TORONTO WATERFRONT
REVITALIZATION CORPORATION

Additional Transportation Analysis
Reduced Peripheral Improvements

DRAFT

Gardiner/Lake Shore Corridor
Great Street Approach

Junel 2005

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EXECUTIVE SUMMARY

In 2004, the Toronto Waterfront Revitalization Corporation developed and documented a preferred conceptual set of potential modifications of the Gardiner / Lake Shore Corridor (GLC) which was identified as the Great Street Approach (GSA). The GSA involves the removal of the elevated central section of the Gardiner Expressway between Spadina Avenue in the west and the Don River in the east. An at-grade street of grand scale would replace the elevated section of the expressway. This Great Street would feature connecting ramps to the Gardiner Expressway (FGE) west of Spadina Avenue and the Don Valley Parkway (DVP) east of the Don River.

The roads and traffic elements of the GSA concept were modeled by Intellican using the state-of-the-art Paramics software system running at the ITS Centre at the Civil Engineering Department of the University of Toronto. The simulation demonstrated that with existing travel demand loads, the GSA concept would result in balanced traffic flows throughout a road network operating reasonably well within the limits of available capacity.

The GSA concept is supported by two related peripheral road improvements which (it has been previously argued) would be prerequisite to the removal of the elevated expressway in as much as they promote a more direct set of travel routes between the expressways and the central area thereby reducing the volume of central area destined traffic otherwise flowing through the central waterfront.

In the west, the first peripheral improvement would be an extension of Front Street west from Bathurst Street to a new set of ramps which would connect to the FGE in both directions. The facility is known as the Front Street Extension (FSE) and has been the subject of an Environmental Assessment Study.

In the east, the second peripheral improvement would include enhancements to the Richmond/Adelaide interchange with the DVP. These improvements would better accommodate the large demand for motorists to travel along the most direct route into and out of the Central Area along Richmond, Adelaide and Front streets east. This improvement has been visualized as including both a) an upgrading of the south to west off-ramp to permit a two lane exit and channeling of a section of Richmond Street / Eastern Avenue on the bridge to eliminate the weaving section to increase both safety and operating capacity, and b) a widening of the east to north on-ramp to two lanes.

Although these peripheral improvements have been previously identified as prerequisite to the implementation of the GSA, as a matter of due diligence, it was determined that a

traffic impact assessment of two specific scenarios which did not include these peripheral improvements should be undertaken. This report documents that assessment.

In Scenario 1, the Front Street Extension is not constructed as part of the preferred Great Street Approach concept plan. In order to make the assessment of Scenario 1 (i.e., no Front Street Extension) reflect a reasonable attempt to mitigate the obvious network imbalances resulting from not constructing the Front Street Extension, the assessment included the addition of Gardiner on and off-ramps to and from the west at Spadina Avenue. In this scenario, these ramps are intended to replace some of the capacity and function which would be lost by not including the FSE. An alternative in which westbound Lake Shore Boulevard traffic was assumed to be grade-separated was also tested for Scenario 1.

In Scenario 2, the improvements planned at the Don Valley Parkway interchange at Richmond/Adelaide are not constructed as part of the preferred Great Street Approach concept plan.

The scenarios are assessed strategically based on a combination of quantitative data from the work completed to date (including existing traffic information and the Paramics modeling work), as well as qualitative input based on fundamental transportation planning principles and expert opinion.

Conclusions

Based on the analysis of the traffic impacts of eliminating the peripheral improvement elements associated with the GSA concept plan undertaken in this study, the following conclusions have been drawn:

Scenario 1

- **The assessment shows that for Scenario 1 (without the Front Street Extension), there is insufficient capacity on the road network to accommodate the inbound and outbound traffic on the FGE at either the Spadina ramps or on the Great Street.** With the expressway delivering more traffic than can be dispersed onto the downtown road network, traffic queues and congestion will quickly develop. Based on the existing travel patterns (in which demand exceeds capacity over the entire day), the queues and congestion can be expected to be consistent through the day. Although the extent of the inbound queue on the Gardiner cannot be quantified based on this assessment, it would most certainly be significant. For the outbound movement to the west, volumes on the Gardiner will likely be quite low. This is because without the FSE, there is insufficient capacity on the downtown road network

to deliver traffic volumes to the expressway. Traffic will be queued on the north-south streets attempting to access the Great Street and the Spadina ramps, as well as along the Great Street itself;

- The analysis also confirms that the addition of the Spadina ramps and the grade-separation of westbound Lake Shore Boulevard would not divert enough traffic to allow the modified Great Street Approach to accommodate traffic at an acceptable level of service without widening beyond 5 lanes each way between Spadina Avenue and Yonge Street. A solution that is neither desirable nor physically achievable;

Scenario 2

- For Scenario 2, the increased traffic volume which could be accommodated by these improved ramps plays a significant role in reducing traffic volumes in the central waterfront thereby allowing the section of the Great Street from Jarvis Street to the Don Roadway to be designed as an eight-lane road rather than a much less desirable ten-lane road as was proposed in an earlier option; and
- Vehicle delays and volume-to-capacity ratios are expected to be greater for the GSA intersections associated with Scenario 2 (i.e., no improvement to the Richmond/Adelaide interchange with the Don Valley Parkway) relative to baseline conditions. These higher traffic volumes would utilize the residual capacity that would otherwise be available to accommodate vehicular demand generated by the planned future development in the east waterfront precincts.

Recommendations

The following actions are recommended:

1. The Front Street Extension should be considered an integral and essential element of the Great Street Approach to the removal of the elevated central and eastern sections of the Gardiner Expressway;
2. The function and capacity of the FSE cannot be adequately replaced by adding ramps between the Gardiner Expressway and Spadina Avenue to and from the west; however, the inclusion of expressway ramps at Spadina may provide significant benefits even with the FSE in place and should therefore be considered in any further work for the preferred Great Street Approach; and

3. Improvements to the Don Valley Parkway (DVP) interchange at Richmond/Adelaide are desirable elements of the GSA concept plan and should be included. Traffic operations in the GLC are expected to be operating close to capacity under baseline conditions, and would be significantly poorer if the ramp improvements were not made. The assessment indicates that vehicle delays would increase and volumes would exceed capacity. More importantly though, the increase in traffic volumes would significantly reduce the residual road capacity which would otherwise be available to accommodate traffic generated by the new development planned for the waterfront precincts.

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1.0 INTRODUCTION

In 2004, the Toronto Waterfront Revitalization Corporation developed and documented a preferred set of potential modifications of the Gardiner / Lake Shore Corridor (GLC) which was identified as the Great Street Approach (GSA). The approach involves the removal of the elevated central and eastern sections of the Gardiner Expressway between Spadina Avenue in the west and the Don River in the east. An at-grade street of grand scale would replace the elevated section of the expressway. This Great Street would feature connecting ramps to the Gardiner Expressway (FGE) west of Spadina Avenue and the Don Valley Parkway (DVP) east of the Don River.

The GSA concept is supported by two related peripheral road improvements which (it has been previously argued) would be prerequisite to the removal of the elevated expressway because they promote a more direct set of travel routes between the expressways and the Central Area, thereby reducing the volume of Central Area destined traffic otherwise flowing through the central waterfront.

In the west, the first peripheral improvement would be a new route to extend Front Street west from Bathurst Street to a new set of ramps which would connect to the FGE in both directions. The facility is known as the Front Street Extension (FSE) and has been the subject of an Environmental Assessment Study.

In the east, the second peripheral improvement would include enhancements to the Richmond/Adelaide interchange with the DVP. These improvements would accommodate the demand for motorists to travel into and out from the Central Area along Richmond, Adelaide and Front streets. This improvement has been visualized as a) an upgrading of the south to west off-ramp to permit a two lane exit and channeling of a section of Richmond Street / Eastern Avenue on the bridge to eliminate the weaving section, increasing both safety and operating capacity, b) a widening of the east to north on-ramp to two lanes.

The roads and traffic elements of the GSA concept were modeled by Intellican using the state-of-the-art Paramics software system running at the ITS Centre at the Civil Engineering Department of the University of Toronto. The simulation demonstrated that

with existing travel demand loads, the GSA concept would result in balanced traffic flows throughout the road network. The road network is expected to operate reasonably well within the limits of available capacity and is comparable with the existing condition during peak travel times.

These peripheral improvements have been identified as prerequisite to the implementation of the GSA. As a matter of due diligence, it was determined that a traffic impact assessment of scenarios which did not include these improvements should be undertaken.

This report documents the findings of the study undertaken to identify and assess the traffic impacts within the GLC associated with two potential alternative scenarios, which would reduce or eliminate these two peripheral road improvements. The two scenarios include:

1. The Front Street Extension is not constructed as part of the preferred GSA; and
2. The improvements planned at the Don Valley Parkway interchange at Richmond/Adelaide are not constructed as part of the preferred GSA.

The scenarios are assessed strategically based on a combination of quantitative data from the work completed to date (including existing traffic information and the Paramics modeling work), as well as qualitative input based on fundamental transportation planning principles and expert opinion.

The quantitative components of the strategic assessment are divided into two sections based on the location of the peripheral improvements associated with the two scenarios. The quantitative analysis of the impacts associated with Scenario 1 (not constructing the FSE) relates to the intersections located within the west section. The impacts associated with Scenario 2 (no improvement to the DVP interchange at Richmond/Adelaide) primarily relates to intersections located within the east section.

The west and east sections are shown below in **Figure 1**.

Marshall Macklin Monaghan has undertaken this study with advisory input from BA Group.

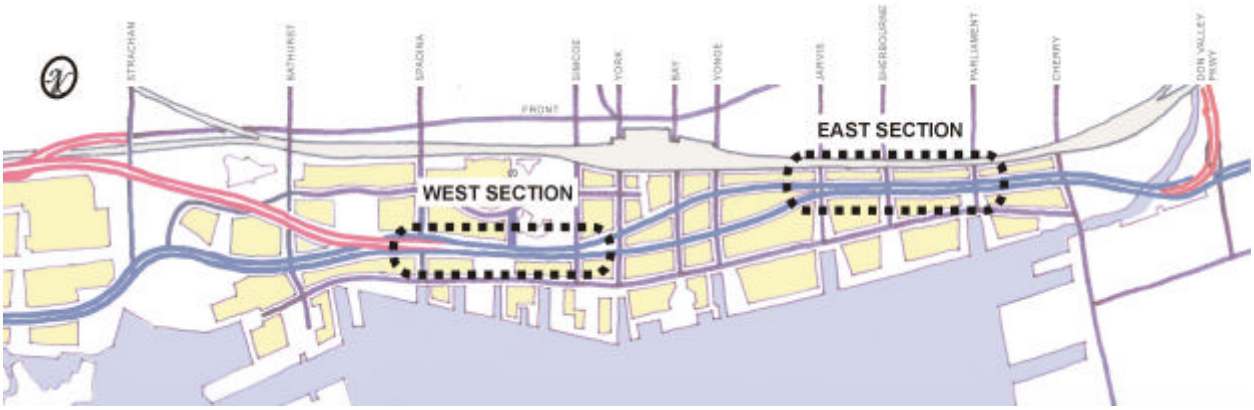


FIGURE 1: WEST AND EAST STUDY AREA SECTIONS

2.0 BASELINE CONDITIONS (GREAT STREET APPROACH)

As stated in the Technical Briefing Report, completed by the GLC Study Team in July of 2004, the Great Steet Approach is the preferred alternative for the Gardiner / Lake Shore Corridor. It offers the highest potential to provide additional developable land and improve the quality of the development frontage. It is also expected to improve the "place-making" character of the waterfront, providing more opportunities for people to live and work in the waterfront. This represents the definition of "sustainable" development. Improved access to the waterfront can best be achieved by rebalancing the transportation system to greatly improve access for non-auto modes of travel while also maintaining acceptable access for vehicles. This better balance between auto and non-auto accessibility to the waterfront would be achieved by adopting the Great Street Approach.

2.1 Road Network

The road network associated with the preferred GSA is shown below in **Figure 2.**

FIGURE 2: GREAT STREET APPROACH ROAD NETWORK

The road network is best described in three sections:

1. Transition Section – located between the new FGE/Great Street transition ramps at Spadina Avenue and Simcoe Street. This boulevard transition section serves a highly functional transportation role;
2. Central Section – located between Simcoe Street and Jarvis Street. In the Central Section, the Great Street will be a pair of 5 lane one-way streets providing access to the central waterfront area. The major street links providing pedestrian and vehicle access to the Central Area are located in this section; and

3. Eastern Section – located between Jarvis Street and the Don Roadway. This section will be a two-way road that is 8 lanes wide. This section does not include the same number of north-south road links to the Central Area, and therefore does not provide as much access.

The FSE and the improvements to the DVP interchange at Richmond/Adelaide are thought to be integral components of the GSA. Their roles are described as follows:

2.1.1 Front Street Extension

The FSE includes introducing a new partial interchange connecting both directions of the Gardiner Expressway with Front Street, primarily serving traffic to and from the Central Area. The FSE is planned to be four lanes wide. The FSE includes the westerly extension of Front Street from Bathurst Street to Dufferin Street. Strachan Avenue will be grade separated over the FSE, and other intermediate connections to streets such as Atlantic Avenue, Jefferson Avenue, Fraser Avenue and Mowat Avenue will also be provided.

The FSE would provide a direct, convenient connection to the Central Area for commuters on the Gardiner Expressway inbound from the west and outbound to the west. As a result of the inbound and outbound volumes expected to use the FSE (discussed below), the GSA plan would reduce the Gardiner from three lanes per direction to two lanes per direction, east of the FSE. This is an important element of the plan, since the Great Street at grade east of Spadina cannot practically be configured to provide sufficient vehicular capacity to accommodate the traffic volumes associated with three inbound expressway lanes.

2.1.2 DVP Interchange Improvements at Richmond/Adelaide

The Richmond/Adelaide interchange improvements contemplated in the GSA concept plan would provide a similar function in the east to the function of the Front Street Extension in the west. The interchange, combined with the one-way pair of Richmond/Adelaide plus Front Street, currently provides a convenient and direct connection to the Central Area.

The DVP interchange improvements at Richmond/Adelaide involve adding a lane to the on and off-ramps to increase their capacity, and also to eliminate weaving problems that have added to the existing congestion in the merge area at the top of the off-ramp. The capacities of the existing single lane ramps limit the number of Central Area destined vehicles that use the east section of the GLC. The increased traffic volumes, which could be accommodated on the improved ramps, would play a significant role in allowing the

section of the Great Street from Jarvis Street to the Don Roadway to be designed as eight lanes rather than a ten-lane road.

It is understood that the need to divert traffic from the east section of the DVP is balanced by the capacity available on Front, Richmond and Adelaide streets to accommodate additional traffic. Numerous signalized intersections as well as high levels of curbside activity (i.e. pedestrians and parallel parking) limit the capacity of these streets. This issue is further discussed in Section 2.2.2 (East Section) of this report.

Existing constraints for the single lane off-ramp are a result of the relatively large demand combined with the fact that the ramp merges with westbound Eastern Avenue traffic, and in a short area there are cross-over weaving manoeuvres destined to both Richmond and Eastern/Front. Approximately 40 percent of existing southbound traffic on the DVP (south of Bloor) uses the off-ramp during the a.m. hour. With improvements to the ramp, more traffic could be expected to use this direct and convenient route thereby reducing the traffic volumes passing through the central waterfront on route to the Central Area.

Adding a second lane to the eastbound to northbound on-ramp would increase the ability of the interchange to accommodate the relatively high demand for this ramp, particularly during the p.m. peak hour. Approximately 30 percent of existing northbound DVP traffic (north of Richmond/Adelaide) uses the on-ramp during p.m. peak hour. Elimination of capacity constraints at this location would ensure adequate direct connection between the Central Area and the northbound DVP, reducing the need for traffic destined to the north to first travel south and through the central waterfront.

In planning the road network, future conditions should be considered. The greatest opportunities for development in the waterfront are located in areas to the east of Yonge Street. These areas include the following precincts:

- East Bayfront;
- West Don Lands; and
- The Port Lands.

These precincts are planned to include a substantial amount of new development. This will require use of any available residual road capacity, particularly in areas to the east. Therefore any opportunity to divert trips that are destined to and from the north, away from these roads, would be of great benefit.

The GSA concept plan, as described above, represents the baseline condition for the analysis summarized in this report. The transportation impacts of not completing the Front Street Extension or the improvements to the DVP interchange at Richmond/Adelaide are compared to this baseline condition.

2.2 Paramics Model and Baseline Traffic Volumes

Traffic operations for the baseline condition were assessed using the network configuration described in Section 2.1 and the traffic volumes projected by the Paramics traffic simulation program.

2.2.1 Paramics Traffic Simulation Model

Paramics is a state-of-the-art simulation model that was set-up and run by Intellican Transportation (associated with the University of Toronto's Intelligent Transportation System Centre). The simulation model was built to represent the road network bounded by Dundas Street, the Humber River, Lake Ontario, and Woodbine Avenue. Origin/destination matrices were developed using the Transportation Tomorrow Survey 1996 database as a "seed". The matrices were modified to closely approximate more recent traffic count data and observed distributions of traffic. The model was calibrated to the reflect the existing distribution of traffic and observed network performance during both the a.m. and p.m. peak hours. The operational characteristics of the system were replicated by specifying to the extent possible the alignments, lane configurations, turn prohibitions, and signal timing/phasing as supplied by the City of Toronto. The simulated behaviour of drivers in the network was optimized by adjusting parameters in the model in an extensive iterative process using a special purpose algorithm and software.

Work has been on going over the last three years to continue to develop the model for various GLC options. Over that time period the model has evolved through optimization and refinement of coding for signal timings, lane geometries, etc., improving the model's ability to replicate downtown traffic patterns for different GLC networks options. The Paramics model was the primary analysis tool for the assessment of the different GLC options. For each simulation run, the model recorded traffic data such as travel time and speed for over 37,500 vehicle trips during the a.m. and p.m. peak hours. These Measures of Effectiveness, which were the basis for comparison of the GLC options, were determined by averaging the data from over 15 runs for the a.m. and p.m. peak hours. The transportation conclusions with respect to the preferred Great Street Approach were also based on the measures of effectiveness generated by the Paramics model.

For more details with respect to the Paramics modeling work, refer to the Microsimulation of the Toronto Waterfront Revitalization Plan report completed by Intellican in December of 2004.

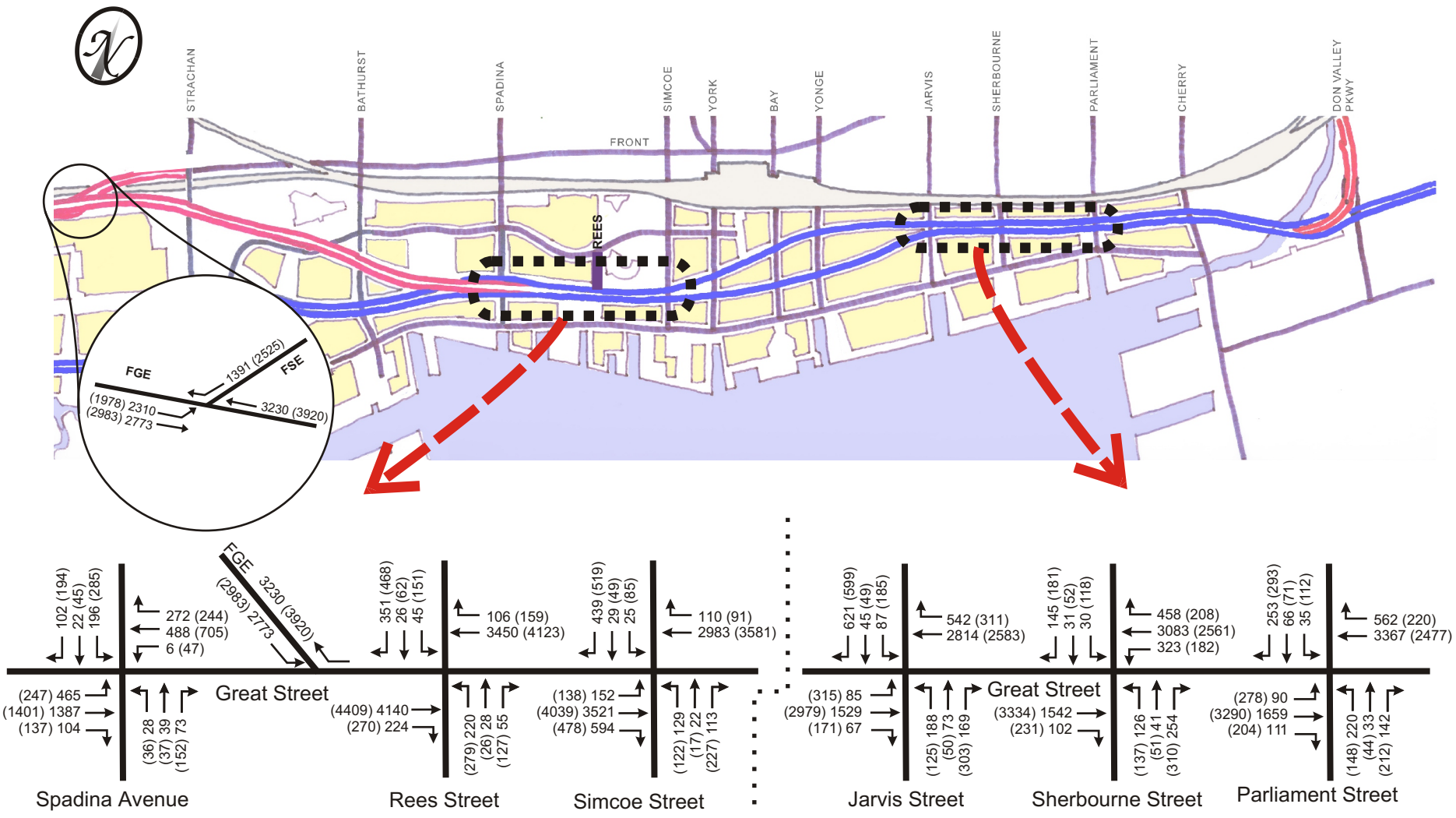
2.2.2 Baseline Traffic Volumes

The average a.m. and p.m. peak hour turning movement volumes associated with the preferred GSA road network at the intersections included as part of this study are summarized in **Figure 3**.

The following key points are noted from Figure 3:

West Section

- The FSE is expected to divert a significant volume of eastbound (inbound) traffic from the Gardiner, enabling the Great Street to adequately function as an at-grade arterial road. The FSE is expected to attract approximately 45 percent (2,300 vehicles) and 40 percent (2,000 vehicles) of the total eastbound trips on the Gardiner during the a.m. and p.m. peak hours respectively. The lane capacities of the FSE are expected to be higher than that of a typical arterial road since the FSE effectively operates as extended on and off-ramp to the Gardiner Expressway. The lane capacities are also higher than typical since traffic at the first few signalized intersections will primarily be through traffic. Large turn volumes tend to decrease the capacity of a road link at an intersection;
- The FSE is expected to attract a significant volume of westbound (outbound) traffic from the Great Street. These vehicles are primarily destined outbound from the Central Area. Approximately 30 percent (1,400 vehicles) of the a.m. peak hour and 40 percent (2,500 vehicles) of the p.m. peak hour total westbound Gardiner traffic is expected to use the FSE;
- For the Great Street, Rees Street is the critical intersection. It is the first signalized intersection where the free-flow freeway traffic must enter the arterial surface roadway. The eastbound and westbound approach volumes at the Rees Street/Lake Shore Boulevard intersection are expected to be approaching their theoretical capacity. Assuming the Great Street has a lane capacity between 800 and 1,000 vehicles per lane per hour (typical capacities for a controlled access arterial road with significant turning volumes), the capacity of the five-lane approaches would be between 4,000 and 5,000 vehicles per hour. The eastbound approach volume is projected to be 4,700 vehicles during the p.m. peak hour; and
- The large volumes of eastbound left turn vehicles are a significant concern for the GSA, as they have been throughout the development and assessment of GLC options.



Not to Scale

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LEGEND

XX (XX) — A.M. (P.M.) Peak Hour Traffic Volumes

Figure 3
BASELINE CONDITION
PEAK HOUR TRAFFIC VOLUMES

\Front Street Removal\Figure 3 - Baseline Volumes.cdr

Even with the FSE and a double eastbound left turn at York Street in place, large eastbound left turn volumes are expected at all major intersections with north-south streets. The problem is worsened during the p.m. peak hour when heavier opposing westbound flows allow less time for conflicting eastbound left turns.

East Section

- The improved off-ramp from the DVP to Richmond is expected to divert a significant number of Central Area destined trips from the east section of the Great Street, allowing the street to function effectively as an eight-lane at-grade arterial road. The improved ramp is expected to attract approximately 2,650 vehicles, which is 75 percent of the southbound trips on the DVP south Bloor, during the a.m. peak hour. During the p.m. peak hour, the off-ramp volume is projected to be approximately 1,800 vehicles. This represents an increase of approximately 600 trips during the a.m. peak hour and 700 trips during the p.m. peak hour, when compared to the existing condition. As was described for the FSE, lane capacities for the DVP ramps to and from Richmond/Adelaide would be in the order of 1,400 vehicles per lane per hour which is reflective of typical capacities for expressway on and off-ramps;
- The improved on-ramp from Adelaide to the DVP is expected to attract a negligible number of new trips during the a.m. peak hour and 450 additional trips during the p.m. peak hour;
- As discussed previously, in order for more traffic to be diverted to the improved DVP ramps at Richmond/Adelaide, additional capacity must be available on Front, Richmond and Adelaide to accommodate the increased demand. The increased number of signalized intersections as well as side friction caused by high levels of pedestrian and parallel parking activity currently present on these streets, limits additional capacity. A review of the projected traffic volumes associated with the GSA concept plan indicates that the increased demand for the DVP off-ramp to Richmond is accommodated by shifting existing westbound vehicle trips from the east on Eastern Avenue to other east-west routes such as King Street, Queen Street and Dundas Street. A comparison of traffic volumes crossing a screenline located just east of Parliament Street for existing and projected GSA conditions is contained in the Appendix; and

- With the elevated Gardiner removed, traffic volumes on Lake Shore in the east section are expected to be approaching the theoretical capacity of the eight-lane road width. The lane capacities in the Paramics simulation were observed to be higher than what was observed for the intersections in the central section. This is because most trips in the east section are through trips or westbound right turns, which maximize the amount of east-west green time available at intersections. During the p.m. peak hour, the increase in southbound left turns is offset by the decrease in westbound traffic.

2.3 Assessment of Traffic Operations

The analysis of baseline conditions was undertaken using the Synchro software package (Version 6). Synchro incorporates analysis of intersection capacity, queuing and delay based on the 2000 Highway Capacity Manual (HCM). The Synchro model is a credible tool to replicate and assess traffic operations through signalized intersections of the GSA; however, it has not been developed or scrutinized to the same level of detail as the Paramics model. Therefore, the Synchro results provide a good basis for comparison; however, the LOS analysis should be considered within the context of the model's relative level of detail. The transportation assessment of the preferred GSA and the other GLC options was based on the Paramics simulation model.

The analysis includes the a.m. and p.m. peak hours. The results of the intersection capacity analysis are summarized in **Table 1**. The definition for Level of Service (LOS) at a signalized intersection is included in **Appendix A**. Detailed capacity calculations for the baseline conditions are included in **Appendix B**. Levels of Service represented by letters 'A' through 'D' generally represent acceptable vehicle delays at an intersection. Levels of Service represented by letters 'E' and 'F' generally represent intersections operating under increasing congestion with significant vehicle delays.

TABLE 1
CAPACITY ANALYSIS
BASELINE CONDITIONS (GSA)

INTERSECTION	A.M. PEAK HOUR		P.M. PEAK HOUR	
	LOS (DELAY in seconds)	CRITICAL MOVEMENTS[1] (v/c ratio)	LOS (DELAY in seconds)	CRITICAL MOVEMENTS[1] (v/c ratio)
WEST SECTION				
Spadina Avenue at Lake Shore Boulevard	C (26)	--	C (29)	--
Rees Street at Lake Shore Boulevard	C (31)	--	D (50)	EB-T (1.11) WB-T (1.02) NB-L (1.00) SB-R (1.10)
Simcoe Street at Lake Shore Boulevard	C (25)	--	E (59)	EB-T (1.09) WB-T (1.04) SB-R (1.10)
EAST SECTION				
Parliament Street at Lake Shore Boulevard	E (60)	EB-L (1.29) WB-T (1.15)	C (21)	--
Sherbourne Street at Lake Shore Boulevard	B (14)	--	D (47)	EB-T (1.12) WB-L (1.15)
Jarvis Street at Lake Shore Boulevard	C (28)	SB-R (1.01) WB-T (1.01)	C (23)	--

Note: 1. For this analysis, critical movements are those movements with a volume-to-capacity ratio exceeding 1.00

The following key observations are noted from Table 1:

West Section

- The intersection of **Spadina Avenue at Lake Shore Boulevard** is expected to operate at a good LOS during the a.m. and p.m. peak hours. In the preferred GSA concept plan, this intersection will be simplified to operate as a four-leg urban intersection with all moves permitted. Although the intersection would still accommodate streetcars, it would not be complicated by ramps to the elevated Gardiner or to the elevated westbound LSB, which are both present for the existing condition;

- The intersection of **Rees Street at Lake Shore Boulevard** is expected to operate at a good to acceptable LOS during the a.m. and p.m. peak hours. Rees Street is the intersection where traffic from Lake Shore Boulevard and the Gardiner are both at-grade; however, eastbound traffic on the Gardiner and Lake Shore is still separated by a median island on the eastbound approach to the Rees intersection. In order to accommodate the significant traffic volume, traffic operations have been simplified by prohibiting eastbound and westbound left turns. Even with intersection simplifications in place, the eastbound and westbound through movements are expected to be operating at theoretical capacity during the p.m. peak hour. Eastbound traffic from the Gardiner is further prohibited from turning right to Rees Street, as it requires crossing in front of eastbound Lake Shore traffic. Eastbound Gardiner and Lake Shore traffic merge onto the new Great Street east of Rees Street; and
- The intersection of **Simcoe Street at Lake Shore Boulevard** is expected to operate at a good LOS during the a.m. peak hour and at a congested LOS during the p.m. peak hour. Simcoe Street represents the first opportunity, east of Front Street, for traffic to turn left (eastbound-to-northbound) in order to access the Central Business District (CBD). The eastbound left turn is not as problematic during the a.m. peak hour since traffic volumes are more tidal (i.e. there is less opposing westbound traffic, thereby allowing more time for the heavy eastbound left turn volume directed into the CBD). For the p.m. peak hour, outbound traffic volumes are higher; however, there is also a significant inbound volume of traffic destined to entertainment, restaurants or other downtown events. This increases the number of conflicting movements at the intersection and tends to decrease the LOS at the intersection. Significant peak hour congestion is normal for many intersections throughout downtown.

East Section

- The intersection of **Parliament Street at Lake Shore Boulevard** is expected to operate at a congested LOS ‘E’ during the a.m. peak hour and a good LOS ‘C’ during the p.m. peak hour. Without the Gardiner, the inbound through and right turn movements from the east are significant. This high volume (approximately 3,900 vehicles) limits the time available for the minimal eastbound left turn volume (approximately 90 vehicles). The high volume of westbound traffic results in longer intersection delays during the a.m. peak hour. Westbound left turns are prohibited at this intersection;
- The intersection of **Sherbourne Street at Lake Shore Boulevard** is expected to operate at a good to acceptable LOS during the a.m. and p.m. peak hours. Eastbound left turns are prohibited at this intersection. The conflicting eastbound through and westbound left turn movements are expected to be operating at theoretical capacity during the p.m. peak hour; and

- The intersection of **Jarvis Street at Lake Shore Boulevard** is expected to operate at a good LOS 'C' during the a.m. and p.m. peak hours. In the preferred GSA, this intersection would be simplified to a more typical four-leg urban intersection, which is not complicated by ramps to and from the Gardiner. As was the case for the intersection at Parliament Street, large westbound approach volumes are expected to be operating at theoretical capacity during the a.m. peak hour. Westbound left turns are prohibited at this intersection.

3.0 SCENARIO 1: WITHOUT THE FRONT STREET EXTENSION

In Scenario 1, the FSE is not constructed. Based on the volume of traffic projected to use the FSE if it were built (i.e. effectively removing a lane of traffic demand from the Gardiner) and the limited amount of excess capacity on the Great Street, traffic operations associated with Scenario 1 can be expected to be extremely poor. Therefore, to make the assessment of Scenario 1 reflect a reasonable attempt to mitigate the obvious network imbalances, the assessment included the addition of Gardiner on and off-ramps to and from the west at Spadina Avenue. In theory, ramps at Spadina Avenue could replace some of the capacity and functionality which would be lost were the Front Street Extension not included as part of the GSA concept plan.

3.1 Feasibility of Ramps at Spadina Avenue

A sketch of one possible future intersection configuration, which accommodates ramps to and from the Gardiner as part of the GSA, is shown below in **Figure 4**.

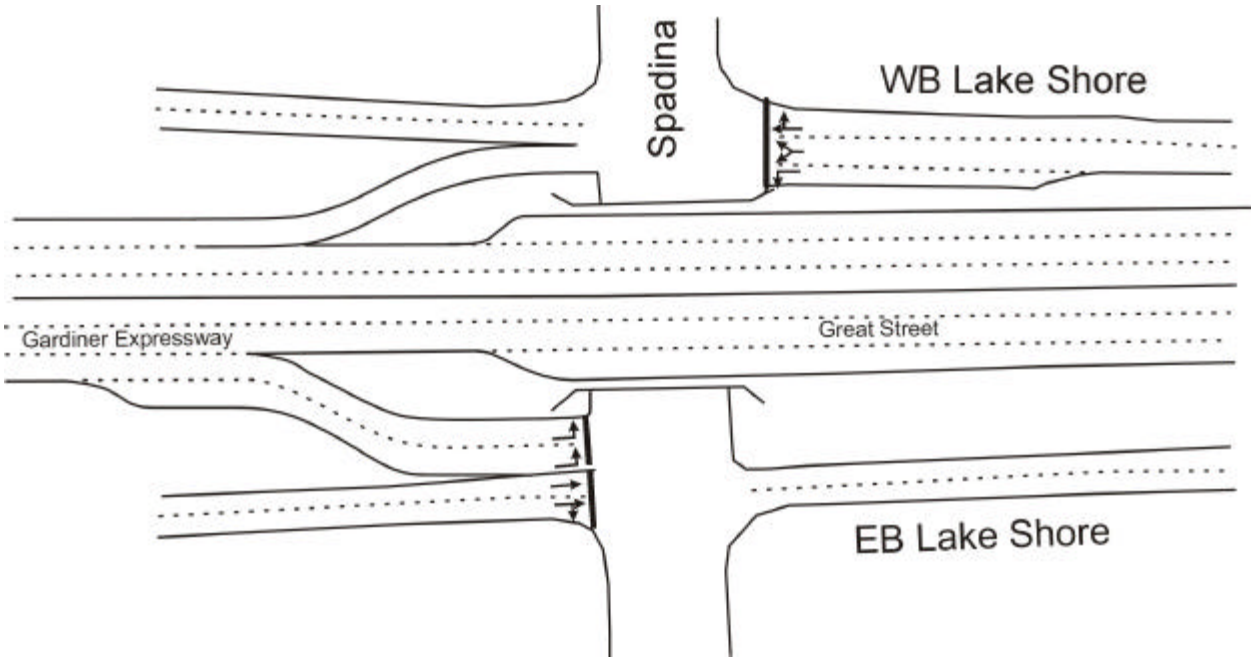


FIGURE 4: CONFIGURATION OF GARDINER RAMPS AT SPADINA

An eastbound Gardiner off-ramp at Spadina could be constructed in the same location as the existing ramp. The existing ramp is a single lane ramp that widens to two lanes as it approaches the signals at Spadina. As part of the proposed construction staging plan for the GSA, this off-ramp is already planned to be temporarily widened to accommodate two full lanes from the Gardiner. In this Scenario, the ramp widening would be permanent. East of the Spadina ramp, the Gardiner would be reduced from three to two lanes as it approaches the transition ramps to the Great Street.

Including a westbound on-ramp to the Gardiner as part of the GSA concept plan would be more difficult to construct and operate. The existing ramp is only accessible from Spadina Avenue southbound since westbound Lake Shore Boulevard is grade separated over Spadina. The existing on-ramp is located between the two elevated roadways and provides access to both Lake Shore and the Gardiner. For the GSA, westbound LSB would still be located north of the FGE but no longer grade separated. This would require the on-ramp to be located on the left side of the road. The configuration of this ramp would be similar to the existing eastbound FGE on-ramp at Jarvis. Intersection operations are further complicated by the presence of a north-south streetcar line. While this configuration is possible, it is far from ideal, as it would likely create some significant queuing problems in the area. The large volume of vehicles destined to the FGE would result in an extreme imbalance in the utilization of the two-lane westbound approach.

3.2 Redistribution of Traffic

In order to assess the implications associated with Scenario 1, the projected traffic that would have used the FSE as part of the GSA concept plan was redistributed. The redistribution of projected FSE traffic, to and from the west, is shown below in **Figure 5**.

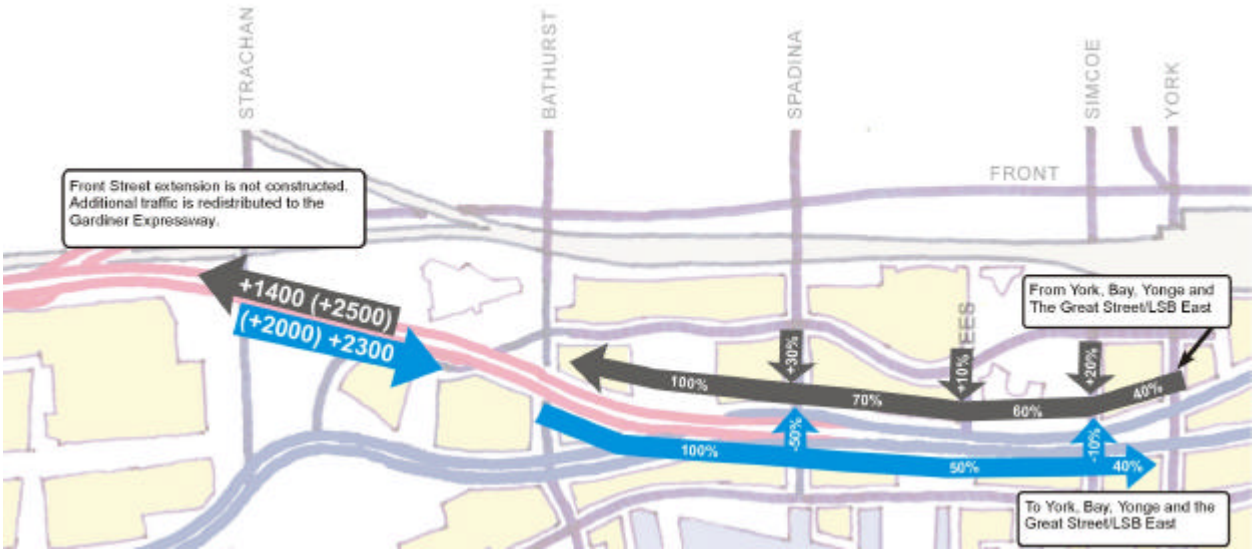


FIGURE 5: REDISTRIBUTION OF FSE TRAFFIC FOR SCENARIO 1

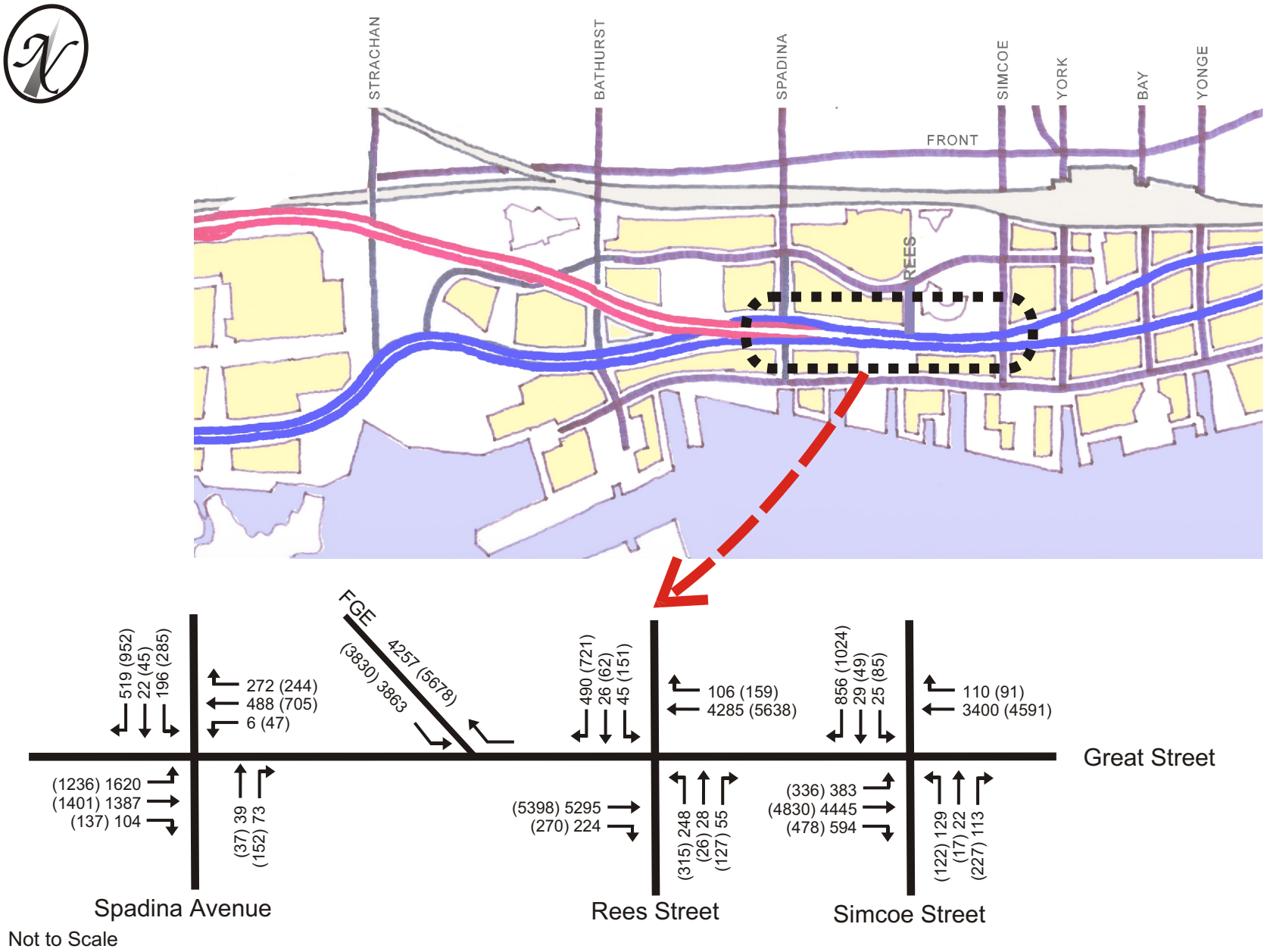
All traffic projected to use the GLC for the preferred GSA was assumed to remain in the corridor (i.e. no trips were assumed to use other routes). This is because traffic volumes projected by the Paramics model already account for a reasonable diversion of vehicles to other routes.

The redistributed a.m. and p.m. peak hour volumes for Scenario 1 are shown in **Figure 6**.

3.3 Assessment of Traffic Operations without the Front Street Extension

The intersections in the west section will control the amount of traffic that is able to access the waterfront to and from the west.

For inbound traffic from the west via the Gardiner, all traffic not exiting at Jameson Avenue will either exit at Spadina, or use the Great Street. Once on the Great Street, traffic will have to pass through the signalized intersection at Rees Street and the signalized intersection at Simcoe Street, which represents the first opportunity, east of the Spadina ramps, for eastbound to northbound left turns.



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XXX (XXX) — A.M. (P.M.) Peak Hour Traffic Volumes

Figure 6
SCENARIO 1: WEST SECTION TRAFFIC VOLUMES

\Front Street Removal\Figure 6 - West Section Volumes.cdr

For outbound traffic to the west via the freeway network, access to the Gardiner is the major issue. From downtown, westbound Gardiner access is only available from the Great Street, or from Spadina Avenue. The ability of the Great Street to deliver traffic to the Gardiner is limited by the capacity of its five-lane width as well as the capacity of the connecting north-south streets.

The capacity analysis for Scenario 1 is summarized in **Table 2**. Detailed capacity calculations are contained in the **Appendix C**.

TABLE 2
CAPACITY ANALYSIS
SCENARIO 1 – NO FRONT STREET EXTENSION

INTERSECTION	A.M. PEAK HOUR		P.M. PEAK HOUR	
	LOS (DELAY in seconds)	CRITICAL MOVEMENTS[1] (v/c ratio)	LOS (DELAY in seconds)	CRITICAL MOVEMENTS[1] (v/c ratio)
WEST SECTION				
Spadina Avenue at Lake Shore Boulevard	F (112)	EB-L (1.48) WB-T (1.01) SB-T (1.09)	F (214)	EB-L (1.90) WB-T (1.37) SB-L (1.11) SB-R (1.68)
Rees Street at Lake Shore Boulevard	F (142)	EB-T (1.30) WB-T (1.22) SB-R (1.15)	F (249)	EB-T (1.52) WB-T (1.55) SB-R (1.40)
Simcoe Street at Lake Shore Boulevard	F (263)	EB-L (1.92) EB-T (1.58) WB-T (1.50) NB-L (1.72) SB-T (1.34)	F (296)	EB-L (2.04) EB-T (1.54) WB-T (1.66) SB-R (1.67)

Note: 1. For this analysis, critical movements are those movements with a volume-to-capacity ratio exceeding 1.00

The following key observations are noted from Table 2:

- At all these intersections projected demand would far exceed capacity by as much as 54 percent for some through movements. Unacceptable delays would occur.
- Traffic demands would significantly exceed intersection capacity at the intersection of **Spadina Avenue at Lake Shore Boulevard.** Overall intersection delays are expected to increase to unacceptable levels. The proposed Spadina off-ramp is not expected to provide enough capacity to offset the loss of the FSE. The capacity of the Spadina off-ramp is limited because the left turning traffic from the ramp would have to share the intersection with opposing westbound Lake Shore traffic, as westbound Lake Shore Boulevard would not be grade separated as part of the GSA. A scenario in which westbound Lake Shore traffic remains grade-separated (as it is under present conditions) is discussed in detail below. The capacity of the Spadina on-ramp is limited by space and the geometry of the upstream road network which makes only a single lane on-ramp feasible;
- Traffic demands would significantly exceed intersection capacity at the intersection of **Rees Street at Lake Shore Boulevard.** Overall intersection delays are expected to increase to unacceptable levels. Even with intersection operations simplified by restricting eastbound and westbound left turns, the increase in traffic on the Great Street cannot be accommodated through this intersection; and
- Traffic demands would significantly exceed intersection capacity at the intersection of **Simcoe Street at Lake Shore Boulevard.** Overall intersection delays are expected to increase to unacceptable levels. The volume of eastbound left turns will significantly increase without the FSE. The increased left turn demand is primarily balanced between the Spadina intersection and the Simcoe intersection. At both intersections the movements have demands well in excess of the theoretical capacity.

The assessment shows that without the Front Street Extension, there is insufficient capacity on the road network to accommodate the inbound traffic on the FGE at either the Spadina ramps or on the Great Street. With the expressway delivering more traffic than can be dispersed onto the downtown road network, traffic queues and congestion will quickly develop. Based on the existing travel patterns (in which demand exceeds capacity over the entire day), the queues and congestion can be expected to be consistent through the day. Although the extent of the inbound queue on the Gardiner cannot be quantified based on this assessment, it would most certainly be significant. For the outbound movement to the west, volumes on the Gardiner will likely be quite low. This is because without the FSE, there is insufficient capacity on the downtown road network to deliver traffic volumes to the expressway. Traffic will be queued on the

north-south streets attempting to access the Great Street and the Spadina ramps, as well as along the Great Street itself.

The inclusion of expressway ramps at Spadina Avenue was originally envisioned to replace some of the capacity and functionality lost with the removal of the Front Street Extension; however, ramps at Spadina may provide significant benefits even with the FSE in place and should therefore be considered in any further work for the preferred Great Street Approach.

3.4 Grade-Separation of Westbound Lake Shore Boulevard at Spadina

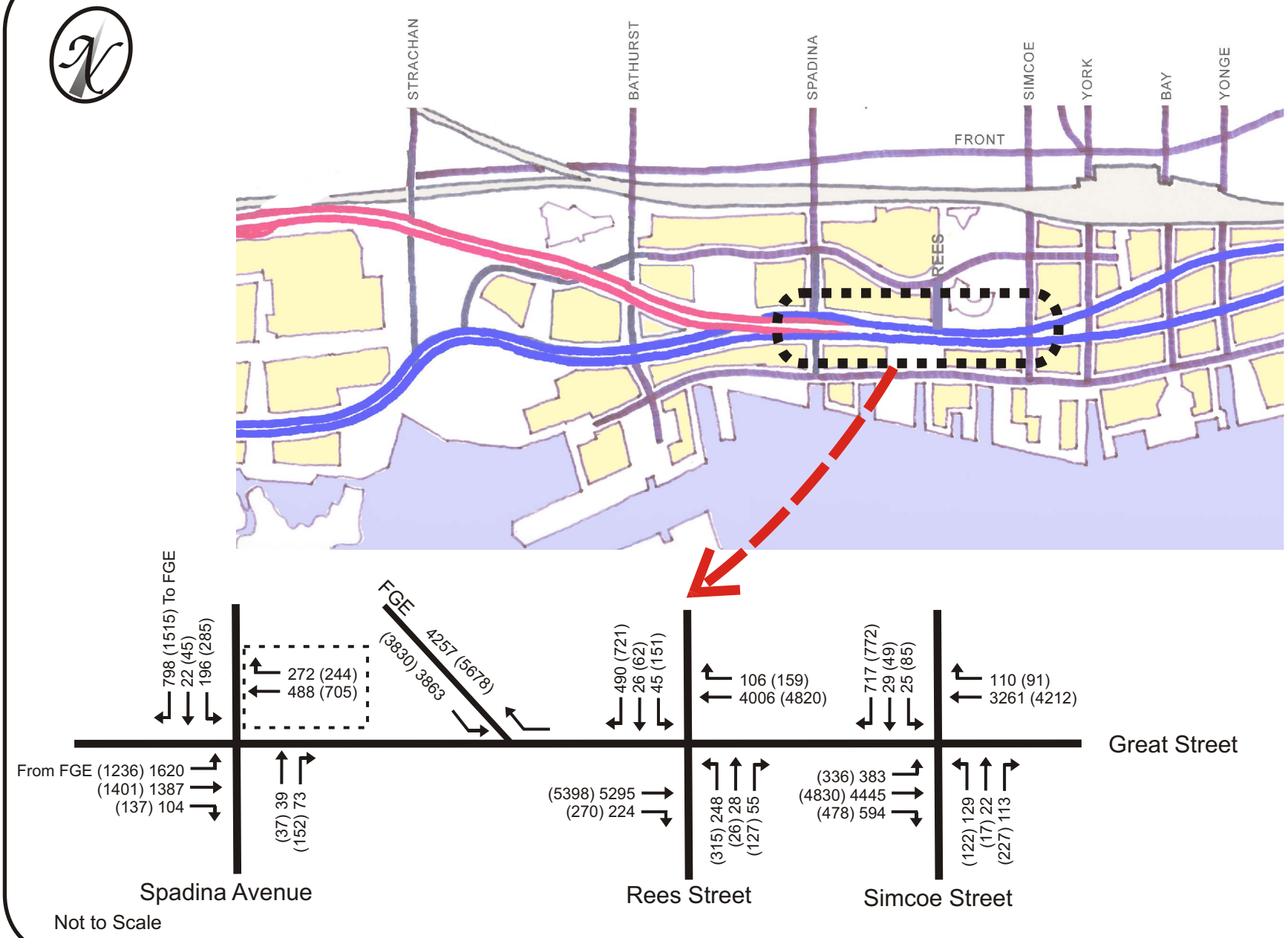
As shown in the analysis, a fundamental constraint on the utility of the FGE ramps at Spadina is that the capacity of the eastbound left turn movement is limited by the presence of westbound Lake Shore Boulevard, which is at-grade in the preferred GSA. A change to the design is possible here. The transition ramps from the FGE to the Great Street will already be grade-separated across Spadina, so the addition of a grade separation for westbound Lake Shore Boulevard would not create a new bridge but rather widen a proposed structure. As a result, an option in which westbound Lake Shore Boulevard is grade-separated across Spadina (as it is today) was assessed.

Given the limited space in the area, more work needs to be done to determine the specific geometry and movements that can be feasibly accommodated with a westbound grade separation for Lake Shore Boulevard in place; however, for purposes of this analysis we have assumed an access scenario similar to the existing condition. The access scenario is summarized as follows:

- Access to Spadina northbound from Lake Shore westbound would be maintained;
- No access to Spadina southbound from Lake Shore westbound would be provided. Only a marginal volume of traffic is expected to make this manoeuvre for the preferred GSA (less than 50 peak hour trips); and
- Access to the FGE westbound from Spadina southbound would be maintained.

The revised Scenario 1 traffic volumes are shown in **Figure 7**. The figure reflects an increase in southbound right turns at Spadina Avenue and a decrease in westbound volumes as a result of introducing an access ramp to the westbound FGE at Spadina similar to the existing condition.

The Scenario 1 analysis was updated to reflect a grade-separation of westbound Lake Shore traffic. The results are summarized in **Table 3**. Detailed capacity calculations are contained in the **Appendix C**.



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A.M. (P.M.) Peak Hour Traffic Volumes
Grade Separated

Figure 7
SCENARIO 1: WEST SECTION
(WB LSB Grade Separated at Spadina Avenue)
TRAFFIC VOLUMES

\Front Street Removal\Figure 6 - West Section Volumes.cdr

TABLE 3
CAPACITY ANALYSIS
SCENARIO 1 – NO FRONT STREET EXTENSION AND
WESTBOUND LSB GRADE-SEPARATED AT SPADINA

INTERSECTION	A.M. PEAK HOUR		P.M. PEAK HOUR	
	LOS (DELAY in seconds)	CRITICAL MOVEMENTS[1] (v/c ratio)	LOS (DELAY in seconds)	CRITICAL MOVEMENTS[1] (v/c ratio)
WEST SECTION				
Spadina Avenue at Lake Shore Boulevard	C (27)	--	C (28)	--
Rees Street at Lake Shore Boulevard	F (129)	EB-T (1.30) WB-T (1.14) SB-R (1.15)	F (181)	EB-T (1.44) WB-T (1.31) SB-R (1.25)
Simcoe Street at Lake Shore Boulevard	F (234)	EB-L (1.62) EB-T (1.54) WB-T (1.42) NB-L (1.52) SB-T (1.15)	F (220)	EB-L (1.68) EB-T (1.43) WB-T (1.46) SB-R (1.39)

Note: 1. For this analysis, critical movements are those movements with a volume-to-capacity ratio exceeding 1.00

As expected, intersection operations are expected to significantly improve at Spadina with westbound Lake Shore Boulevard grade-separated; however, traffic operations at the intersections of Lake Shore Boulevard at Rees and Simcoe Streets, although slightly improved, are still expected to be operating poorly with traffic demands well in excess of the capacity.

One solution could be to assign more inbound and outbound traffic to the ramps at Spadina in order to ease the burden on the Rees and Simcoe intersections. This solution is not realistic for the following reasons:

- The capacity of Spadina, north of Lake Shore Boulevard, will not increase significantly from present conditions. The capacity will continue to be controlled by the signals at Bremner Boulevard. Therefore, the capacities for the high demand inbound eastbound left turn movement from the FGE off-ramp at Spadina, and the southbound right turn movement to the FGE on-ramp at Spadina, will not be significantly higher than they are under existing conditions;
- East-west green-time at the Lake Shore/Spadina intersection will also continue to be limited by the presence of the north-south streetcar line. In fact, the future amount of east-west green-time available may further decrease as streetcar frequencies increase to meet future transportation demands; and

- The traffic assignment assumed for Scenario 1 already reflects a volume increase relative to existing conditions for the inbound and outbound movements associated with the FGE ramps at Spadina.

This assessment shows that even with westbound Lake Shore Boulevard grade separated at Spadina Avenue, without the Front Street Extension there is insufficient capacity on the road network to accommodate the inbound and outbound traffic on the preferred GSA road network.

4.0 SCENARIO 2: WITHOUT DVP INTERCHANGE RAMP IMPROVEMENTS AT RICHMOND/ ADELAIDE

In Scenario 2, no improvements would be made to the DVP interchange at Richmond/Adelaide. The ramps would continue to provide the same vehicular capacity that they do under existing conditions.

4.1 Redistribution of Traffic

In order to assess the implications associated with Scenario 2, the additional traffic that would have used the improved DVP interchange at Richmond/Adelaide was redistributed to the Great Street as shown in **Figure 8**. Only inbound traffic is affected since the improved on-ramp to the DVP is expected to attract a negligible number of outbound trips during the a.m. and p.m. peak hours.

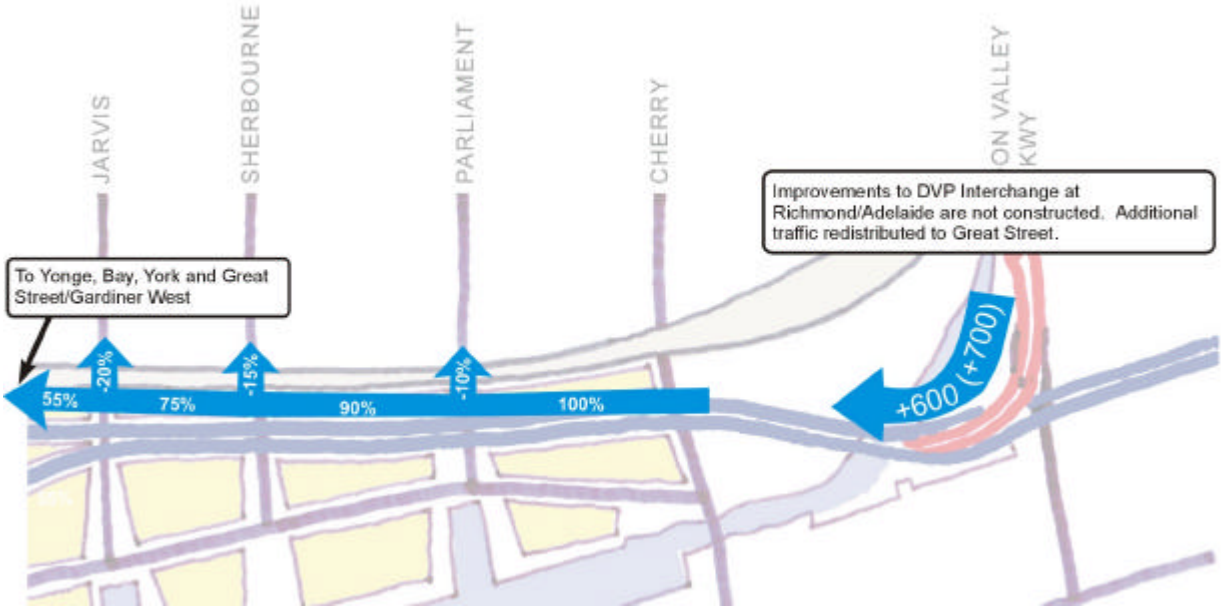

FIGURE 8: REDISTRIBUTION OF TRAFFIC FOR SCENARIO 2

As was the case for Scenario 1, all traffic projected to use the improved ramps or the GLC for the preferred GSA was assumed to remain in the corridor (i.e. no trips were assumed to use other routes). The traffic volumes projected by the Paramics model already account for a reasonable diversion of vehicles to other routes.

The redistributed a.m. and p.m. peak hour volumes for Scenario 2 are shown in **Figure 9**.

4.2 Assessment of Operations

The intersections in the east section will control the amount of traffic that is able to access the waterfront to and from the north (via the DVP) and to and from the east (via LSB, east of the Don Roadway).

Traffic to and from the east is limited by the capacity of an eight-lane road from the Don Roadway to Jarvis Street. The urban design and sustainability goals of the GSA are felt to be unacceptably compromised by the creation of a wider road for this two-way traffic section.

The capacity analysis for Scenario 2 is summarized in **Table 4**. Detailed capacity calculations are contained in **Appendix D**.

TABLE 4
CAPACITY ANALYSIS
SCENARIO 2 – NO DVP INTERCHANGE IMPROVEMENTS

INTERSECTION	A.M. PEAK HOUR		P.M. PEAK HOUR	
	LOS (DELAY in seconds)	CRITICAL MOVEMENTS[1] (v/c ratio)	LOS (DELAY in seconds)	CRITICAL MOVEMENTS[1] (v/c ratio)
EAST SECTION				
Parliament Street at Lake Shore Boulevard	F (110)	EB-L (1.29) WB-T (1.31)	D (54)	EB-L (1.22) WB-T (1.17)
Sherbourne Street at Lake Shore Boulevard	C (31)	WB-T (1.05)	D (47)	EB-T (1.13) WB-L (1.15)
Jarvis Street at Lake Shore Boulevard	D (35)	SB-R (1.08) WB-T (1.05)	D (38)	EB-L (1.06) WB-T (1.09)

Note: 1. For this analysis, critical movements are those movements with a volume-to-capacity ratio exceeding 1.00

The following key observations are noted from Table 4:

- At all three intersections, traffic volumes would exceed intersection capacity by as much as 30 percent for certain movements;
- Overall vehicle delays at the intersection of **Parliament Street at Lake Shore Boulevard** are expected to increase as a result of not implementing any improvements to the DVP interchange at Richmond/Adelaide. The overall intersection delay is expected to increase by over 50 seconds during the a.m. peak hour. The critical westbound through and eastbound left turn movements are also expected to experience increased congestion; and

- Overall vehicle delays at the intersections of **Sherbourne Street at Lake Shore Boulevard** and **Jarvis Street at Lake Shore Boulevard** are also expected to increase relative to the preferred GSA concept plan. Although the increases are not as large as was observed for the removal of the FSE, they would utilize any residual capacity that would otherwise be available to accommodate vehicular growth associated with future development in the east precincts. Inbound traffic volumes at these intersections are controlled by the capacity of the Parliament Street at Lake Shore Boulevard intersection to deliver traffic. The outbound traffic volumes are controlled by the capacity of the north-south streets to deliver traffic to the Great Street.

5.0 CONCLUSIONS AND RECOMMENDATIONS

As stated in the Technical Briefing Report, the Great Street Approach is the preferred approach to the Gardiner / Lake Shore Corridor. Improved access to the central waterfront can only be achieved by improving acccess for non-auto modes of travel while maintaining acceptable access for private automobiles. This preferred balance between auto and non-auto accessibility to the waterfront is best achieved by the Great Street Approach;

The FSE includes introducing a new partial interchange connecting both directions of the Gardiner Expressway with Front Street, primarily serving traffic to and from the downtown. The Front Street Extension would provide a direct, convenient connection to downtown for commuters on the Gardiner Expressway inbound from the west and outbound to the west. Scenario 1 assessed the implications of not constructing the Front Street Extension. The assessment included Gardiner on and off-ramps at Spadina, intended to replace some of the functionality lost without the FSE. An option in which westbound Lake Shore Boulevard traffic was grade separated at Spadina was also assessed.

The Richmond/Adelaide interchange provides a similar function in the east to the function of the Front Street Extension in the west. The interchange provides a convenient high-capacity connection to downtown. Scenario 2 assessed the implications of not making any improvements to the DVP interchange at Richmond/Adelaide.

5.1 Conclusions

Based on the analysis of the traffic impacts of eliminating the peripheral improvement elements associated with the GSA concept plan undertaken in this study, the following conclusions have been drawn:

Scenario 1

- **The assessment shows that for Scenario 1 (without the Front Street Extension), there is insufficient capacity on the road network to accommodate the inbound and outbound traffic on the FGE at either the Spadina ramps or on the Great Street.** With the expressway delivering more traffic than can be dispersed onto the downtown road network, traffic queues and congestion will quickly develop. Based on the existing travel patterns (in which demand exceeds capacity over the entire day), the queues and congestion can be expected to be consistent through the day. Although the extent of the inbound queue on the Gardiner cannot be quantified based on this assessment, it would most certainly be significant. For the outbound movement to the west, volumes on the Gardiner will likely be quite low. This is

because without the FSE, there is insufficient capacity on the downtown road network to deliver traffic volumes to the expressway. Traffic will be queued on the north-south streets attempting to access the Great Street and the Spadina ramps, as well as along the Great Street itself;

- The analysis also confirms that the addition of the Spadina ramps and the grade-separation of westbound Lake Shore Boulevard would not divert enough traffic to allow the modified Great Street Approach to accommodate traffic at an acceptable level of service without widening beyond 5 lanes each way between Spadina Avenue and Yonge Street. A solution that is neither desirable nor physically achievable;

Scenario 2

- For Scenario 2, the increased traffic volume which could be accommodated by these improved ramps plays a significant role in reducing traffic volumes in the central waterfront thereby allowing the section of the Great Street from Jarvis Street to the Don Roadway to be designed as an eight-lane road rather than a much less desirable ten-lane road as was proposed in an earlier option; and
- Vehicle delays and volume-to-capacity ratios are expected to be greater for the GSA intersections associated with Scenario 2 (i.e., no improvement to the Richmond/Adelaide interchange with the Don Valley Parkway) relative to baseline conditions. These higher traffic volumes would utilize the residual capacity that would otherwise be available to accommodate vehicular demand generated by the planned future development in the east waterfront precincts.

5.2 Recommendations

The following actions are recommended:

1. The Front Street Extension should be considered an integral and essential element of the Great Street Approach to the removal of the elevated central and eastern sections of the Gardiner Expressway;
2. The function and capacity of the FSE cannot be adequately replaced by adding ramps between the Gardiner Expressway and Spadina Avenue to and from the west; however, the inclusion of expressway ramps at Spadina may provide significant benefits even with the FSE in place and should therefore be considered in any further work for the preferred Great Street Approach; and

3. Improvements to the Don Valley Parkway (DVP) interchange at Richmond/Adelaide are desirable elements of the GSA concept plan and should be included. Traffic operations in the GLC are expected to be operating close to capacity under baseline conditions, and would be significantly poorer if the ramp improvements were not made. The assessment indicates that vehicle delays would increase and volumes would exceed capacity. More importantly though, the increase in traffic volumes would significantly reduce the residual road capacity which would otherwise be available to accommodate traffic generated by the new development planned for the waterfront precincts.