Subway Station and York Region Transit's Richmond Hill Centre Terminal is a key corridor

Yonge Street between the Finch Subway Station and York Region Transit's (YRT) Richmond Hill Centre Terminal is a key transit corridor in York Region. This route provides a key link between Richmond Hill, Highway 407, Highway 7 and the TTC subway system. Approximately 22,000 transit users travel along this corridor daily. During peak hours, some sections carry about 30 Viva buses and 10 YRT buses per hour per direction. It is the corridor with the highest number of transit users in York Region. This corridor also carries a high volume of commuter vehicle trips during the peak hours. During the AM peak (06:00 to 09:00) the peak hourly flow is about 1900 vehicles per hour in the southbound direction, and during the PM peak (16:00 to 19:00) the peak hourly flow is about 2200 vehicles per hour in the northbound direction, making it one of the busiest 4-lane arterials in York Region. The capacity of a 4-lane urban arterial is about 1900 – 2400 vehicles per hour per direction, depending on signal timings. For comparison, the capacity of a freeway lane is about 1900 vehicles per hour.

A subway is planned for the length of this corridor. However, at this time there is no certainty as to when an estimated \$3 billion of funding will be available for the construction of the subway. Even if funding was available, the subway would not be completed until about 2020. The construction of Viva rapidways on Yonge Street, north of Highway 7 is scheduled for completion by 2016. It is therefore likely that for some period of time there will be a discontinuity in the rapid transit system between Highway 7 and Finch Subway Station and there will be a continued reliance of transit vehicles operating in mixed traffic for large parts of this corridor. Therefore it is critical to manage travel on this corridor to minimize delay and provide better transit travel time reliability. The most current information is a 2008 report from the Organization for Economic Co-operation and Development which estimates the cost of congestion in the GTA to be about \$ 3.3 billion per year, with the Region's share at \$893 million per year.

The section of Yonge Street between Steeles Avenue and the Finch Subway Station is under the jurisdiction of the City of Toronto. The traffic signals on this section are already optimized to minimize delays using the City's Split Cycle Offset Optimization Technique (SCOOT) control system. Regional staff therefore focused their efforts on the section of Yonge Street under Regional jurisdiction - between Steeles Avenue and Highway 7. However, observations were still conducted south of Steeles Avenue and Regional staff coordinated with City of Toronto staff to address any issues noted during the review.

The objective of the traffic operational review was to identify and implement immediate short term operational improvements

The objective of the traffic operational review was to identify and implement immediate and short term operational improvements along Yonge Street to: a) reduce travel times for transit in mixed traffic, while recognizing the needs of all roads users, and b) to improve the consistency of travel times.

These are improvements aimed at changing how vehicles operate along roadways and/or intersections. Examples of the types of operational improvements that can reduce travel times along an arterial corridor are: turn restrictions, changing signal phases, changing signal timings and adjusting signal off-sets to improve signal coordination.

4. ANALYSIS AND OPTIONS

The Yonge Street Traffic Operational Review was carried out in four interrelated phases:

- Data Collection
- Analysis
- Implementation

- Evaluation

The primary sources of data used in this study were vehicle travel time studies and YRT/Viva's travel time data for Viva buses

Vehicle travel time studies involve using special equipment to continually record vehicle speeds while driving the study route, on a typical weekday, as close to the speed limit as possible, four to five times in each direction, during both the AM and PM peaks. The speed profile information collected can be used to determine travel times and delays between any two intersections, to identify bottlenecks (i.e. candidate locations for capacity improvements) and to identify intersections that may be out of sync with adjacent signals.

YRT/Viva travel time data was collected through the Automatic Vehicle Location (AVL) system on the Viva buses. This provided information on average travel times for Viva buses before and after the implementation of operational improvements. Video logging data was also obtained from some Viva buses and were reviewed to obtain background information on typical Viva bus operations along Yonge Street.

Updated traffic counts were obtained at certain intersections in order to update the Synchro traffic modeling software. This software was used extensively to assess the potential impacts of increasing cycle lengths, changing signal timings and synchronization offsets, as well as to identify the most appropriate operational improvement strategies.

The following operational improvements were implemented in mid-September of 2011

- The signal phasing sequence at the intersection of Yonge St/ Hwy 7 Ramp/ Garden Avenue was changed to permit westbound traffic to proceed before the eastbound direction. This change allows transit vehicles that have just turned left onto Yonge Street to travel through the two downstream Highway 407 ramp intersections on a green phase.
- During the AM peak on Yonge Street, traffic signal cycle lengths at Clark, Doncaster and Glen Cameron were increased from 115 seconds and 110 seconds to 130 seconds to improve signal synchronization.
- During the PM peak traffic control signals along the study corridor had 120 second cycle lengths. To increase northbound and southbound capacity, and to better synchronize traffic signals, all cycle lengths were increased to 130 seconds.
- At all traffic signals side-road green phases were reduced to their absolute minimum allowable durations, based on minimum pedestrian crossing times. Any available time

was assigned to the Yonge Street green phases. This resulted in marginal increases in delays to side road vehicles and pedestrians along the corridor. However, the increased side road delays are offset by decreased travel times along the improved Yonge Street corridor for both motor vehicles and transit vehicles and therefore pedestrians using transit.

- Optimal traffic signal offsets were implemented in order to achieve good progression for southbound vehicles during the AM peak and for northbound vehicles during the PM peak.

After the operational improvements were implemented in mid-September 2011, staff conducted follow-up studies to assess the effectiveness of the improvements

Staff collected and analyzed vehicle and transit travel time data after the operational improvements were implemented and then compared the results with those of similar data that was collected in mid-September, just before the improvements were implemented.

During the initial follow-up studies, Regional staff discovered that the City of Toronto's traffic signal at Yonge Street and Steeles Avenue was not running the proper timing plan. This had a significant and detrimental impact on Yonge Street traffic operations north of Steeles Avenue. City of Toronto staff was immediately informed and soon after the City of Toronto fixed the Yonge/Steeles traffic signal.

The immediate short-term improvements implemented during the Yonge Street operational review resulted in significant travel time reductions

The results achieved in the AM Peak southbound direction are illustrated below. **Figure 1** and **Table 1** compare the 'before' and 'after' vehicular travel times along the corridor for the critical AM peak southbound direction, while **Figure 2** and **Table 2** compare the travel times for Viva transit buses.

The Viva transit times exclude dwell times at transit stops. The 'before' data was collected in September 2011 and the 'after' data was collected in February 2012. The improvements implemented for AM peak traffic operations reduced the average vehicular travel time of 637 seconds (10 minutes and 37 seconds) by 193 seconds (3 minutes and 13 seconds), a reduction of **30 per cent**. The average Viva transit travel time of 824 seconds (13 minutes and 44 seconds) was reduced by 196 seconds (3 minutes and 16 seconds), a reduction of **24 per cent**.

Figure 1
AM Peak – Southbound: Comparison of Vehicular Travel Times

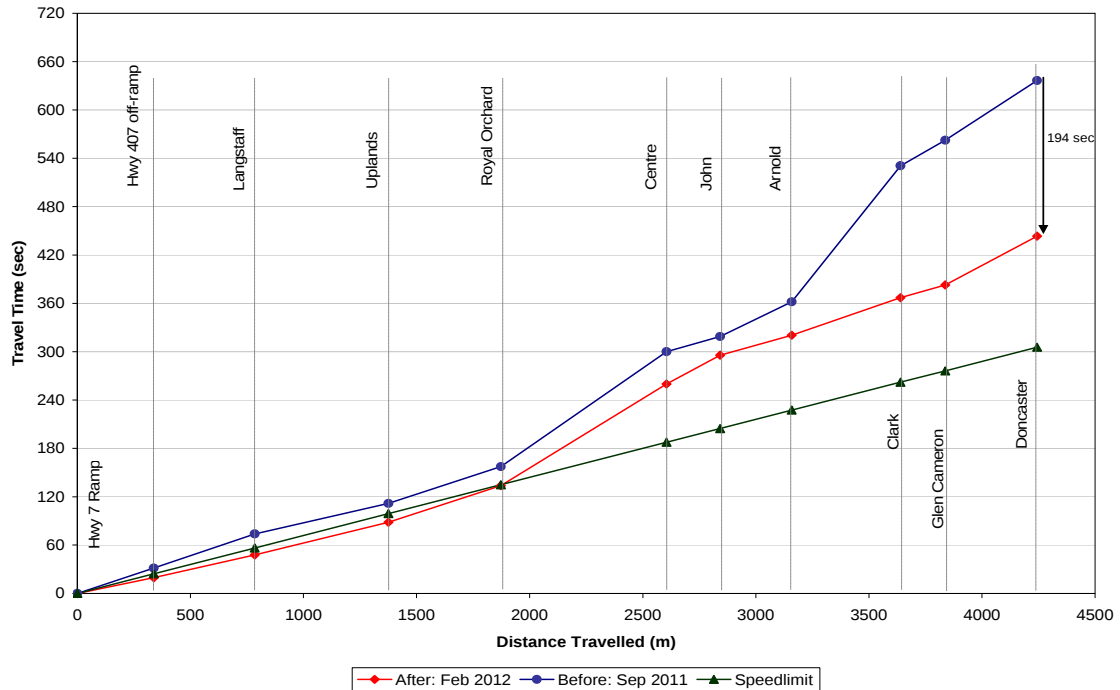


Table 1
AM Peak – Southbound: Vehicular Travel Time Results

Intersection	Distance (m)	Total Distance (m)	Before : Sep 2011			After : Feb 2012		
			Travel Time (sec)	Speed (km/h)	Total Time (sec)	Travel Time (sec)	Speed (km/h)	Total Time (sec)
Hwy 7 Ramp	0	0	0		0	0		0
Hwy 407 off-ramp	338	338	31.5	39	32	19.6	62	20
Langstaff	446	784	42.3	38	74	28	57	48
Uplands	591	1375	38	56	112	40.6	52	88
Royal Orchard	498	1873	45.5	39	157	45.6	39	134
Centre	732	2605	142.8	18	300	126	21	260
John	237	2842	18.8	45	319	35.8	24	296
Arnold	317	3159	43	27	362	24.8	46	320
Clark	481	3640	168.8	10	531	46.6	37	367
Glen Cameron	197	3837	31.8	22	563	15.8	45	383
Doncaster	406	4243	74	20	637	60.6	24	443

Figure 2
AM Peak – Southbound: Comparison of Viva Transit Travel Times

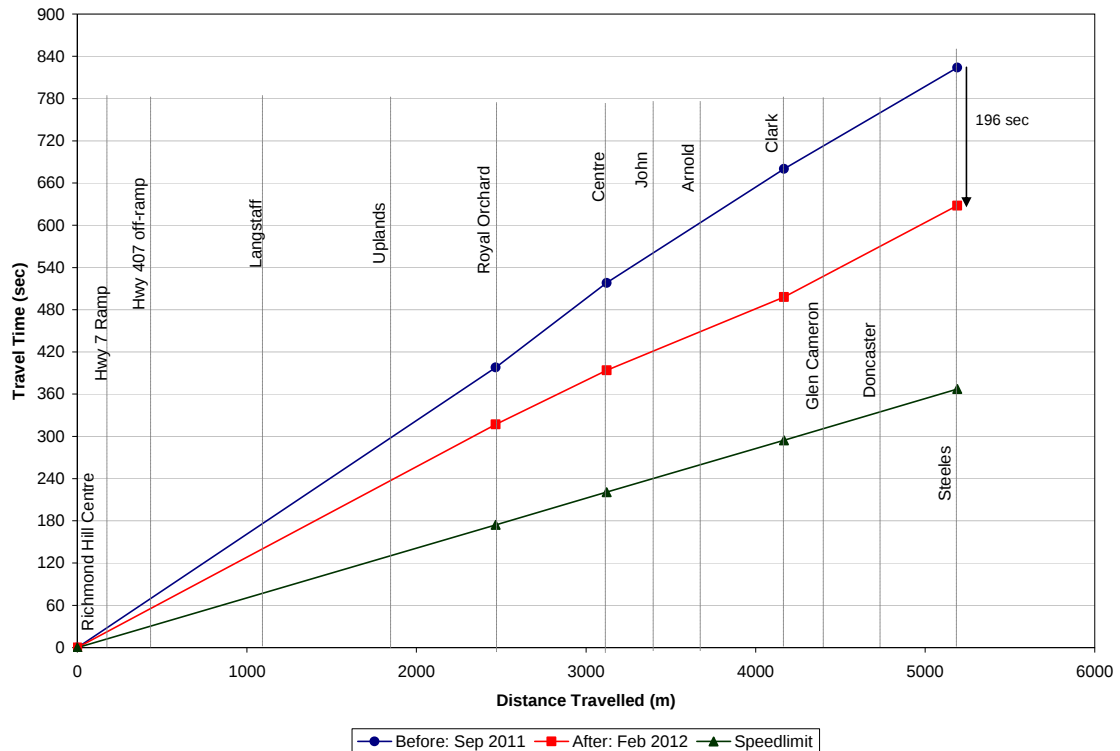


Table 2
AM Peak – Southbound: Viva Travel Time Results

Intersection	Distance (m)	Total Distance (m)	Before : Sep 2011			After : Feb 2012		
			Travel Time (sec)	Speed (km/h)	Total Time (sec)	Travel Time (sec)	Speed (km/h)	Total Time (sec)
Richmond Hill Centre	0	0	0		0	0		
Royal Orchard Blvd.	2472	2472	398	22	398	317	28	317
Centre Street	655	3127	120	20	518	77	31	394
Clark Avenue	1045	4172	162	23	680	104	36	498
Steeles Avenue	1022	5194	144	26	824	130	28	628

The results achieved in the PM Peak northbound direction are illustrated below. **Figure 3** and **Table 3** compare the 'before' and 'after' vehicular travel times along the corridor for the critical PM peak northbound direction, while **Figure 4** and **Table 4** compare the travel times for Viva transit buses. The improvements implemented for PM peak operations decreased the average vehicle travel time of 439 seconds (7 minutes, 19 seconds) by 111 seconds, a reduction of **25 per cent**. The average Viva transit travel time of 649 seconds (10 minutes and 49 seconds) was reduced by 25 seconds, a marginal reduction of **4 per cent**.

Figure 3
PM Peak – Northbound: Comparison of Vehicular Travel Times

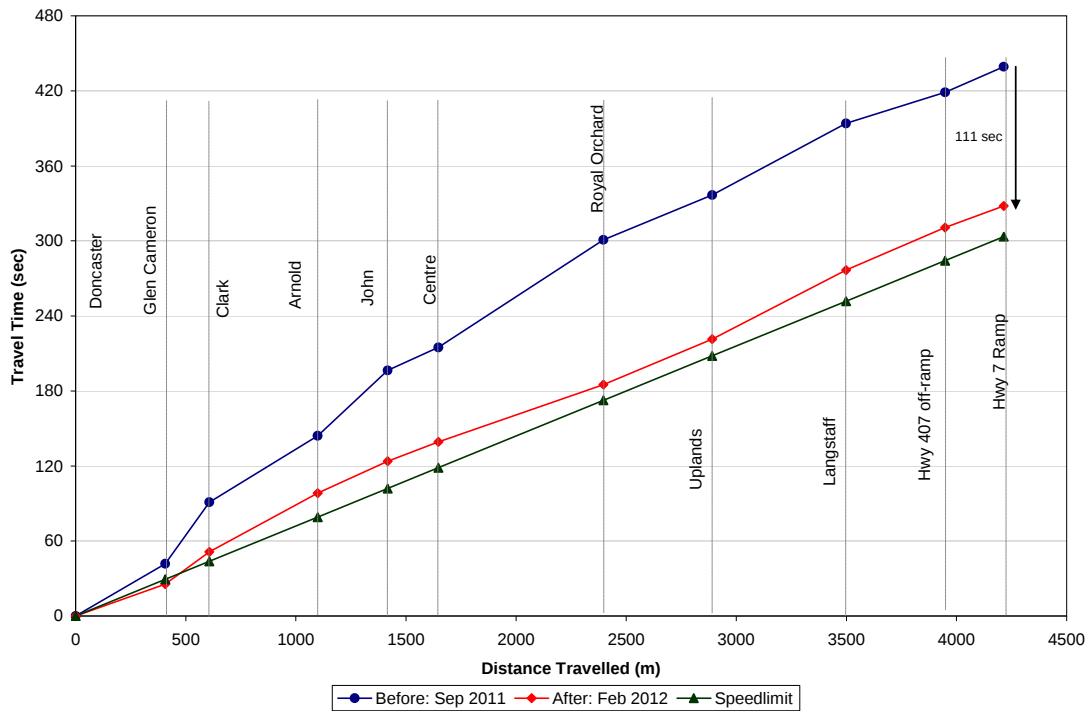


Table 3
PM Peak – Northbound: Vehicular Travel Time Results

Intersection	Distance (m)	Total Distance (m)	Before : Sep 2011			After : Feb 2012		
			Travel Time (sec)	Speed (km/h)	Total Time (sec)	Travel Time (sec)	Speed (km/h)	Total Time (sec)
Doncaster	0	0	0		0	0		0
Glen Cameron	407	407	41.8	35	42	25.5	57	26
Clark	200	607	49.3	15	91	25.8	28	51
Arnold	492	1099	53	33	144	47	38	98
John	318	1417	52.3	22	196	25.5	45	124
Centre	230	1647	18.5	45	215	15.5	53	139
Royal Orchard	749	2396	86	31	301	45.8	59	185
Uplands	494	2890	35.8	50	337	36.3	49	221
Langstaff	608	3498	57.3	38	394	55.3	40	277
Hwy 407 WB	450	3948	24.8	65	419	34	48	311
Garden	266	4214	20.5	47	439	17.3	55	328

Figure 4
PM Peak – Northbound: Comparison of Viva Transit Travel Time

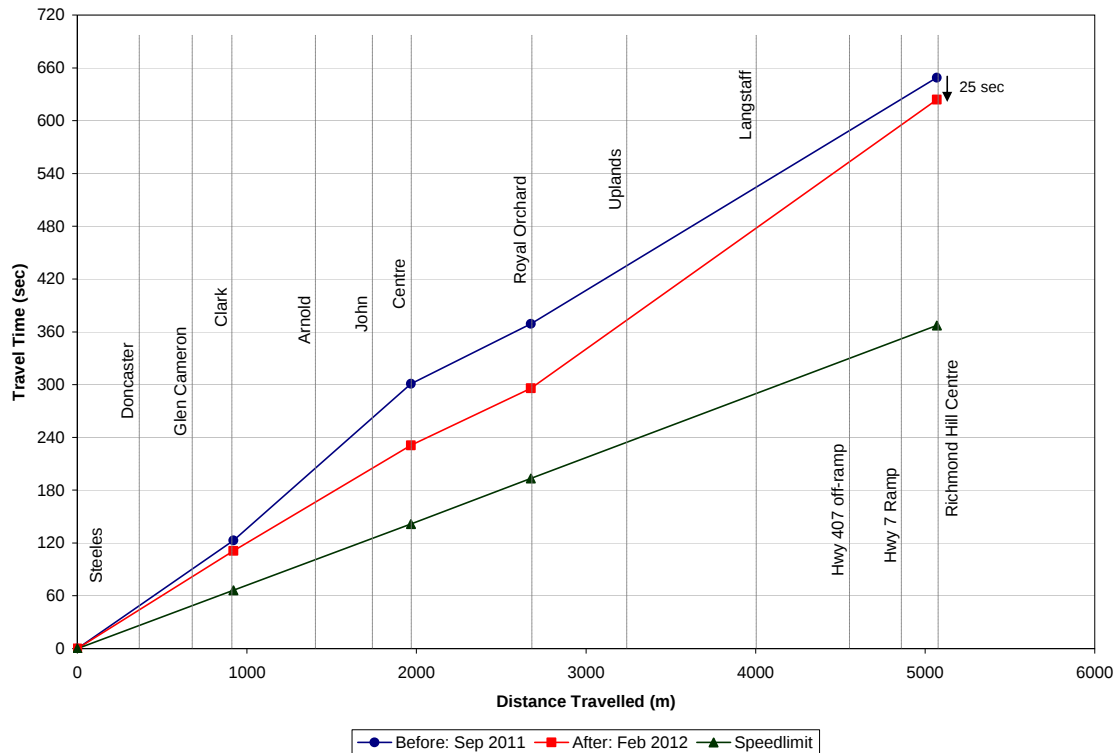


Table 4
PM Peak – Northbound: Viva Travel Time Results

Intersection	Distance (m)	Total Distance (m)	Before : Sep 2011			After : Feb 2012		
			Travel Time (sec)	Speed (km/h)	Total Time (sec)	Travel Time (sec)	Speed (km/h)	Total Time (sec)
Steeles Avenue	0	0	0		0	0		0
Clark Avenue	920	920	123	27	123	111	30	111
Centre Street	1046	1966	178	21	301	120	31	231
Royal Orchard Blvd.	718	2684	68	38	369	65	40	296
Richmond Hill Centre	2417	5101	280	31	649	328	27	624

The reason for the marginal improvement in the average travel times for northbound transit vehicles during the PM peak (649 seconds to 624 seconds) is that operating conditions were already good during the 'Before' period. This made it difficult to obtain the same scale of improvement as achieved for the southbound transit vehicles during the AM peak period (824 seconds to 628 seconds).

While the results from the Yonge Street operational improvements have improved YRT/ Viva Transit travel times along the corridor, there are also disadvantages that result to other road users

Different road users can have competing objectives and perspectives on what the optimal signal operation should be. At traffic control signals, pedestrians do not want to wait too long to cross and want enough time to cross the intersection safely; while side street traffic or local residents want to get in and out of their communities quickly. Commuters, on the other hand, do not want to stop and want to get to their destinations as quickly as possible. The challenge was to look at these competing demands with a focus on achieving the objective of reducing travel times for transit in mixed traffic, while recognizing the needs of all roads users. **Table 5** provided below highlights both the key advantages and disadvantages.

Table 5
Yonge Street Traffic Operational Improvements

Advantages	Disadvantages
Reduced travel time, delays and stops to transit vehicles during critical peak periods.	Increased delays to side road vehicles.
Reduced travel time, stops and delays for commuters on Yonge Street during critical peak periods.	Increased delays to northbound and southbound left turn phases at some intersections.
Greater consistency in travel times as a result of reduced stops.	Increased delays to pedestrians crossing main street (Yonge Street).

There is little scope for further substantial reductions in travel time by means of operational improvements alone. Further mobility improvements in this corridor will only be possible through physical improvements such as dedicated transit lanes or the Yonge Subway extension into York Region. In order to sustain the benefits achieved through this operation review, ongoing monitoring and periodic adjustments will be required to allow for changes in traffic volumes and patterns over time.

Link to Key Council–approved Plans

The work completed in the Yonge Street Traffic Operational Review directly supports York Region’s 2011 to 2015 Strategic Plan. Specifically, the Operational Review supports the “Continue to Deliver and Sustain Critical Infrastructure” Priority Area by optimizing vehicle and transit travel times in the existing road configuration. In so doing, the Operational Review facilitates an increase in non-automotive travel in this key transit corridor, which is an “Indicator of Success” for this Priority Area within the Multi-Year Action Plan.

5. FINANCIAL IMPLICATIONS

There are three traffic operations technologists and one traffic engineer dedicated to all aspects of traffic signal operations, including signal timing and synchronization.

The Yonge Street operational review required an extensive amount of data collection, analysis and evaluation. All efforts associated with this review were carried out in-house using regional staff's expertise and knowledge of the Yonge Street corridor. The cost associated with traffic signal timing and synchronization improvements is included in the existing Transportation and Community Planning operating budget. The total annual operating cost for these types of reviews is approximately \$160,000 which represents less than 0.1% of the total Transportation and Community Planning operating budget. These reviews are necessary to reduce the approximate annual congestion cost of \$893 million in York Region.

6. LOCAL MUNICIPAL IMPACT

Optimizing traffic flows along an arterial corridor is achieved through good synchronization along the length of the arterial roadway. This helps the local municipalities avoid neighbourhood infiltration issues by keeping the traffic on the arterial roads.

7. CONCLUSION

The immediate short term improvements implemented during the Yonge Street traffic operational review resulted in significant travel time reductions for both motorist and transit vehicles along the Yonge Street corridor in mixed traffic conditions. The improvements implemented for AM peak traffic operations reduced the average vehicle travel time by **30 per cent** and the average Viva transit travel time by **24 per cent**. The improvements implemented for PM peak operations decreased the average vehicle travel by **25 per cent** and the average Viva transit travel time by a marginal **4 per cent**.

Traffic patterns are ever changing due to growth and development, therefore, the need to continuously monitor and adjust traffic control signal timings is required to ensure progression along corridors. In addition, technology advancements in Intelligent Transportation Systems will assist in managing congestion and delays on the Regional road network.

For more information on this report, please contact Steven Kemp, Director of Traffic Management and Intelligent Transportation Systems at Ext. 5226.

The Senior Management Group has reviewed this report.

Yonge Street Operational Review

(Highway 7 to Finch Avenue)

**Presentation to
Transportation Services Committee**

(Reference Agenda Item D1)

Steven Kemp

June 13, 2012

Background

- ❑ Key transit corridor in York Region
- ❑ VIVA BRT north of Hwy 7 by 2015
- ❑ Critical need for rapid transit link between Richmond Hill Centre and Finch Station
- ❑ Timing for Yonge Subway extension not certain
- ❑ Discontinuity in rapid transit system along Yonge Street corridor between Finch Subway and Hwy 7.
- ❑ Need to optimize existing operations to improve transit

Project Objective

- ❑ To identify and implement immediate short term operational improvements along Yonge Street from Finch Avenue to Highway 7 to:
 - ❑ Reduce travel times for transit in mixed traffic, while recognizing the needs of all road users, and
 - ❑ Improve the consistency of transit travel times

Results Achieved

- ❑ The immediate short term improvements implemented during the Yonge Street operational review resulted in significant travel time reductions.
 - ❑ AM Peak – Southbound
 - ❑ 30% vehicle travel time reduction
 - ❑ 24% VIVA transit travel time reduction
 - ❑ PM Peak – Northbound
 - ❑ 25% vehicle travel time reduction
 - ❑ 4% VIVA transit travel time reduction

Methodology

The project was carried out in four interrelated steps



Data Collection

- ❑ Data was collected from several different sources:
 - ❑ Field observations
 - ❑ Travel time surveys
 - ❑ YRT transit travel time data
 - ❑ Bluetooth sensors
 - ❑ Transit video logging

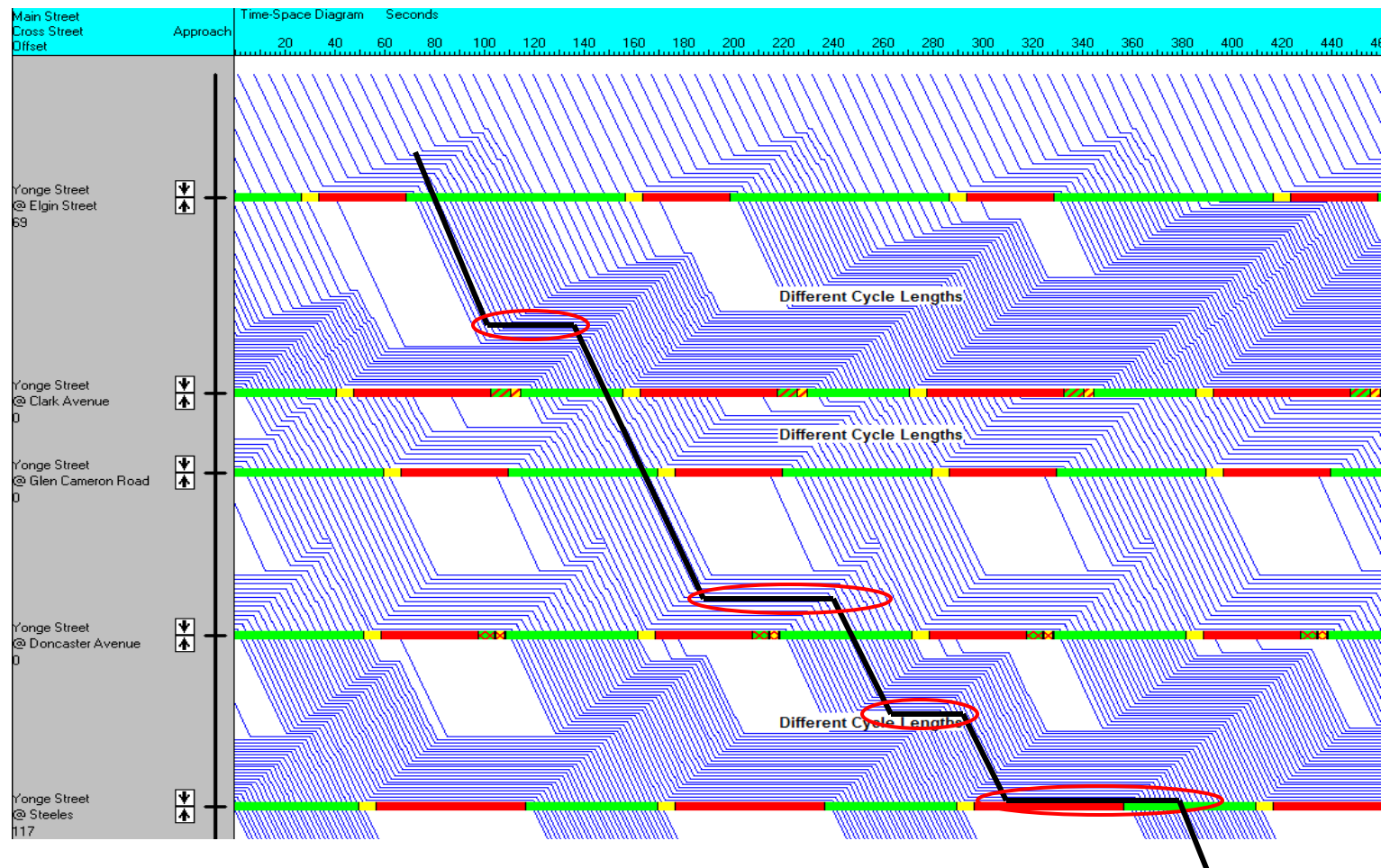
Analysis

- ❑ Synchro traffic modeling software was used extensively to assess the potential impacts of:
 - ❑ Increasing cycle lengths
 - ❑ Optimizing signal timings
 - ❑ Adjusting offsets
 - ❑ Changing signal phasing sequence

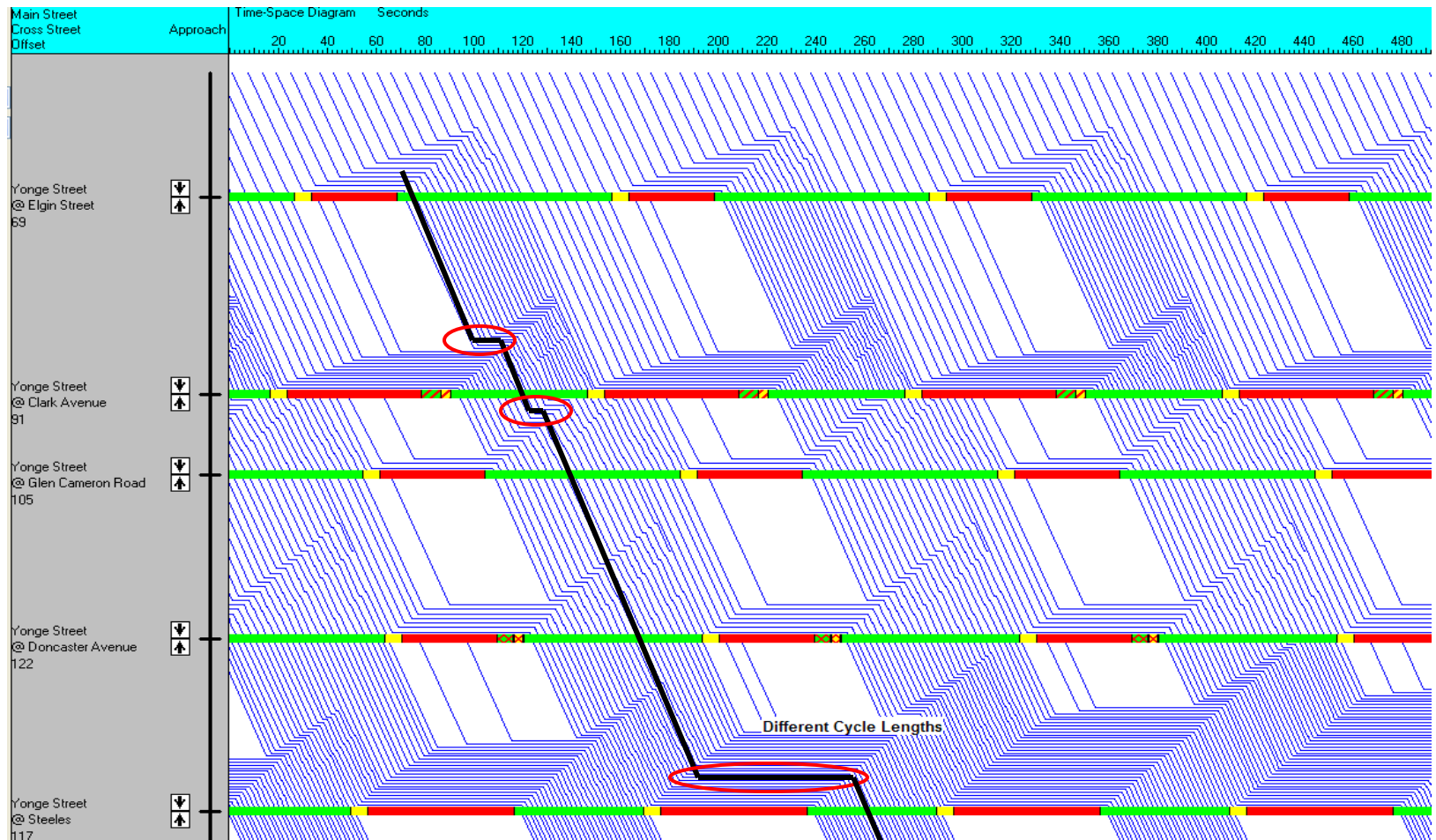
Implementation

- ❑ The operational improvements that were implemented in September 2011 included:
 - ❑ Signal Phasing Sequence changes at Yonge St and Garden Ave/Highway 7 Ramp: before and after
 - ❑ Cycle length and Signal Timing adjustments
 - ❑ Signal offset adjustments

Time~Space Diagrams - Before



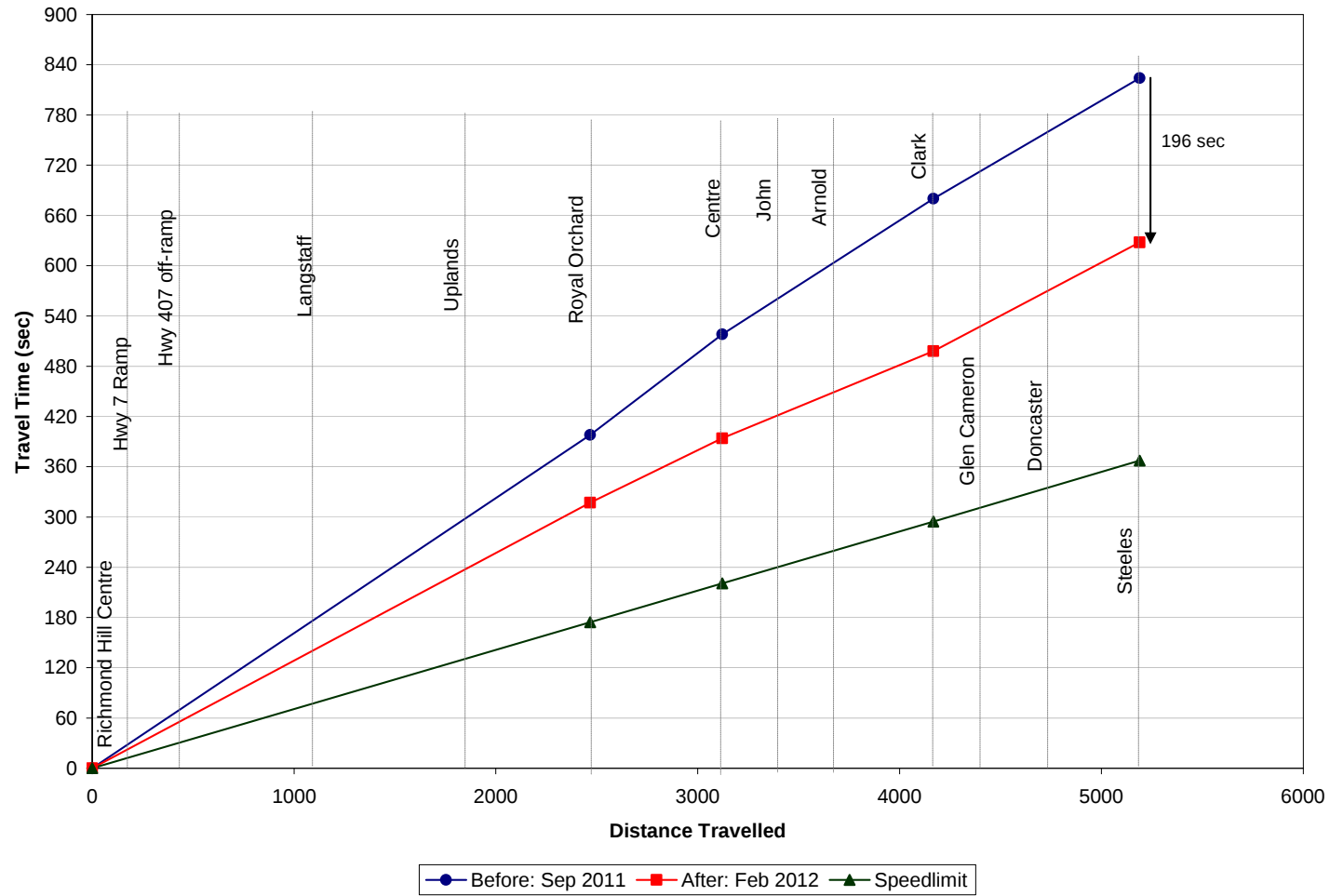
Time~Space Diagrams - After



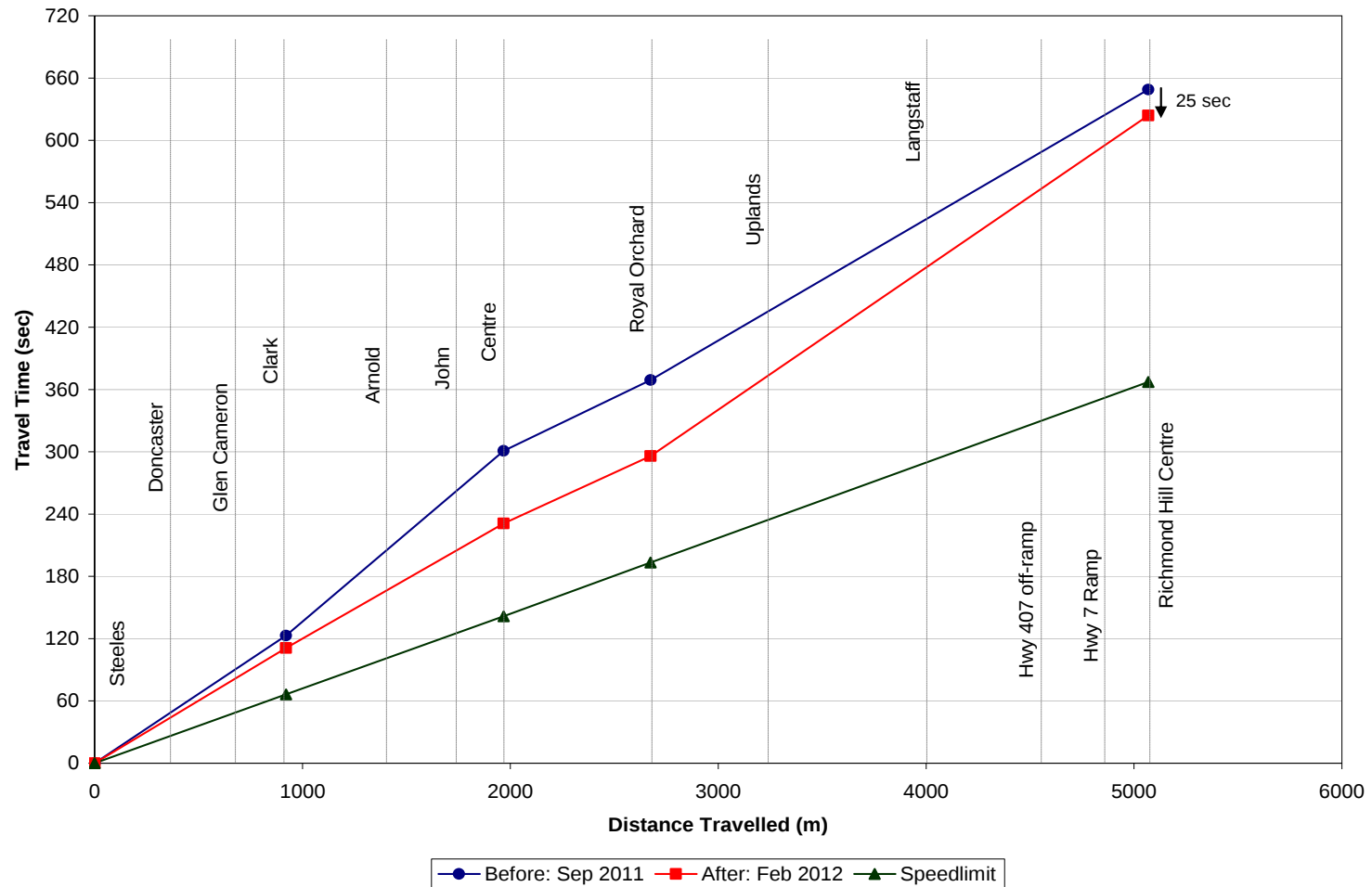
Evaluation

- ❑ “After” studies were conducted to assess the effectiveness of the operational improvements
- ❑ Challenges encountered during the follow up review included:
 - ❑ Signal co-ordination issues with intersection at Steeles Avenue
 - ❑ Transit strike

Transit Travel Time – AM Peak Southbound



Transit Travel Time – PM Peak Northbound



Lessons Learned

- ❑ Key lessons learned included:
 - ❑ Communication with City of Toronto and YRT staff proved important
 - ❑ Value in comparing data sources (e.g. travel time studies, Bluetooth data, YRT travel time data)
 - ❑ Bus Lane/HOV lanes between Arnold Ave. and Steeles Ave. are very beneficial to transit operations
 - ❑ Value in designing longer right turn lanes to facilitate queue jumping for transit vehicles

Advantages vs Disadvantages

Advantages

- ❑ Reduced travel time, delays and stops to transit vehicles during critical peak periods
- ❑ Reduced travel time stops and delays for commuters on Yonge Street during critical peak periods
- ❑ Greater consistency in travel times as a result of reduced stops

Disadvantages

- ❑ Increased delays to side road vehicles
- ❑ Increased delays to northbound and southbound left turn phases at some intersections
- ❑ Increased delays to pedestrians crossing main street (Yonge Street)

Future Improvements

- ❑ Ongoing monitoring and adjusting
- ❑ Physical Improvements
 - ❑ Dedicated HOV/Bus Lane
 - ❑ Localized improvements to turn lanes to facilitate queue jumping
- ❑ ITS enhancements for traffic monitoring and route balancing
- ❑ Other operational corridor reviews to support transit

Questions?