UNION STATION 2031
DEMANDS AND OPPORTUNITIES STUDY

DRAFT FINAL
Fall 2012
# Contents

1 Introduction .............................................................................................................. 1
1.1 Background ........................................................................................................ 1
1.2 Purpose and Scope ........................................................................................... 2
1.3 Related Initiatives ............................................................................................. 3

2 Study Design Overview .......................................................................................... 5

3 Existing and Future Rail Travel Market Analysis ............................................. 9
3.1 Introduction ........................................................................................................ 9
3.2 A.M. Peak Period GO Rail Ridership by GO Lines ............................................. 10
3.3 A.M. Peak Period GO Rail Market Destined to PD 1 by Origin Regions .......... 11
3.4 A.M. Peak Period Passenger Egress Characteristics from Union Station ........ 11
3.5 Historical Land Use Growth .............................................................................. 13
3.6 Historical GO Rail Ridership Growth ............................................................... 15
3.7 Future Land Use and Travel Market Analysis .................................................. 18
3.8 Key Conclusions ............................................................................................... 25

4 Precedent Analysis .................................................................................................. 27
4.1 Toronto Context ............................................................................................... 27
4.2 Case Studies ...................................................................................................... 32
4.3 Madrid – Intermodal Exchange Stations (IES) .................................................... 33
4.4 Melbourne – Downtown Rail Loop .................................................................... 38
4.5 Montreal – Physical Integration ........................................................................ 44
4.6 Sao Paulo – Metro-Commuter Rail Integration .................................................. 48
4.7 Findings/Implications for Toronto and Union Station ..................................... 55

5 Model Development and Base Case Model Analysis ......................................... 58
5.1 Model Development ......................................................................................... 58
5.2 Base Case Analysis .......................................................................................... 64
5.3 Assignment Review ................................................................. 69
5.4 Screenline Analysis ............................................................... 71
5.5 System Analysis Process ......................................................... 72

6 Transportation System Option Development ............... 74
6.1 Overview ........................................................................ 74
6.2 Transportation System Option Workshop ......................... 75
6.3 Summary of Workshop Discussion ......................................... 82

7 Transportation System Options Screening Assessment........ 84
7.1 Overview ........................................................................ 84
7.2 Screening Assessment .......................................................... 85
7.3 Carry Forward Transportation System Options Short List ............ 85

8 System Option Evaluation ....................................................... 91
8.1 Overview ........................................................................ 91
8.2 Definition of Themes for Detailed Analysis ......................... 91
8.3 Analysis and Evaluation ........................................................ 97
8.4 Transportation System Option Evaluation Summary ............... 104

9 Final Network Assessment ....................................................... 109
9.1 Overview ........................................................................ 109
9.2 Transportation System Option 4B ........................................ 109
9.3 Transportation System Option 5A-2 ..................................... 112
9.4 Transportation System Option 6B ........................................ 113

10 Findings/Conclusions and Recommendations ..................... 116
10.1 Overview of Problem – Future Union Station Demand Levels ......... 116
10.2 Alternative Options to Offload 2031 Passenger Demands at Union Station 117
10.3 Screening Evaluation of Base Transportation System Options ............ 119
10.4 Transportation System Options Evaluation ............................ 121
10.5 Final Network Assessment .................................................. 124
10.6 Next Steps ........................................................................................................................................ 125
List of Figures

Figure 1 - Overview of Study Process ................................................................. 7
Figure 2 - Union Station Transit Service ............................................................. 9
**Figure 3 - Distribution of GO Train Passengers from Union Station (a.m. Peak Period)** .......................................................... 12
Figure 4 - PD 1 Employment Trend, 2001-2009 .................................................. 15
Figure 5 - GO Rail Catchment Areas ................................................................ 16
Figure 6 - Total Transit Market Share ................................................................. 21

![Graph showing the percentage of Barrie-Bradford 905 area total, Georgetown 905 area total, Lakeshore East 905 area total, Lakeshore West 905 area total, Milton 905 area total, Richmond Hill 905 area total, Stouffville 905 area total, and Total GO catchment area in the 905 region from 1986 to 2006.

Figure 7 - Proportion of GO Rail to Total Transit .............................................. 21
Figure 8 - Focus Area and Destination GO Trips (2006) ..................................... 24
Figure 9 - Employment Growth by Zones and Potential Interceptor Stations ......... 25
Figure 10 - Location of Planning District 1 within the City of Toronto .................. 28
Figure 11 - Early Toronto Rapid Transit Plan ...................................................... 29
Figure 12 - City of Toronto: 2006 Employment Densities (jobs/1,000m²) ............... 30
Figure 13 - Existing Locations of Intermodal Integration ..................................... 31
Figure 14 - Aluche Station .................................................................................. 35
Figure 15 - Map of MMA Road Network and IES Stations ............................... 36
Figure 16 - Moncloa Station ............................................................................... 37
Figure 17 - Schematic of MURL Project (as built) and 3D View of Downtown Melbourne ............................................................................................................... 41
Figure 18 - Vendome Station Physical Integration .............................................. 45
**Figure 19 - Map of Sao Paulo City and Metropolitan Area** ............................. 49
Figure 20 - Population Density Plot – Sao Paulo Metropolitan Region ............... 49
Figure 21 - Photo of Sao Paulo City .................................................................. 50
Figure 22 - Current Sao Paulo Rapid Transit Network ........................................ 51
Figure 23 - Luz Station .................................................................52
Figure 24 - Barra Funda Station .....................................................53
Figure 25 - Sao Paulo - Results of Integration Program (from 1993) .......54
Figure 26 - Union Station Base Network .........................................66
Figure 27 - Inner and Outer Cordon Screenline Locations .................72
Figure 28 - System Analysis Process ..............................................73
Figure 29 - System Option 1 - Existing/Committed Rail/Subway Interchange Stations .................................................................76
Figure 30 - System Option 2 – Satellite Stations ................................77
Figure 31 - Option 3 - North Toronto Subdivision via Summerhill .........78
Figure 32 - System Option 4 – GO / Downtown Rapid Transit Integration .....79
Figure 33 - System Option 5 – New GO CBD Terminal ......................80
Figure 34 - System Option 6 – Second Terminal at Union Station ..........81
Figure 35 - System Option 4A-1 (Full DRT with Limited Stops) ..........92
Figure 36 - System Option 4A-2 (Full DRT with Regularly Spaced Stops) 93
Figure 37 - System Option 4B .........................................................94
Figure 38 – System Option 5A-2 .....................................................95
Figure 39 – System Option 6A .........................................................96
Figure 40 – System Option 6B .........................................................97
Figure 41 - Summary Evaluation of Transportation System Option 4 .......106
Figure 42 - Summary Evaluation of Transportation System Option 5 ........107
Figure 43 - Summary Evaluation of Transportation System Option 6 (Compared to Options 4 and 5) .................................................108
Figure 44 - Bathurst North Station Track Layout ................................110
Figure 45 - Bathurst North Yard Station Interface with DRT .................111
Figure 46 – New GO Station and Possible Station Access .....................115
List of Tables

Table 1 - Study Deliverables and Milestones.................................................................8
Table 2 - GO Train Ridership (6:30-9:30 a.m. arriving at Union Station)......................10
Table 3 - 2006 a.m. Peak Period GO Rail Market Destined to PD 1 by Origin Regions
..........................................................11
Table 4 - Historical GTHA Land Use Change by Municipalities .................................14
Table 5 - Historical Population Growth by GO Line Catchment Area .........................17
Table 6 - Historical GO Ridership (Daily Total Inbound Boardings by GO Line)............18
Table 7 - GTHA Land Use Growth Scenario.................................................................19
Table 8 - Forecast GO Ridership by Line (Daily Total Passenger Boardings)..............20
Table 9 - Forecast GO Ridership by Line (Morning Peak Period Total Passenger
Boardings – TTS)........................................................................................................23
Table 10 - Shortlisted Case Study Cities.......................................................................32
Table 11 - Overview of Benchmark Cities.................................................................33
Table 12 - Transit Patronage (unlinked trips), Melbourne and Toronto ......................39
Table 13 - Urban Rail Station Catchments, Melbourne and Toronto .........................39
Table 14 – Historical AM Peak Period Ridership by Station in Greater Montreal.......46
Table 15 – Land Use Allocation to Zone Systems.........................................................59
Table 16 - 2031 Places to Grow Population and Employment Forecasts...................59
Table 17 - Alternate 2031 City of Toronto Land Use Scenarios.................................60
Table 18 - DRTES 2031 Land Use Forecasts...............................................................60
Table 19 - GTHA 2031 Population and Employment Forecasts...............................61
Table 20 - 2031 a.m. Peak Period GO and Subway Passengers Assignment Summary
..............................................................................................................................63
Table 21 - GTHA 2031 DRTES Population and Employment Forecasts ........................................64
Table 22 - Region of Durham Proportion of 2031 a.m. Peak Period Total Trips Destined to PD 1 ........................................................................................................................................69
Table 23 - Union Station Base GO Alightings by Line at Union Station - 2031 a.m. Peak Period ................................................................................................................................................69
Table 24 - Union Station Base 2031 a.m. Peak Period Subway Passenger Forecasts ....70
Table 25 - 2031 a.m. Peak Period Transit Inner and Outer Cordon Screenline Passenger Summary ..........................................................................................................................................................71
Table 26 - Screening Analysis for Transportation System Option 2 and Option 3 ......88
Table 27 - Screening Analysis for Transportation System Option 4 and 5 .................89
Table 28 - Screening Analysis for Transportation System Options 5 and 6 .........90
Table 29 - Checkmark Matrix of Evaluation Criterion by Transportation System Option ....................................................................................................................................................................105
1 Introduction

1.1 Background

Union Station, Canada’s busiest passenger transportation facility, serves over 240,000 users per day (including GO Rail, Toronto Transit Commission – TTC - and Via Rail passengers). The City of Toronto owns the Union Station building and property while the rail corridor, platforms and train shed are owned by Metrolinx. Currently, the following rail transit services converge at Union Station:

- Seven GO Rail lines
- TTC Yonge/University/Spadina Subway
- TTC Harbourfront and Spadina Streetcar lines

The Downtown GO Bus Terminal on Bay Street is located adjacent to Union Station and connected via a pedestrian bridge to the GO Transit train platforms providing train passengers access to inter-regional bus routes. Union Station is also the central facility for VIA Rail service in the Greater Toronto Hamilton Area (GTHA) providing rail passenger connections to Ontario cities/towns as well as major cities throughout the rest of Canada and the USA.

On a daily basis, GO Transit operates about 180 train trips to and from Union Station and approximately 425 bus trips originate or terminate at the Downtown Bus Terminal. The 180 train trips occur on seven lines radiating from Union Station (Lakeshore West, Milton, Georgetown, Barrie, Richmond Hill, Stouffville and Lakeshore East) with access to 60 stations which provide a total of approximately 60,000 parking spaces.

Upwards of 95% of GO Train customers travel to and from Union Station, with upwards of 45,000 customers using the nine tracks and seven platforms in the morning peak hour. During the morning peak period (6:30 a.m. – 9:30 a.m.) the number of GO Train customers is approximately 72,000 (2009).

Metrolinx’s Regional Transportation plan, The Big Move, identifies the need to create a system of connected mobility hubs at key locations on the Greater Toronto and Hamilton Area (GTHA) rapid transit network defined by existing and planned subway lines and upgraded commuter rail lines. These mobility hubs will allow seamless access to various modes of transportation, help generate transit supportive development densities and support various Metrolinx initiatives including fare
integration (Big Move 6), an active transportation network and the Metrolinx investment strategy. Union Station will continue to be the primary Anchor Hub in the region’s transit system.

In the 25 year planning horizon, Big Move demand estimates suggest that the a.m. peak period boarding and alighting passengers at Union Station could approach 265,000. This forecast is approximately four times the 2006 a.m. peak period boarding and alighting passengers (60,000). This level of demand cannot be accommodated by the changes being implemented through the GO 2020 Plan to tracks and signal systems in the Union Station Corridor. These changes are expected to double the existing train capacity of the Station by 2020.

1.2 Purpose and Scope
Metrolinx initiated the Union Station 2031 Demands and Opportunities Study to achieve four main objectives:

- Refine existing long term estimates of future passenger demand at Union Station, including documentation of the origins and destinations of rapid transit users travelling to and from downtown Toronto via Union Station;
- Identify potential strategies to reduce future Union Station passenger demand by intercepting and/or off-loading projected Union Station demands at secondary transit terminals and to other elements of the regional and local transit network within the vicinity of Union Station;
- Assess the extent to which forecast Union Station passenger demand created by planned regional rapid transit network expansion and the introduction of Express Rail\(^1\) might be reduced by implementing the identified off-loading strategies, and identify the high level next steps that my be required to confirm these conclusions; and
- Collaborate with parallel Metrolinx studies, such as the Union Station & Union Station Rail Corridor (USRC) Track Capacity Study and the GO Electrification Study, and the TTC on their ongoing Downtown Rapid Transit Expansion Study (DRTES) in addressing Union Station and related rapid transit capacity issues.

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1 “Express Rail” services, as defined in The Big Move (page 28), are “…high speed trains, typically electric, serving primarily longer distance regional trips with two-way, all day service”. The models for planned GTHA Express Rail Services are the RER service in Paris and the Bay Area Rapid Transit in San Francisco. The existing GO Rail services are described in The Big Move as “Regional Rail” and are slower, less frequent, and have lower capacity than the proposed Express Rail services.
The assessment of off-loading opportunities included the review of possible new connections between the GO rail and TTC systems in central Toronto such as enhanced GO/TTC integration on the Bloor-Danforth Line (at the planned Dundas West/Bloor Mobility Hub or in the vicinity of Danforth/Main), potential satellite stations west of Union Station (e.g. near Bathurst Street) and east of Union Station (e.g. near Cherry Street), as well as the feasibility and potential benefits of future GO Rail services on the Canadian Pacific (CP) North Toronto Subdivision serving Dupont and Summerhill TTC Stations.

1.3 Related Initiatives

The research and analysis undertaken in considering the feasibility, benefits (and costs) of possible secondary inter-modal terminals builds on the findings and conclusions of recent implementation programs including the following:

- Union Station Infrastructure Expansion plans currently being implemented, including replacement of signal systems; modernization of tracks and switches; construction of new platforms and new passenger routes in and out of Union Station which reflect GO Transit’s GO 2020 Plan.

- Georgetown Corridor Expansion Area and Union Pearson Air Rail Link (ARL) which is planning for increased GO Train service on the Georgetown GO Line and a new rail service between Pearson Airport and Union Station (which is to be implemented by Metrolinx prior to the 2015 Pan-Am games).

- Inter-regional Bus Terminal

  Planning for a future new inter-regional bus terminal adjacent to Union Station.

The Union Station 2031 Demands and Opportunities Study was closely coordinated with a number of major concurrent studies being undertaken by Metrolinx and other agencies. The relevant studies include:

- Union Station and Union Station Rail Corridor Track Capacity Study, which is assessing the train carrying capacity of future tracks associated with the Union Station Infrastructure Expansion and the GO 2020 Plan.

- The recently completed GO Electrification Study, which assessed various equipment types and operating procedures to establish the “next steps” required to implement an electrified GO Commuter Rail system in the future.

- The TTC DRTES, which is assessing the TTC’s future rapid transit capacity requirements in light of the TTC’s Transit City plans, the expected growth in subway system demands, and existing capacity deficiencies on the subway system, particularly on the Yonge Line, south of Bloor.
In addressing Union Station capacity concerns, it was necessary to recognize the short and long term implications of potential solutions on future demands on the TTC’s subway system. Proposals to reduce Union Station demands must consider any impacts on the TTC’s existing and planned rapid transit system, such as potential overloading of the Yonge Subway. Therefore the Union Station and TTC Rapid Transit Expansion Studies were closely coordinated with the goal to creating win-win conditions.
2 Study Design Overview

The study involved the following major tasks:

1. Study Area Definition and Data Assembly
2. Existing Rail Travel Market Analysis
3. Future Land Use and Rail Market Analysis
4. Precedent Analysis
5. Travel Demand Modelling
6. Model Assembly
7. Model Validation
8. System Options Development
9. Network Analysis and Evaluation
10. Network Assessment
11. Final Report & Key Deliverables

Supporting the study design were the following Technical Committees that provided updates on concurrent studies as well as a forum to discuss databases, land use forecasts and travel demand forecasting procedures. A summary of the Technical Committees convened during the course of the study include:

Metrolinx Internal Working Group
- Policy, Planning and Innovation
- Corporate Infrastructure
- Operations
- Investment Strategy and Project Evaluation
- Union Station and USRC Track Capacity Study Team
- Electrification Study Director
Metrolinx – Downtown Modelling Working Group
- Metrolinx Internal Working Group
- City of Toronto Transportation Planning
- TTC Staff and Consultants
- Ministry of Transportation
- Region of York Transportation Planning

In addition to the Technical Committees, a Transportation System Option Workshop was held with participation from the following agencies/groups:

- Metrolinx Policy, Planning and Innovation
- Metrolinx Corporate Infrastructure
- Metrolinx Operations
- City of Toronto Community Planning
- City of Toronto Transportation Planning
- TTC Service Planning
- External Transportation Specialists
- Metrolinx/TTC/City of Toronto Project Consultants

The following flow chart, presented in Figure 1, provides an overview of the study process. The travel market analysis included a detailed review of travel characteristics related to Union Station, such as ridership by corridor, historical ridership growth and distribution of ridership by origin. Population and employment forecasts were then assembled and incorporated in the Greater Golden Horseshoe Model (GGHM). The precedent analysis was carried out to understand the role of secondary transit hubs (intermodal transit stations) in addressing transit capacity challenges.

Following this work a number of transportation system options were developed to study the potential alternatives to alleviate capacity at Union Station. These options were assessed with the travel demand forecasting model, and evaluated to identify preferred options requiring further detailed study.
A summary of the key study deliverables and milestone dates that relate to the study design are presented in Table 1.
Table 1 - Study Deliverables and Milestones

<table>
<thead>
<tr>
<th>Key Deliverable</th>
<th>Milestone Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Design Document</td>
<td>June 2010</td>
</tr>
<tr>
<td>Existing Rail Travel Market Analysis</td>
<td>July 2010</td>
</tr>
<tr>
<td>Future Land Use and Travel Market Analysis</td>
<td>September 2010</td>
</tr>
<tr>
<td>Precedent Analysis</td>
<td>September 2010</td>
</tr>
<tr>
<td>Model Development / Validation / Base Case Analysis</td>
<td>September 2010</td>
</tr>
<tr>
<td>Systems Option Development / Stakeholder Meetings</td>
<td>October 2010</td>
</tr>
<tr>
<td>Network (System Options) Analysis and Evaluation</td>
<td>December 2010</td>
</tr>
<tr>
<td>Final Network Assessment</td>
<td>December 2010</td>
</tr>
<tr>
<td>Draft Report</td>
<td>Spring 2011</td>
</tr>
<tr>
<td>Final Report</td>
<td>Fall 2011</td>
</tr>
</tbody>
</table>
3 Existing and Future Rail Travel Market Analysis

3.1 Introduction
This section reviews historical and existing demands and alternative projections of future demands at Union Station to provide an appropriate context for understanding current and future passenger demands. Union Station is a major multi-modal terminal, with five modes operated by three separate service providers. They are:

- GO Transit - Seven commuter rail lines
- GO Transit – bus terminal
- TTC – Two subway lines
- TTC – Two streetcar lines
- VIA Rail – provides inter-city and national connectivity

A map of transit services in the GGH area (TTC subway, GO rail and GO Bus) is shown in Figure 2.

Figure 2 - Union Station Transit Service
3.2 **A.M. Peak Period GO Rail Ridership by GO Lines**

GO Rail is a commuter rail service, with an inbound flow of riders to downtown during the morning peak period, outbound flow during the afternoon peak period, and less intense midday ridership. Historically, the inbound ridership during the morning peak period (6:30-9:30 a.m. arriving at Union Station) comprises 85-90% of daily inbound trips.

To understand the operations of Union Station during its busiest time, Table 2 summarizes GO rail service and ridership levels during the morning peak period (6:30-9:30 a.m. arriving at Union Station) in 2006 and 2009. The Lakeshore West, Lakeshore East and Milton corridors carry almost 70% of GO Transit riders and utilize the greatest number of GO Trains.

The majority of the customer base resides outside the City of Toronto. Table 2 indicates that the trips originating at stations within the City of Toronto are relatively low, representing approximately 7,000 passengers, or 10% of total trips. The Lakeshore East Line carries the majority (60%) of trips made from stations within the City of Toronto. It must also be noted that while ridership to Union Station significantly increased by 10% over the three year period, the majority of the growth originated outside the City of Toronto.

**Table 2 - GO Train Ridership (6:30-9:30 a.m. arriving at Union Station)**

<table>
<thead>
<tr>
<th>GO Lines</th>
<th>Ridership Approaching City of Toronto Boundary</th>
<th>Ridership Approaching Union Station</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 2006</td>
<td>Year 2009</td>
</tr>
<tr>
<td>Barrie</td>
<td>4,500</td>
<td>6,000</td>
</tr>
<tr>
<td>Georgetown</td>
<td>5,700</td>
<td>6,200</td>
</tr>
<tr>
<td>Lakeshore E</td>
<td>12,000</td>
<td>13,600</td>
</tr>
<tr>
<td>Lakeshore W</td>
<td>18,100</td>
<td>18,500</td>
</tr>
<tr>
<td>Milton</td>
<td>10,600</td>
<td>11,600</td>
</tr>
<tr>
<td>Richmond Hill</td>
<td>3,300</td>
<td>3,700</td>
</tr>
<tr>
<td>Stouffville</td>
<td>3,800</td>
<td>5,200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>58,000</strong></td>
<td><strong>64,800</strong></td>
</tr>
</tbody>
</table>

Source: GO Transit cordon counts
3.3 **A.M. Peak Period GO Rail Market Destined to PD 1 by Origin Regions**

Planning District 1 (PD 1) covers the downtown district and is a common analysis area for both land use planning and transportation planning. A summary of the geographical area covered by PD1 is presented in Figure 10 on page 28. GO rail ridership and total travel demand to PD 1 during the morning peak period (trips between 6:30-9:30 a.m.) is shown in Table 3.

<table>
<thead>
<tr>
<th>Origin Municipalities</th>
<th>Total Person Trips</th>
<th>Total GO Trips</th>
<th>Total GO Trips %</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD 1</td>
<td>62,600</td>
<td>20</td>
<td>0.0%</td>
</tr>
<tr>
<td>Rest of Toronto</td>
<td>217,900</td>
<td>6,800</td>
<td>3.1%</td>
</tr>
<tr>
<td>Durham Region</td>
<td>14,600</td>
<td>9,800</td>
<td>66.9%</td>
</tr>
<tr>
<td>York Region</td>
<td>38,300</td>
<td>10,800</td>
<td>28.1%</td>
</tr>
<tr>
<td>Peel Region</td>
<td>37,500</td>
<td>18,800</td>
<td>50.0%</td>
</tr>
<tr>
<td>Halton Region</td>
<td>13,100</td>
<td>9,900</td>
<td>75.1%</td>
</tr>
<tr>
<td>Hamilton Region</td>
<td>2,100</td>
<td>1,100</td>
<td>53.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>386,100</strong></td>
<td><strong>57,000</strong></td>
<td><strong>14.8%</strong></td>
</tr>
<tr>
<td>Toronto</td>
<td>280,500</td>
<td>6,800</td>
<td>2.4%</td>
</tr>
<tr>
<td>Rest of GTHA</td>
<td>105,600</td>
<td>50,200</td>
<td>47.6%</td>
</tr>
</tbody>
</table>

Source: 2006 Transportation Tomorrow Survey (Trips starting at 6:30-9:30 a.m.)

PD 1 has historically attracted high transit patronage due to its high employment concentration (approximately 439,000 jobs in 2006) and limited parking supply (and hence, associated high parking costs). A total of 57,000 (15%) of all GTHA trips destined to PD1 use GO Transit and this percentage more than triples (48%) for residents outside the City of Toronto. For the 2006 a.m. peak period; trip rates for PD 1, as they pertain to employment, were 0.88 total person trips/job, and 0.13 total GO trips/job. Conversely, areas outside of PD1 do not have the distinctive combination of high employment concentration and low parking supply, and therefore do not attract similarly high transit patronage. It should also be noted that of the total 2006 a.m. peak period GO trips destined to the City of Toronto (approximately 61,000), 93% (approximately 57,000 trips) are destined to areas within PD1, with only 7% of GO trips destined to areas outside PD1.

3.4 **A.M. Peak Period Passenger Egress Characteristics from Union Station**

The majority of GO Train passengers alighting at Union Station are destined to an area bounded by Spadina Avenue / Bloor Avenue / Parliament Street. Within this area, approximately 90% of GO Train passengers alighting at Union Station are destined to a location approximately within a 1.75 km distance from Union Station (at College Street). The distribution of passenger destinations within this area, as well as the proportion of passengers walking to these destinations, is presented in Figure 3.
Information from the 2006 Transportation Tomorrow Survey (TTS) for the a.m. peak arrival period indicates that approximately 55,000 GO trips are destined to the defined area presented in Figure 3. Approximately 84% of travellers taking part in these GO trips walk to their destination from the station. As can be expected, a higher proportion of passengers tend to walk to destinations that are closer to Union Station and as the destination distance from Union Station increases, the dominant mode shifts from walking to using the TTC. For passengers destined to areas between College Street and Bloor Street for instance, 78% choose to take the TTC instead of walk.

The long distances that GO patrons are willing to walk to reach their destinations reflects two factors: the lack of fare integration between GO Rail and TTC subway
services (and the need to pay a second fare to use the TTC even for very short distances) and the existence of the PATH system.

The PATH system, which provides a safe and protected walkway, extending from Front Street to north of Dundas Street, appears to play a significant role in achieving the over 80% factor of passengers reaching their destinations within the defined area by walking. North of Dundas Street, there is a significant reduction in the number of persons walking to their destination because this requires a walk of more than 15 minutes using the available on-street walk ways or more than 20 minutes using the less direct PATH system.

3.5 **Historical Land Use Growth**

As presented in Table 4, during the decade between 1996 and 2006 both population and employment increased at an average annual rate of approximately 2%. During this period, significant population growth occurred in the GO Rail markets of York Region (approximately 51% growth), Peel Region (approximately 38%), Halton Region (approximately 29%) and Durham Region (approximately 20%).

Employment opportunities within the City of Toronto also grew, as there were approximately 82,000 new jobs created in the 1996-2006 period, almost half of which (40,000), were located in PD1, which is the primary market for GO Rail services.

At the GTHA level, approximately 82% of the employment growth experienced between 1996 and 2006 occurred in the regional municipalities outside the City of Toronto, with less than 10% of the GTHA employment growth occurring in Toronto’s PD1.
### Table 4 - Historical GTHA Land Use Change by Municipalities

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PD 1</td>
<td>147,000</td>
<td>188,000</td>
<td>41,000</td>
<td>28.0%</td>
<td>399,000</td>
<td>439,000</td>
<td>40,000</td>
<td>9.9%</td>
</tr>
<tr>
<td>Rest of Toronto</td>
<td>2,159,000</td>
<td>2,258,000</td>
<td>99,000</td>
<td>4.6%</td>
<td>858,000</td>
<td>900,000</td>
<td>42,000</td>
<td>4.9%</td>
</tr>
<tr>
<td>Durham Region</td>
<td>450,000</td>
<td>540,000</td>
<td>90,000</td>
<td>19.8%</td>
<td>150,000</td>
<td>185,000</td>
<td>35,000</td>
<td>23.7%</td>
</tr>
<tr>
<td>York Region</td>
<td>568,000</td>
<td>858,000</td>
<td>290,000</td>
<td>51.1%</td>
<td>276,000</td>
<td>408,000</td>
<td>132,000</td>
<td>47.8%</td>
</tr>
<tr>
<td>Peel Region</td>
<td>813,000</td>
<td>1,119,000</td>
<td>307,000</td>
<td>37.7%</td>
<td>389,000</td>
<td>556,000</td>
<td>167,000</td>
<td>42.7%</td>
</tr>
<tr>
<td>Halton Region</td>
<td>328,000</td>
<td>423,000</td>
<td>95,000</td>
<td>28.8%</td>
<td>141,000</td>
<td>191,000</td>
<td>40,000</td>
<td>34.8%</td>
</tr>
<tr>
<td>Hamilton Region</td>
<td>462,000</td>
<td>487,000</td>
<td>25,000</td>
<td>5.4%</td>
<td>161,000</td>
<td>183,000</td>
<td>22,000</td>
<td>1.1%</td>
</tr>
<tr>
<td>Total</td>
<td>4,927,000</td>
<td>5,873,000</td>
<td>946,000</td>
<td>19.2%</td>
<td>2,394,000</td>
<td>2,862,000</td>
<td>467,000</td>
<td>19.5%</td>
</tr>
</tbody>
</table>

| Average Annual Growth Rate | 1.9% | 2.0% |

Source: Transportation Tomorrow Survey (TTS)

**Figure 4** presents an overview of historical employment trends within PD 1, based on data collected as part of City of Toronto Employment Surveys, the most reliable source of year to year changes in total employment.² PD 1 has been the destination for most GO Transit commuters over the last decade. Between 2001 and 2009, the adverse impact of changing economic conditions is evident in the two periods of decline, namely 2001-03 and recently, since 2008. It must be noted that even during the period of upswing (2003-08), employment growth was relatively slow.

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² Note that Toronto Employment Survey data is not directly comparable to Census Place of Work or TTS based estimates of PD 1 employment as it does not include local residents who live and work at home.
3.6 Historical GO Rail Ridership Growth

GO Rail ridership growth can be attributed to GO Transit service improvements, downtown employment growth and population growth in the suburbs, as well as GO Transit service improvements. To analyse the correlation of population growth along each of the GO Rail corridors, the TTS zones were grouped into catchment areas for each of the GO Rail Lines in the City of Toronto, and the rest of the GTHA. The resulting GO Rail analysis catchment areas are presented in Figure 5.
Historical population growth from 1986 to 2006 in each of the GO rail corridor catchment areas is shown in Table 5. The average annual growth rate is approximately
2.25%. The highest percentage growth by catchment areas occurs for the GO Barrie, Milton, and Stouffville Lines. However, from an absolute growth perspective, 50% of the population growth occurs in the catchment areas of the Georgetown, Milton, and Barrie Lines. The Lakeshore West and Lakeshore East GO Rail line catchment areas account for only 24% of population growth from 1986 to 2006.

Table 5 - Historical Population Growth by GO Line Catchment Area

<table>
<thead>
<tr>
<th>GO Lines</th>
<th>1986</th>
<th>1996</th>
<th>2006</th>
<th>% Growth over 20 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrie</td>
<td>428,000</td>
<td>551,000</td>
<td>709,000</td>
<td>66%</td>
</tr>
<tr>
<td>Georgetown</td>
<td>645,000</td>
<td>766,000</td>
<td>958,000</td>
<td>49%</td>
</tr>
<tr>
<td>Lakeshore E</td>
<td>633,000</td>
<td>775,000</td>
<td>879,000</td>
<td>39%</td>
</tr>
<tr>
<td>Lakeshore W</td>
<td>808,000</td>
<td>908,000</td>
<td>1,000,000</td>
<td>24%</td>
</tr>
<tr>
<td>Milton</td>
<td>449,000</td>
<td>607,000</td>
<td>756,000</td>
<td>68%</td>
</tr>
<tr>
<td>Richmond Hill</td>
<td>321,000</td>
<td>386,000</td>
<td>466,000</td>
<td>45%</td>
</tr>
<tr>
<td>Stouffville</td>
<td>311,000</td>
<td>408,000</td>
<td>528,000</td>
<td>70%</td>
</tr>
<tr>
<td>Rural areas*</td>
<td>62,000</td>
<td>79,000</td>
<td>91,000</td>
<td>45%</td>
</tr>
<tr>
<td>Core Toronto</td>
<td>406,000</td>
<td>446,000</td>
<td>485,000</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,063,000</strong></td>
<td><strong>4,926,000</strong></td>
<td><strong>5,872,000</strong></td>
<td><strong>45%</strong></td>
</tr>
</tbody>
</table>

Source: TTS.
* Within the GTHA but outside of GO rail catchment areas

Data from the GO Rail Passenger Survey/Cordon Count data, summarized in Table 6 indicates that the daily total passenger boardings have increased from approximately 31,100 in 1987 to approximately 78,600 in 2006. The growth in daily passenger boardings represents a 152% increase, which is more than three times the growth in population over this period. The rapid growth in GO ridership over this period reflects positive service factors, including the comfort and convenience of GO services compared to driving on the increasingly congested highways serving downtown Toronto and continued improvements to GO Rail services (increased train frequency and improved schedule adherence).

The total 2009 GO Rail daily passenger boardings, also presented in Table 6, are estimated at approximately 88,300, indicating a growth rate of 2.84 when compared to 1987 daily passenger boardings of approximately 31,100.

Given the near tripling in GO Rail ridership over a twenty year period and the tendency for the majority of passengers to alight at Union Station, it follows that Union Station is now handling an unprecedented volume of GO Rail passengers. Based on these recent trends, passenger demands at Union Station might be expected to possibly triple over the next 20 plus years.
Table 6 - Historical GO Ridership (Daily Total Inbound Boardings by GO Line)

<table>
<thead>
<tr>
<th>GO Line</th>
<th>Year 1987</th>
<th>Year 1996</th>
<th>Year 2006</th>
<th>Year 2009</th>
<th>% Growth (1987-2009)</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrie</td>
<td>500</td>
<td>900</td>
<td>4,600</td>
<td>6,000</td>
<td>1011%</td>
<td>11.11</td>
</tr>
<tr>
<td>Georgetown</td>
<td>3,100</td>
<td>4,800</td>
<td>7,900</td>
<td>9,000</td>
<td>190%</td>
<td>2.90</td>
</tr>
<tr>
<td>Lakeshore E</td>
<td>10,000</td>
<td>15,000</td>
<td>21,000</td>
<td>21,900</td>
<td>119%</td>
<td>2.19</td>
</tr>
<tr>
<td>Lakeshore W</td>
<td>13,000</td>
<td>17,000</td>
<td>25,000</td>
<td>28,600</td>
<td>120%</td>
<td>2.20</td>
</tr>
<tr>
<td>Milton</td>
<td>2,500</td>
<td>6,500</td>
<td>11,000</td>
<td>11,900</td>
<td>376%</td>
<td>4.76</td>
</tr>
<tr>
<td>Richmond Hill</td>
<td>1,300</td>
<td>2,700</td>
<td>4,000</td>
<td>4,400</td>
<td>238%</td>
<td>3.38</td>
</tr>
<tr>
<td>Stouffville</td>
<td>700</td>
<td>1,600</td>
<td>5,100</td>
<td>6,500</td>
<td>856%</td>
<td>9.56</td>
</tr>
<tr>
<td>Total</td>
<td>31,100</td>
<td>48,500</td>
<td>78,600</td>
<td>88,300</td>
<td>184%</td>
<td>2.84</td>
</tr>
</tbody>
</table>

Source: GO Rail Passenger Surveys

3.7 Future Land Use and Travel Market Analysis

3.7.1 Land Use Projections

The Growth Plan for the Greater Golden Horseshoe (Growth Plan), adopted in 2006, provides the planning policies that reflect the Places to Grow Plan (the Ontario Government’s program to plan for growth and development). The population and employment forecasts up to 2031 that were the basis for The Big Move transportation plan were developed by the Ontario Ministry of Transportation (MTO) to represent the population and employment growth assumed in the Growth Plan. For the GTHA, the Growth Plan identified a population target of 8,620,000 and an employment threshold of 4,330,000 for the year 2031.

Each Regional Municipality and the City of Toronto are currently undertaking a compliance review of the Places to Grow population and employment guidelines and the allocations to specific municipalities and geographical units, including traffic zones used in the GGHM.

As part of this study, each of the Regional Municipalities and the City of Toronto were contacted to provide the most recent population and employment forecasts for the year 2031. Table 7 provides a summary of the population and employment for 2006, 2031 current municipal planned land use scenario and 2031 Growth Plan for the Greater Golden Horseshoe targets.

The comparison of the 2031 GGHM and Places to Grow population forecasts indicate that the model forecasts are generally in line on a Regional Municipality basis with Places to Grow. The model population forecast for the City of Toronto is approximately 5,000 less than that defined by Places to Grow.
The comparison of the 2031 model and Places to Grow employment forecasts indicate that the model forecasts are approximately 190,000 higher than the Places to Grow allocation. The majority of this difference occurs in the City of Toronto.

Table 7 also includes the 2031 Activity Rate (Employment Forecast/Population Forecast) for each Regional Municipality.

The forecast Activity Rate for the Region of Durham is substantially lower than the forecast Activity Rates for York, Peel or Halton Regions, which will result in considerable net outbound travel from Durham Region to major employment centres such as PD1.

Table 7 - GTHA Land Use Growth Scenario

<table>
<thead>
<tr>
<th>Region</th>
<th>Population</th>
<th>Employment</th>
<th>Activity Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2006</td>
<td>2031 GGH Model</td>
<td>2031 Places to Grow (2031)</td>
</tr>
<tr>
<td>Total Toronto</td>
<td>2,445,900</td>
<td>3,075,300</td>
<td>26%</td>
</tr>
<tr>
<td>Durham</td>
<td>539,500</td>
<td>952,100</td>
<td>76%</td>
</tr>
<tr>
<td>York</td>
<td>857,500</td>
<td>1,507,500</td>
<td>76%</td>
</tr>
<tr>
<td>Peel</td>
<td>1,119,100</td>
<td>1,640,000</td>
<td>47%</td>
</tr>
<tr>
<td>Halton</td>
<td>422,700</td>
<td>780,100</td>
<td>85%</td>
</tr>
<tr>
<td>Hamilton</td>
<td>487,100</td>
<td>659,700</td>
<td>35%</td>
</tr>
<tr>
<td>Total GTHA</td>
<td>5,871,800</td>
<td>8,614,700</td>
<td>47%</td>
</tr>
<tr>
<td>PD1</td>
<td>187,800</td>
<td>312,600</td>
<td>65%</td>
</tr>
<tr>
<td>Rest of Toronto</td>
<td>2,258,200</td>
<td>2,762,700</td>
<td>22%</td>
</tr>
</tbody>
</table>

*When comparing 2006 Employment to 2031 GGH Model
Source: 2006 data: Transportation Tomorrow Survey (TTS); Places to Grow (2031) data: Ontario Ministry of Public Infrastructure Renewal; 2031 GGH Model data: Ontario Ministry of Transportation (MTO).

3.7.2 GO Rail Ridership Outlook

To estimate future GO Rail ridership, and establish relevant and independent “benchmarks”, available historical GO Rail survey and TTS data were reviewed. While the GO Rail survey data provides information on ridership by line and time of the day since 1990, the TTS data provides comparable population, travel habits and transit modal split trend data for the 1986 to 2006 period. Both sources provide useful insights into the possible future level of ridership that GO Transit commuter rail services can be expected to achieve.
3.7.3 **GO Rail Survey Based Estimate of Future GO Rail Ridership**

A review of daily total passenger boardings between 1990 and 2009 was undertaken for the following GO Rail lines: Georgetown, Lakeshore East, Lakeshore West, Milton, and Richmond Hill, to establish a trend forecast to 2031 (22 years), based on 19 years of data. For the newer GO services on the Barrie and Stouffville GO lines, the trend forecast is based on daily passenger boardings between 2002 and 2009.

The 2031 trend forecast for daily total passenger boardings results in daily boardings increasing to approximately 191,000, which reflects more than double the value for 2009 observed daily boardings (2.2 times) and 2.4 times the 2006 observed daily boardings.

A summary of the trend forecasts is presented in Table 8.

**Table 8 - Forecast GO Ridership by Line (Daily Total Passenger Boardings)**

<table>
<thead>
<tr>
<th>GO Line</th>
<th>1990</th>
<th>2002</th>
<th>2006</th>
<th>2009</th>
<th>% Annual Growth</th>
<th>2031 Projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrie</td>
<td></td>
<td>3,000</td>
<td>4,600</td>
<td>6,000</td>
<td>14%</td>
<td>24,500</td>
</tr>
<tr>
<td>Georgetown</td>
<td>4,000</td>
<td></td>
<td>7,900</td>
<td>9,000</td>
<td>7%</td>
<td>21,900</td>
</tr>
<tr>
<td>Lakeshore E</td>
<td>16,100</td>
<td>21,000</td>
<td>21,900</td>
<td></td>
<td>2%</td>
<td>30,800</td>
</tr>
<tr>
<td>Lakeshore W</td>
<td>17,100</td>
<td>25,000</td>
<td>28,600</td>
<td></td>
<td>4%</td>
<td>50,800</td>
</tr>
<tr>
<td>Milton</td>
<td>5,600</td>
<td>11,000</td>
<td>11,900</td>
<td></td>
<td>6%</td>
<td>27,500</td>
</tr>
<tr>
<td>Richmond Hill</td>
<td>2,400</td>
<td>4,000</td>
<td>4,400</td>
<td></td>
<td>4%</td>
<td>8,800</td>
</tr>
<tr>
<td>Stouffville</td>
<td>3,300</td>
<td>5,100</td>
<td>6,500</td>
<td></td>
<td>14%</td>
<td>26,500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>78,600</td>
<td>88,300</td>
<td></td>
<td></td>
<td>190,800</td>
</tr>
</tbody>
</table>

Source: GO Rail Passenger Survey.

3.7.4 **TTS Based Estimate of Future GO Rail Ridership**

Utilizing TTS data and current population projections, the GO Rail ridership during the morning peak period was projected, recognizing expected population growth in each existing GO Rail corridor and estimates of achievable overall transit modal splits and GO Transit modal splits (GO’s share of total transit ridership).

For each of the GO line catchment area outside the City of Toronto, historical (1986-2006)\(^3\) trips to PD 1 in the morning for total trips, total transit trips and total GO Rail transit trips were generated. Based on a review of trends in total transit and GO Rail transit market shares (Figure 6 and Figure 7), benchmark or maximum likely transit

\(^3\) 1991 data was not used due to limited sample size.
market shares and GO Rail market shares were estimated for each of the seven GO lines in 2031. For example, Lakeshore East and West have been the only two corridors providing two-way all day service. These corridors achieved the highest total transit market shares observed across the GO Rail system and the highest proportions of GO Rail trips to total transit trips. The trends observed for the transit and GO shares of total commute trips for the Lakeshore Corridors were used to estimate future values for these measures in the other GO Rail corridors where two-way, all day services are planned. For the Richmond Hill, Barrie and Stouffville corridors, lower proportions of GO Rail trips to total transit trips were projected due to the availability of alternative higher order transit options (TTC Subway/VIVA).

Figure 6 - Total Transit Market Share
Total trips, by catchment area, from outside the City of Toronto to PD 1 in 2031, were projected based on the DRTES population projections documented in Section 5.2.1. GO Rail trips were then projected utilizing the benchmark 2031 transit and GO transit market shares shown in Table 9.

Taking into account the population growth and transit/GO Rail market share trends, it is estimated that based on historical trends there will be approximately 102,000 GO Rail trips from regional municipalities and other areas outside the City of Toronto to PD 1 in the a.m. peak period by 2031, which is about double from the 2006 TTS estimate of GO Rail ridership (1.9 times the 2006 figure). The population in the rest of the GTHA, outside the City of Toronto, is expected to increase by 56% over this 20 year period. The rate of increase in GO Rail ridership exceeds population growth, because of expected increase in the overall transit market share as well as proportion of GO Rail trips to total transit trips. It should be noted that this estimate does not take into account tipping point impacts of congestion and the greater level of transit service improvements planned over the next twenty years when compared to the previous twenty years.
It should be noted that trips from the City of Toronto area was excluded for this benchmarking exercise, given that most current and future GO Rail trips are and will be from the regions outside the City of Toronto.

Table 9 - Forecast GO Ridership by Line (Morning Peak Period Total Passenger Boardings – TTS)

<table>
<thead>
<tr>
<th>GO Line and catchment area outside the City of Toronto</th>
<th>Population</th>
<th>Total Trips</th>
<th>Total transit %</th>
<th>Proportion of GO to Total Transit</th>
<th>Total GO related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrie area total</td>
<td>413,000</td>
<td>14,400</td>
<td>62%</td>
<td>49%</td>
<td>4,400</td>
</tr>
<tr>
<td>Georgetown area total</td>
<td>484,700</td>
<td>10,200</td>
<td>64%</td>
<td>85%</td>
<td>5,600</td>
</tr>
<tr>
<td>Lakeshore East area total</td>
<td>502,000</td>
<td>15,900</td>
<td>72%</td>
<td>93%</td>
<td>10,700</td>
</tr>
<tr>
<td>Lakeshore West area total</td>
<td>906,600</td>
<td>20,400</td>
<td>72%</td>
<td>95%</td>
<td>13,900</td>
</tr>
<tr>
<td>Milton area total</td>
<td>560,300</td>
<td>21,600</td>
<td>69%</td>
<td>75%</td>
<td>11,300</td>
</tr>
<tr>
<td>Richmond Hill area total</td>
<td>180,700</td>
<td>11,300</td>
<td>72%</td>
<td>38%</td>
<td>3,100</td>
</tr>
<tr>
<td>Stouffville area total</td>
<td>229,700</td>
<td>11,300</td>
<td>69%</td>
<td>54%</td>
<td>4,200</td>
</tr>
<tr>
<td>Total GO catchment area outside the City of Toronto</td>
<td>3,277,000</td>
<td>105,100</td>
<td>69%</td>
<td>73%</td>
<td>53,200</td>
</tr>
</tbody>
</table>

2006 to 2031 Growth Estimates

<table>
<thead>
<tr>
<th>GO Line and catchment area outside the City of Toronto</th>
<th>Population</th>
<th>Projected Total Trips</th>
<th>Total transit % (based on historical trend)</th>
<th>Projected Proportion of GO to Total Transit (based on historical trend)</th>
<th>Projected GO Transit Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrie area total</td>
<td>732,300</td>
<td>25,600</td>
<td>75%</td>
<td>65%</td>
<td>12,500</td>
</tr>
<tr>
<td>Georgetown area total</td>
<td>833,800</td>
<td>17,500</td>
<td>75%</td>
<td>90%</td>
<td>11,800</td>
</tr>
<tr>
<td>Lakeshore East area total</td>
<td>893,500</td>
<td>28,300</td>
<td>75%</td>
<td>93%</td>
<td>19,800</td>
</tr>
<tr>
<td>Lakeshore West area total</td>
<td>1,155,600</td>
<td>26,000</td>
<td>75%</td>
<td>95%</td>
<td>18,400</td>
</tr>
<tr>
<td>Milton area total</td>
<td>636,200</td>
<td>32,300</td>
<td>75%</td>
<td>90%</td>
<td>21,800</td>
</tr>
<tr>
<td>Richmond Hill area total</td>
<td>252,900</td>
<td>15,900</td>
<td>75%</td>
<td>65%</td>
<td>7,700</td>
</tr>
<tr>
<td>Stouffville area total</td>
<td>413,900</td>
<td>20,400</td>
<td>75%</td>
<td>65%</td>
<td>9,900</td>
</tr>
<tr>
<td>Total GO catchment area outside the City of Toronto</td>
<td>5,120,200</td>
<td>164,200</td>
<td>75%</td>
<td>83%</td>
<td>102,000</td>
</tr>
</tbody>
</table>

2006 to 2031 Growth Estimates

<table>
<thead>
<tr>
<th>GO Line and catchment area outside the City of Toronto</th>
<th>Population</th>
<th>Projected Total Trips</th>
<th>Total transit % (based on historical trend)</th>
<th>Projected Proportion of GO to Total Transit (based on historical trend)</th>
<th>Projected GO Transit Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrie area total</td>
<td>1.6</td>
<td>1.6</td>
<td></td>
<td></td>
<td>1.9</td>
</tr>
</tbody>
</table>

3.7.5 Focus Area

To analyse the opportunities to potentially off-load passengers in/near the downtown area, a Focus Area was established. The Focus Area consists of four zones: southwest downtown, southeast downtown, the Union Station area, and the area north of Bloor Street, as presented in Figure 8.

A review of the 2006 TTS a.m. peak period GO trips indicate that approximately 94% of the trips to the Focus Area fall within the Union Station zone bounded by Spadina Avenue, Bloor Street and Parliament Street. The high percentage of trips destined to the Union Station zone suggests that satellite stations outside of the Union Station...
catchment area will serve few potential riders unless there is substantial development outside of the identified Union Station area.

Figure 8 - Focus Area and Destination GO Trips (2006)

A further review of planned employment growth opportunities within PD1 and the Focus Area, as presented in Figure 9, indicates that the majority of the employment growth is expected in PD1. The location of potential interceptor stations at Liberty Village/Exhibition Station, Summerhill Station and Cherry Street Station are identified in relation to employment growth areas.
Employment growth in the Focus Area is concentrated between Spadina Avenue, Bloor Street and Parliament Street, and this growth is consistent with the current GO Rail market. The identified inner city growth opportunities appear to limit the potential role of interceptor stations located beyond the area bounded by Spadina Avenue, Bloor Street and Parliament Street.

3.8 Key Conclusions
The market analysis was carried out independent of any travel demand modelling. Based on the data presented, there has been a trend of population growth in the GO rail catchment areas, and employment growth in the GO rail passenger destination areas, which will support continued increases in ridership.

The GO ridership trend analyses documented in sections 2.73 and 3.74 indicates that the GO Rail trips destined to PD1 will increase by 1.9 to 2.4 times from 2006 to 2031. Given a near tripling in ridership over a twenty-two year period to 2009 and the
tendency for the majority of passengers to alight at Union Station, it follows that Union Station is now handling an unprecedented number of GO Rail passengers and can be expected, based on the trends analyses, to accommodate at least a doubling of daily passenger boardings over the next twenty plus years.

The GO Rail ridership developed from the trend analyses is lower than the “quadrupling” of growth indicated in The Big Move and is approximately 25% lower than initial GGHM transit assignments undertaken for the Union Station 2031 Demands and Opportunities Study (250,000 daily GO riders alighting at Union Station).

The review of employment growth in the Focus Area is concentrated between Spadina, Bloor and Parliament maintaining the current GO Rail market. This therefore suggests that there are limits to the opportunities for interceptor stations outside of the Union Station catchment area.
4 Precedent Analysis

The precedent analysis was undertaken as a series of case studies of intermodal terminals (secondary transit hubs) that appear to be successful at intercepting or diverting demands that would otherwise travel through a main terminal, such as Union Station. The intent of this section is to understand potential benefits of such secondary transit terminals, including satellite stations and subway/commuter rail interchanges.

Section four reviews the historical evolution of downtown Toronto and its subway and GO Rail system to provide context for the identification and analysis of relevant case studies. This is followed by a summary of individual case studies and lessons learned for Toronto and Union Station.

4.1 Toronto Context

The history of Toronto, its downtown, and transit system, help define the requirements for relevant case studies.

4.1.1 Historical Context

The Downtown Core (southern part of Planning District 1, as shown in Figure 10) has been the focus of the City’s transit system even prior to 1900. When the Yonge subway was opened from Eglinton to Union Station in 1954, the TTC system continued to focus on the Yonge/King area which was the centre of the central business district (CBD). However, when the first east-west subway line was built along Bloor Street instead of Queen Street, conditions changed. With the opening of the Bloor/Danforth subway line in 1966, the focal point of the TTC rapid transit system became Bloor/Yonge/University, despite the fact that downtown employment was still concentrated further south in the downtown core. This shift in network focus resulted in a very high transfer rate on the subway system as persons using the Bloor-Danforth Line, destined for the Downtown Core, had to transfer to the Yonge-University-Spadina Line at St. George or Yonge/Bloor Stations.

The decision to build the Bloor-Danforth Line helped to create a distinct mid-town area, which currently accounts for about 25% all the jobs in the Downtown area (Planning District 1). As a result, the Yonge/Bloor Subway Station functions as both a transfer station and a secondary transit terminal.
Early Toronto planners had intended to continue to focus the City’s transit system in the core area, as illustrated in Figure 11, and the GO Rail System maintains the same pattern in that it provides direct express transit service to the downtown core. The GO system began operations in 1967, with Lakeshore corridor services between Oakville and Pickering. Today, GO Trains take commuters from seven corridors serving the GTHA directly to Union Station, within walking distance of the highest concentration of jobs in Canada. The high employment densities achieved in the downtown core area served by the GO Rail system is illustrated in Figure 12.
Figure 11 - Early Toronto Rapid Transit Plan

RAPID TRANSIT LINES PROPOSED – 1946

Source: A Most Intriguing Map... Implications for Rapid Transit Network Expansion and Connectivity in the GTA. Edward J. Levy. July, 2004
In 2006, there were approximately 190,000 residents and 440,000 jobs within PD 1. Approximately 60% of these jobs were located within the traditional downtown core or CBD (south of Dundas), an area within a 15 minute walk from Union Station.

The GO Train system offers premium, express transit services to commuters from regional municipalities outside Toronto. Union Station, the only transit terminal/interchange station in the area, serves well over 90% of GO Rail patrons and accounts for most transfers between the GO Rail and TTC Subway systems.

The majority of GO patrons destined for Union Station walk to work either using downtown sidewalks or the PATH System, which terminates north of Dundas Street. More than half of all GO commuters make use of the PATH. The large majority (80%) of commuters who are destined for locations south of Dundas Street walk from Union Station to their destinations (a distance of up to 1300 m). In contrast the majority of commuters traveling to locations north of Dundas Street transfer to the TTC system and pay a second fare.

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4 Transportation Tomorrow Survey (TTS) 2006
4.1.2 Current Intermodal Transfer Options

While Union Station is the major destination and GO/TTC transfer location, the current system also has good transfer connections at Kipling and Kennedy stations on the Bloor-Danforth Subway Line and less attractive connections elsewhere, as shown in Figure 13. In Figure 11, Kipling and Kennedy stations are shown as having “good intermodal integration” whereas the Dundas West/Bloor and Main/Danforth connections are not convenient.

Figure 13 - Existing Locations of Intermodal Integration

Transfers between GO and TTC services at Kipling and Kennedy subway stations involve a two to three minute walk between the GO and TTC platforms. On a typical weekday in 2006, approximately 700 transfers were made between the GO stations and the two Bloor-Danforth Subway stations.

The location of TTC and GO stations at Dundas West/Bloor Station and Main/Danforth Station on the Bloor-Danforth Line also provide possibilities to transfer between GO Rail and TTC Subway stations but with a longer walking distance between platforms and no physical protection or amenities. As a result, there are relatively few intermodal transfers reported at these locations.
Despite some apparent cost/time advantages, Kipling and Kennedy stations are not well used by GO patrons destined for the mid-town area which is served by the Bloor-Danforth Subway Line. Of the almost 800 Milton GO corridor riders who are destined to mid-town area in the morning peak period, only 60 transfer at Kipling Station and use the Bloor-Danforth Line (whereas more than 700 travel through Union Station). For the approximately 270 Stouffville GO corridor riders destined for the mid-town, more than 200 transfer to TTC at Union Station, rather than using the Kennedy Station transfer.

One would expect that the Milton and Stouffville line GO patrons would save both money and time by transferring to the Bloor-Danforth Line to complete their trips, rather than continuing on to Union Station and transferring to the Yonge-University Line. The reasons for such observed behaviour therefore need to be better understood.

### 4.2 Case Studies

A short list of six potential case study cities, shown in Table 10, were identified through consultation with Metrolinx staff, various advisors and Halcrow staff in the UK and USA.

#### Table 10- Shortlisted Case Study Cities

<table>
<thead>
<tr>
<th>City</th>
<th>Multi modal transit</th>
<th>Physical Integration</th>
<th>Fare integration (intermodal)</th>
<th>Selected for Further Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madrid, Spain</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>✓</td>
</tr>
<tr>
<td>New York, USA</td>
<td>●</td>
<td>(                    )</td>
<td>(                            )</td>
<td></td>
</tr>
<tr>
<td>New Jersey, USA</td>
<td>●</td>
<td>(                    )</td>
<td>(                            )</td>
<td></td>
</tr>
<tr>
<td>Melbourne, Australia</td>
<td>●</td>
<td>(                    )</td>
<td>●</td>
<td>✓</td>
</tr>
<tr>
<td>Montreal, Canada</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>✓</td>
</tr>
<tr>
<td>Sao Paulo, Brazil</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>✓</td>
</tr>
</tbody>
</table>

Legend: ● present/ full integration
        (                    ) weak integration
        ✓ selected

Four cases were identified for further study based on three criteria:

- Existence of multi-modal transit
- Extent and nature of physical integration between transit modes, and
- Existence of potentially relevant examples of fare integration.
The main objective in selecting the case study cities was to identify specific examples of inter-modal transit integration that might be relevant to Toronto and the potential for an emerging capacity situation at Union Station.

Each city was selected because it provides examples of policies and designs relevant to offloading Union Station capacity. The selected cities are listed in Table 11.

Table 11 - Overview of Benchmark Cities

<table>
<thead>
<tr>
<th>City</th>
<th>Key Features</th>
<th>Cntal Station(s)</th>
<th>Station of Interest</th>
<th>Physical Integration</th>
<th>Fare Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madrid</td>
<td>12 Metro, 3 LRT, 9 commuter rail lines, + urban interurban bus</td>
<td>1+</td>
<td>5 IES</td>
<td>5 intermodal exchange stations with excellent intermodal connection</td>
<td>monthly pass (flat fare within predetermined zone) for all modes</td>
</tr>
<tr>
<td>Melbourne</td>
<td>15 commuter rail, 28 tram, + urban + suburban bus</td>
<td>2</td>
<td>Southern Cross</td>
<td>minimal</td>
<td>zonal fares</td>
</tr>
<tr>
<td>Montreal</td>
<td>4 Metro lines, 5 commuter rail lines, and urban + suburban bus</td>
<td>2</td>
<td>Vendome, Parc, Concorde</td>
<td>metrocommuter rail integrated at 5 points (including 2 downtown stations)</td>
<td>zonal fares</td>
</tr>
<tr>
<td>Sao Paulo</td>
<td>5 Metro lines, 5 commuter rail lines, and bus</td>
<td>1+</td>
<td>Barra Funda, Luz</td>
<td>metrobus integrated 22 terminals metrocommuter rail integrated at 5 points</td>
<td>multiple fares, including special integration fares</td>
</tr>
</tbody>
</table>

4.3 Madrid – Intermodal Exchange Stations (IES)

The greater Madrid area is comparable in population size to the GTHA (but with higher reported car ownership) and has managed to build an extensive, integrated transit system in less than 20 years (starting in 1986). Madrid has achieved great success in terms of increasing transit ridership and reducing private automobile use as a result of service integration policies. Madrid offers very good examples of how to provide improved physical integration required to divert demand away from overcrowded facilities and increase transit’s overall market share.

Until 1985, transit use within the Madrid Metropolitan Area (MMA) was in a state of decline due to lack of service coordination, limited investment, and poor service quality. In 1985, the government introduced a policy to improve performance by encouraging transit and fare integration. The initiative was three fold:

- Administrative integration of transit modes: creation of the Consorcio Regional de Transportes de Madrid (CRTM) in 1986;
- Fare integration: creation of a month travel pass in 1987 for all modes for specific zones; and
• Modal integration: creation of IES to improve the physical connections between metro, bus and rail systems.

These measures helped to bolster ridership and improve the perception of service quality. Improved transit integration increased ridership after 1987 but little information is available on the relative contribution of each of the three elements. Nevertheless, all of the available documentation suggests that the heavily discounted “travel pass”, which was introduced in 1987, had a major influence on travel behaviour, especially for persons commuting into the City of Madrid. Whereas travel pass users accounted for 11.3% of “ticket sales” (fare revenues) in 1987, by 2004 pass users accounted for 65% of fare revenues. Note that the introduction of the new travel pass and a reduced price ten ride ticket involved substantial subsidies to Madrid MMA riders. Vassallo, author of “Measures to Increase Urban Transport Affordability”, reports that whereas the operator fare per trip (the amount paid to bus, metro and rail companies) was 1.17 Euros, the ten ride ticket price was $0.58 Euros and the travel pass price was $0.37 Euros. In 2003, the reported total operating requirement was approximately 1.3 billion Euros with subsidies from three levels of government totalling $674 million Euros.

Madrid has undertaken extensive physical integration among transit services by establishing Intermodal Exchange Stations (IES). These stations are strategically located and consolidate various modes of public transit, providing convenient transfer environments and customer amenities. Integration of the public transit network has greatly improved, resulting in increased transit market share for trips to the downtown area and other destinations. The Madrid case provides lessons regarding how the TTC, GO and various other transit networks in the GTHA can be better integrated.

Aluche Station, planned and developed prior to 1985, is an excellent example of physical integration of rail and bus modes.

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5 Madrid 2005 a world reference, Comunidad de Madrid/Consortio Transportes Madrid, May 2005, p. 6
Aluche Station served as a model for subsequent Inter-modal Exchange Stations, as commuter trains, metro trains, buses and cars share a single multi-level terminal, as shown.

The five new IESs identified in Figure 15, focus on integrating Madrid’s extensive suburban bus system with the metro system. Unlike Toronto, there are many nodes in the Madrid subway network. There is a circular subway line surrounding the downtown that intersects all other subway lines, further improving network connectivity. The Madrid City Centre is connected to the suburbs by various radial highways (Figure 15). These radial highways are primarily served by regional buses that bring commuters to the city centre, where they can subsequently transfer to the metro or urban bus system. Four of the five IESs are strategically located at the intersection of the radial highways and circular subway. Using these IESs, commuters from the suburbs can take regional bus/rail to anywhere in the downtown.

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7 Comunidad de Madrid. "Madrid 2005: a world conference".
The five intermodal stations include both new and renovated stations re-opened between 1995 and 2008. All these stations provide enhanced physical integration between suburban buses and the metro system.

The various IESs were designed as large multi-level, underground facilities to intercept suburban buses from travel to more urban areas and provide convenient transfers to and from other transit modes. As shown in Figure 16, Moncloa Station features a three-level station design integrating a large bus platform with underground metro and shopping area.

---

At these IESs, transfers between transit modes are made convenient and pleasant by:

- Reducing transfer time (minimal walking distance)
- Increasing convenience and comfort (weather-proof transfer and waiting areas)
- Facilitating bus access/egress through transit priority lanes
- Increasing passenger convenience and amenities (information system and ancillary services)

Other benefits of IESs include cost savings for bus operators due to easier access/egress and land use and environmental planning benefits such as redevelopment/intensification potential.

The new IESs have resulted in bus market share increases of 15 to 30% and large increases in rail use for travel to inner city locations other than the traditional CBD.

IES investments have been judged successful and there has been continued development of new inter-modal exchange stations since 2000. Subsequent plans have been funded through Public Private Partnerships (P3) Concessions of 25 to 35 years.

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Lessons learned

The Madrid case demonstrates that fare and service integration are important and complementary means to improving transit’s competitive position relative to the private automobile. Madrid initiated their transit integration programs with costly fare integration schemes before implementing physical integration measures. The introduction of the discounted monthly travel pass in 1987 increased ridership but at considerable expense. Between 1987 and 2004, travel pass users went from 11% of fare revenues to 65% with large shift from ten ride tickets (at .58 Euros per trip) to travel passes (at .37 Euros per trip) and the subsidy level was reported to be more than 50% by 2003 (compared to less than 30% for TTC).

In developing its IES Madrid focused on improving integration of various transit modes (metro, rail, and/or local bus and inter-city bus and auto), increasing the extent of the destination areas where transit is competitive with the private automobile.

Madrid also established an inner city loop route to improve access to a wide range of CBD destinations. The Madrid example also demonstrates that transit integration at non-central stations can attract more riders to existing rapid transit systems by providing improved access to non-downtown destinations.

4.4 Melbourne – Downtown Rail Loop

Transportation in Toronto and Melbourne has frequently been compared. with Melbourne sometimes presented as the example of “what not to do” if one wants to maximize ridership.

For example, Paul Mees extensive comparison of Melbourne and Toronto\(^\text{10}\) demonstrated that whereas Toronto achieved impressive ridership increases between 1950 and 1990, Melbourne saw declines in ridership as shown in Table 12 despite Melbourne’s more extensive electrified rail rapid transit network illustrated in Table 13.

Table 12 - Transit Patronage (unlinked trips), Melbourne and Toronto
(Source: Mees, Paul. page 178, Table 6.2)

<table>
<thead>
<tr>
<th>Year</th>
<th>Patronage (m)</th>
<th>Population (m)</th>
<th>Per capita patronage</th>
<th>Patronage (m)</th>
<th>Population (m)</th>
<th>Per capita patronage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>584</td>
<td>1.3</td>
<td>449</td>
<td>350</td>
<td>1.2</td>
<td>292</td>
</tr>
<tr>
<td>1960</td>
<td>441</td>
<td>2</td>
<td>222</td>
<td>330</td>
<td>1.8</td>
<td>183</td>
</tr>
<tr>
<td>1970</td>
<td>355</td>
<td>2.5</td>
<td>142</td>
<td>480</td>
<td>2.6</td>
<td>185</td>
</tr>
<tr>
<td>1980</td>
<td>258</td>
<td>2.7</td>
<td>95</td>
<td>660</td>
<td>3.1</td>
<td>213</td>
</tr>
<tr>
<td>1990</td>
<td>292</td>
<td>3</td>
<td>97</td>
<td>869</td>
<td>3.9</td>
<td>223</td>
</tr>
</tbody>
</table>

Table 13 - Urban Rail Station Catchments, Melbourne and Toronto
(Source: Mees, Paul. page 207, Table 7.4)

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Melbourne</th>
<th>Toronto</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of station (incl. CBD stations)</td>
<td>185</td>
<td>64</td>
</tr>
<tr>
<td>Population within station catchments</td>
<td>620,541</td>
<td>574,255</td>
</tr>
<tr>
<td>Total population</td>
<td>3,022,533</td>
<td>3,893,046</td>
</tr>
<tr>
<td>Share of total population within catchments</td>
<td>20.5%</td>
<td>14.8%</td>
</tr>
</tbody>
</table>

With its grid street network in the CBD and low-density suburban form, the Melbourne area is comparable in urban form to the GTA. Similarly, Toronto and Melbourne are comparable in terms of auto ownership.

Administrative integration in Melbourne is minimal as, historically, the region’s transit system has been both deregulated and privatized. The Melbourne Metropolitan Area is served by an extensive rail system (Metro Trains) and tram network (Metro Trams), of which both are radial and designed to primarily move people between the CBD and the suburbs. Conversely, the bus network is local and orbital, serving rail stations and local destinations. Train, tram and feeder bus services in Melbourne are privatized. In terms of fare integration, a smartcard technology (MyKi) has been recently introduced allowing for travel on all modes, based on zonal pricing. However, there is minimal physical integration between the two main transit modes, metro tram and metro rail.

Similar to Toronto, transit commute patterns in the Melbourne Metropolitan Area are heavily oriented towards the downtown core, with most riders using the Metropolitan train systems. Since 1990, Melbourne’s auto ownership level has been similar to Toronto, but while Toronto’s transit ridership and rides per capita have grown, Melbourne’s have stagnated (at least until recently). This is despite Melbourne’s much larger rail network, which started in the early 1920s as commuter rail but has been upgraded to more frequent rapid transit since being electrified starting in 1926.
The Melbourne case study is focused on improvements to relieve congestion at Flinders Street Terminal, Melbourne’s Union Station. Traditionally commuter traffic to downtown Melbourne has been heavily oriented to Flinders Street Station, similar to the current situation at Union Station in Toronto. It initially appeared that traffic at Flinder’s Street had been redirected to Southern Cross terminal but the reality proved to be more complex.

Melbourne’s two downtown rail terminal stations are located on the fringes of the CBD, in locations that are not too different from that of Union Station. Also, Melbourne’s current metro train service provides a model of what electrified Express Rail services might look like in the long term, in that the metro train service uses rapid transit EMU trains, rather than typical commuter rail equipment.

Melbourne has a downtown oriented rail network focusing on two major terminal stations: Flinders Street and Southern Cross (formerly Spencer Street Station). By the 1960s serious rail capacity issues became apparent at the downtown terminals. A disproportionately high number of passengers were arriving from the eastern and southern suburbs, and as a result passenger demand was disproportionately high at Flinders Street Station, which was handling almost eight times the passenger volume of Spencer Street Station, located about 1.6 km west of Flinders Street Station.

As shown in Figure 17, the establishment of the Melbourne Underground Rail Loop (MURL) in the mid-1980s connected Flinders Street and Spencer Street stations. Although there is no physical integration between the rail and tram systems the MURL is well serviced by trams above ground.

The MURL has proven successful in relieving and re-directing passenger demand patterns in the downtown core because it not only linked the two historic terminal stations but also added three new stations closer to downtown commuter’s final destinations.
Figure 17 - Schematic of MURL Project (as built) and 3D View of Downtown Melbourne
The key benefits of the MURL can be summarized as follows:

- Allowed for the distribution of commuters across five CBD stations instead of a concentration of commuters at Flinders Street Station.
- Enabled trains to reverse and return along the same line during off-peak periods.
- Allowed for a greater number of trains to pass through the CBD during peak hours than was possible before.

According to the Metropolitan Transit Authority, the MURL “reversed the 30 year trend of decreased patronage and has created a multi-station terminal system, which copes with increasing peak commuter loadings, enhances service and provides the means to improve the efficiency of operating the entire railway system”.

Although the projected increases in CBD employment and CBD-oriented commuter rail trips that were used to justify the project had not materialized by 2005, the MURL has improved overall transit service to Melbourne’s CBD and has provided important operational benefits. Perhaps Melbourne’s earlier investments in downtown rapid transit supported by recent land use and Transportation Demand Management (TDM) policies (e.g. parking levies), have attracted additional downtown development and encouraged a further modal shift to transit.

The MURL system serves as a useful example for Toronto, in that a new underground commuter rail line with three new CBD stations was constructed to distribute demands that would have otherwise travelled through the overused Flinders Street Station. The Melbourne experience suggests a possible option for Toronto, to create a similar downtown commuter rail loop, as an alternative to the proposed Downtown Rapid Transit Line. Such a loop, if feasible, could provide downtown workers with alternatives to walking from Union Station by taking commuters directly to major office concentrations in the CBD, using an east-west corridor between King and Queen Streets. In the case of the MURL, the three new underground stations on the downtown loop were strategically located so as to improve access to major office buildings in the downtown and direct demand away from the overcrowded Flinders Street Station.

Melbourne had two peripheral downtown stations, both offering convenient access to downtown jobs, prior to 1926 when the rail system was electrified. However, starting with electrification in 1926, the development of the Melbourne commuter rail system into a rail rapid transit system over time is consistent with the Express Rail concept proposed in earlier studies.
A key lesson learned is that the failure to fully integrate metro trains with other local transit modes (trams and buses) has reduced the attractiveness of transit in Melbourne. Recent events have proven to be interesting, given the bad press that Melbourne has been receiving at the hands of various analysts over the last decade. It has long been argued that downtown employment and related demands used to justify the MURL were over-estimated. However, recent statistics suggest rapid downtown employment growth since 2004/2005 which has contributed to reported increases in ridership since 2004. Also, recent policy changes, including a parking levy, and improved fare and service integration, appear to support further increases in transit ridership (65% modal split in Melbourne’s Core reported in 2007).

Between 2004 and 2009 Melbourne metro ridership increased from less than 150 million boardings per annum to more than 200 million in 2008/2009, suggesting a substantial increase compared to the 1951 value (153,000). It can be argued that earlier investment in the MURL made the recent growth in downtown Melbourne possible, along with the rapid growth in transit ridership.

**Lessons Learned**

Despite Melbourne’s extensive rail system, compared to Toronto’s it has not been as successful as Toronto in maintaining and attracting riders.

Melbourne’s rebuilt Southern Cross Station (formerly Spencer Street Station) did not provide an example of a new satellite station that substantially off-loaded a main downtown rail/subway terminal. The Melbourne MURL project created a new downtown underground rail loop route that succeeded in directing substantial traffic away from the overcrowded Flinders Street Station by providing patrons with alternative stations that brought them closer to their destinations in Melbourne’s CBD.

Melbourne provides an example of rapid transit expansion being achieved by upgrading electrified commuter rail lines to a metro/subway standard using rapid transit equipment to dramatically increase the extent of rapid transit services into growing suburban areas. It has been argued by local commentators that Melbourne’s privatized metro train system has suffered because it limited fare and service integration with other modes.

The Melbourne case also points to the potential longer term benefits of capital intensive rapid transit investments in supporting future downtown development. Many concerns were raised by various critics, including Paul Mees, about the justification for the MURL project, because the projected increases in rail trips used
to justify the project in the early 1980s had not materialized by 2005. However, recent developments in Downtown Melbourne suggest that the MURL has supported substantial increases in employment since 2005. This growth was possible because transit supportive policies and the MURL supported substantial increases in transit ridership and transit’s share of total travel to downtown Melbourne.

4.5 Montreal – Physical Integration

Montreal is Toronto’s nearest big city neighbour in Canada and important similarities (size, modes and organization) and key differences exist between the two cities. Montreal and Toronto have similar population densities, travel patterns and auto ownership levels at both the city and metropolitan scale. The city scale metro system and urban bus network are operated by Société de Transport de Montréal (STM), and the regional commuter rail and inter-city bus systems are operated by the Agence Métropolitaine de Transport (AMT). The AMT’s role, objectives and responsibilities are similar to those of Metrolinx but the AMT has a higher degree of financial independence.

Montreal has been implementing fare and service integration since 1982 and provides examples of physical integration that is relevant to Toronto. The AMT has provided access to data regarding impacts due to improved physical integration that point to the scale of benefits that can be expected in Toronto. Note that there are also important differences – Montreal’s lack of a single primary station such as Union Station, for example, partially limits the relevance of the following lessons learned.

Montreal has had a head start in attempting to integrate commuter rail and conventional transit systems, beginning in 1981 under the Parti Québécois (PQ) government. In the early 1980s, the one fare provided access to any mode within the inner city fare zones where bus, metro and commuter train riders could all use the same low cost pass, and the Montreal urban community moved quickly to improve physical integration of train and metro lines, beginning with Vendome Station. Vendome Station was reconstructed in 1986 to shorten the distance between the metro and train platforms. As shown in Figure 18, the rail platform was relocated adjacent to the Metro to reduce the walking distances for persons wishing to transfer between the two modes.
Following the redesign of Vendome Station, there was little change in commuter rail boardings at this station during the a.m. peak period, despite improved physical integration and fare integration. However, a substantial increase in AM peak alightings occurred shortly thereafter, from about 100 transfers from rail to metro prior to reconstruction, to 1,923 transfers in October 1988 (two years later). During the same period, alightings at the downtown terminal of the Rigaud Line (Windsor Station) increased from 4,327 to 5,088, suggesting that downtown riders were not diverted from the downtown terminal in large numbers. However, the increase in transfers between Commuter Rail and Metro at Vendome Station accounted for most of the observed increase in daily Rigaud train ridership. Most of the increase in ridership resulted from trips destined to non-core destinations, such as the University of Montreal, rather than to the downtown core.

Beginning in 1988, a number of changes occurred to Metro and Commuter Rail services in Montreal. In the Downtown Core, Lucien L’Allier Station replaced Windsor Station as the terminal for the Rigaud Line. This new station functions as a commuter terminal, and does not offer inter-city rail passenger service. Vendome Station is now served by three commuter rail lines; Blainville-St Jerome, Dorion-Rigaud, and Delson-Candiac, as well as eleven bus routes. Additional inter-modal stations have been added since 1988, including:

- Parc Station, which connects to Metro Line 5 (Blue Line) and the new Blainville Commuter Rail Line.
- De la Concorde Station, which is the newest intermodal terminal in Laval, connecting the Laval Extension to Metro Line 2 (in Laval) to the Blainville Line.
These new inter-modal terminals have continued to build transit ridership by encouraging more train to metro transfers in the a.m peak. (from about 100 in 1986 to 4800 today) at suburban stations feeding the Lucien-L’Allier (former Windsor) Station, as shown in Table 14.

Table 14 – Historical AM Peak Period Ridership by Station in Greater Montreal

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendôme</td>
<td>100</td>
<td>1,900</td>
<td>1,100</td>
<td>1,800</td>
<td>2,500</td>
<td>2,900</td>
</tr>
<tr>
<td>Parc</td>
<td>na</td>
<td>na</td>
<td>800</td>
<td>1,300</td>
<td>900</td>
<td>900</td>
</tr>
<tr>
<td>De la Concorde</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>900</td>
<td>1000</td>
</tr>
<tr>
<td><strong>Total transfer to Metro outside DT</strong></td>
<td><strong>100</strong></td>
<td><strong>1,900</strong></td>
<td><strong>1,900</strong></td>
<td><strong>3,100</strong></td>
<td><strong>4,300</strong></td>
<td><strong>4,800</strong></td>
</tr>
<tr>
<td>Lucien-L’Allier / Windsor</td>
<td>na</td>
<td>na</td>
<td>200</td>
<td>500</td>
<td>500</td>
<td>600</td>
</tr>
<tr>
<td>Gare Central/Bonaventure*</td>
<td>na</td>
<td>na</td>
<td>906</td>
<td>1700</td>
<td>1700</td>
<td>2100</td>
</tr>
</tbody>
</table>

* Gare Central is connected to metro station Bonaventure through an underground tunnel
Source: AMT onboard surveys

The Montreal example demonstrates the importance of convenient physical integration between modes. Fare integration, in the absence of good physical integration and seamless transfers, proved not to be a strong incentive for riders to use both rail and metro services. The redesigned Vendome Station increased am peak transfers from commuter rail to metro dramatically from about 100 to almost 2000 a.m. peak passengers within two years (an increase of approximately one million rides per year).11

The introduction of new transfer opportunities at Parc and De la Concorde stations resulted in further increases in inter-modal transfers for travel to non-CBD destinations (commuter rail to metro during the a.m. peak period).

The scale of the ridership changes associated with improved physical integration in Montreal since 1986 was relatively modest (less than three million/year). While substantial changes were observed in commuter rail to metro transfers during the a.m. peak period, the improved physical integration resulted in only small changes

11 Assuming average daily ridership is twice the am peak and annual ridership is approximately 300 times average weekday ridership.
in transfer volumes from metro to commuter rail (in the a.m. peak period) or between commuter rail and bus.

Another key finding is that if the commuter rail fares are similar to the Metro fares, as they have been in inner Montreal zones, one can expect a higher proportion of transit riders to choose commuter rail because of its superior service level, assuming that these services have residual capacity available. Recently, capacity concerns led to the reintroduction of a premium fare differential by the AMT, in an attempt to divert some patrons back to regular transit services, including the metro.

**Lessons Learned**

In 1981, the government of Quebec initiated a new transit integration program with a costly fare integration scheme that substantially reduced fares (and Montreal’s revenue/cost performance) before implementing physical integration measures. By the mid-1980’s Montreal focused on improving the physical integration of various transit modes (metro, rail, and local bus and inter-city buses), increasing the extent of the destination areas where transit is competitive with the private automobile. The Montreal experience shows that improved physical integration of metro and commuter rail services, supported by fare integration, can result in substantial increases in commuter rail ridership but little to no diversion of passenger demand from downtown terminal stations. Furthermore, the scale of the increased ridership associated the fare and physical integration in Montreal has been relatively small at less than three million net riders since 1986.

Another key finding with Union Station implications is that if the commuter rail fares are similar to Metro (subway) fares, as they have been in inner Montreal zones since 1981, a higher proportion of transit riders will likely choose commuter rail because of its superior service level, assuming that these services have residual capacity available.

The Montreal case study (especially Vendome Station) provides examples of how improved commuter rail to metro service transfers (within about 400m or a five minute walk) attracted additional ridership, despite the existence of fare integration prior to the opening of the rebuilt station. This suggests that physical integration is more important than fare integration in attracting new ridership. Furthermore, it suggests that any satellite stations being considered as part of the Union Station 2031 Demands and Opportunities Study should provide direct and convenient transfer linkages between commuter rail and rapid transit (e.g. subway).
The Montreal case study (especially Vendome Station) also suggests that few patrons are likely to transfer from commuter rail to bus or comparable slow local transit services such as streetcars. Forced transfers at satellite stations to modes not directly linked to subway (or other rapid transit services) are likely to result in substantially reduced ridership potential.

4.6 Sao Paulo – Metro-Commuter Rail Integration

Sao Paulo, Brazil, provides another example of transit integration, including physical integration that may be relevant to Toronto. While Sao Paulo currently has a population of more than 19 million, in 1960 its population was only six million (comparable to today’s population of the GTHA).

As illustrated in Figure 19, Figure 20 and Figure 21 Sao Paulo has a much higher population density than Toronto at both the city (Sao Paulo City – comparable to City of Toronto - and metropolitan scale - Sao Paulo Metropolitan Region). The Sao Paulo metropolitan area, despite being similar in size (area) to the GTHA, is more than three times denser than the GTHA in terms of population per hectare because the built up urban area that extends beyond the City, features high density development. Figure 21 illustrates the type of development that now extends well beyond the city of Sao Paulo into areas that are the equivalent to Peel, York and Durham Regions in the GTHA.

Automobile ownership in the greater Sao Paulo area has increased significantly since the 1990s and has resulted in considerable congestion on the area’s road network. During weekday peak periods, 20% of cars are banned from the extended city centre.
Figure 19 - Map of Sao Paulo City and Metropolitan Area

Figure 20 - Population Density Plot – Sao Paulo Metropolitan Region
The organization responsible for transit operations and policy in the state of Sao Paulo is the Secretaria de Transportes Metropolitana (STM). This agency oversees the operation of three key transportation agencies, which are responsible for intercity bus, subway and commuter rail services respectively. In addition, various privately operated bus companies provide local bus service within individual corridors.

Due to limited capability of the metro system to accommodate future ridership growth, the focus of past and present transit plans has been to upgrade the commuter rail system to a metro-quality standard. The upgraded commuter rail services use electric-powered rapid transit equipment that operates as frequently as metro-type services and maintains higher average operating speeds because of longer station spacing.

The first line of the Sao Paulo Metro was opened in 1974 and the network now includes five metro lines, as well as an extensive electrified commuter rail system, as shown in Figure 22.
Figure 22 - Current Sao Paulo Rapid Transit Network

Legend

<table>
<thead>
<tr>
<th>Line 1 Blue</th>
<th>Line 2 Green</th>
<th>Line 3 Red</th>
<th>Line 4 Yellow (M-F: 9h-16h)</th>
<th>Line 5 Lilac</th>
<th>Line 7 Burgundy</th>
<th>Line 8 Diamond</th>
<th>Line 9 Emerald</th>
<th>Line 10 Turquoise</th>
<th>Line 11 Coral</th>
<th>Line 11 Cora-Express</th>
<th>Line 12 Sapphire</th>
<th>Special Omnibus Line</th>
<th>Tourist Express</th>
<th>ORCA bridge-free</th>
<th>ORCA bridge-not free</th>
</tr>
</thead>
<tbody>
<tr>
<td>METRÔ</td>
<td>METRÔ</td>
<td>METRÔ</td>
<td>VIAQUATRO</td>
<td>METRÔ</td>
<td>CPTM</td>
<td>CPTM</td>
<td>CPTM</td>
<td>CPTM</td>
<td>CPTM</td>
<td>CPTM</td>
<td>CPTM</td>
<td>CPTM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metropolitan Omnibus corridor</td>
<td>Metropolitan Omnibus terminal</td>
<td>Station</td>
<td>Integration Station (free)</td>
<td>Integration Station (not free)</td>
<td>Stations with elevators</td>
<td>Paracies</td>
<td>Bicycle Rack</td>
<td>Bicycle rack with loan</td>
<td>Integrated Parking: Metro, CPTM, Onibus</td>
<td>Ônibus</td>
<td>Free Intermodal Transfer Station</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Central Integration Project, part of the *Plano Integrado de Transportes Urbanos* (PITU) 2020, was completed in 2005. This project involved improvements to the *Ferrovia Paulista S.A.* (FEPASA) and *Companhia Brasileira de Trens Urbanos* (CBTU) east-west commuter rail lines, and takeover of both lines by the new agency *Companhia Paulista de Trens Metropolitanos* (CPTM). Physical infrastructure was upgraded to increase capacity of this new line from 10,000 people per hour per direction (phpd) to 30,000 (to take pressure off Metro Line 3 RED). The CBTU east line was extended west from Roosevelt Station, providing connections to Luz Station (to Metro Line 1 and CBD) and Barra Funda Station on Metro Line 3 (which also connects with other rail lines and inter-city buses). *Figure 23* and *Figure 24* provide pictures of the two stations.

**Figure 23 - Luz Station**
Luz Station predated Union Station, but was originally similar in design. The station has since been rebuilt to allow convenient transfers between commuter rail and metro and is heavily used by commuter rail passengers destined for the CBD who transfer to Metro Line 1 (north-south Blue Line). The extension of commuter rail services to Luz Station has allowed rail passengers to transfer to Metro Line 1 to complete their trip downtown. Previously transit users were forced to make an inconvenient transfer at Metro Rail Line 3 at Bras Station, a location which did not provide good access the downtown.

Barra Funda Station offers another interesting design approach by integrating the commuter rail and metro lines within the same terminal building. Barra Funda Station is also served by local and inter-regional bus services providing additional opportunities for transfer between modes.

As a result of the Central Integration Project, crowding on Metro Line 3 was reduced by providing a parallel, high capacity commuter rail alternative. Transfer activity at Luz Station was made much more convenient, and resulted in significant increase in transfer activity from commuter rail to Metro Line 1 (Blue). The benefits of the Integration Program are illustrated in Figure 25. In the period after 1993, transit market share increased and auto driver market share decreased. Auto driver modal split increased from 30% in mid 60s to 50% in 1997, and then gradually decreased to 45% in 2007, following the project. On the other hand, public transit market share decreased from 70% in the mid 60s to 50% in 1997, and then gradually increased to 55% in 2007, following the project (even as more people shifted from walking and cycling to owning and using vehicles).
The Sao Paulo case illustrates how upgraded intermodal stations, providing good physical integration, can encourage intermodal transfers so as to divert demands from overloaded metro (subway) services to upgraded commuter rail services, as envisioned in The Big Move.

The Sao Paulo case study also demonstrates that commuter rail services can be upgraded to a metro/subway standard comparable to Express Rail, as envisioned in earlier studies (from 10,000 phpd capacity, similar to the existing GO Lakeshore West Corridor, to approximately 30,000 phpd capacity). Further investigation of the design features of the Sao Paulo commuter rail upgrade may be worthwhile in the context of both the Union Station Capacity Study and the GO Rail Electrification Study.

Lessons Learned
Sao Paulo initiated their transit integration programs with costly fare integration schemes before implementing physical integration measures. Sao Paulo improved
the physical and fare integration of various transit modes (metro, rail, and/or local bus and inter-city bus), increasing the extent of the destination areas where transit is competitive with the private automobile and this resulted in substantial increases in total transit ridership and transit’s market share.

Sao Paulo provides an example of rapid transit expansion being achieved by upgrading electrified commuter rail lines to a metro/subway standard using rapid transit equipment. This upgraded commuter rail system has off-loaded the overcrowded Metro Line 3 (Red) and substantially increased the extent of rapid transit services in the rapidly growing suburban areas of the Sao Paulo region.

4.7 Findings/Implications for Toronto and Union Station

Fare integration designed to reduce costs to users has been shown to be effective in attracting new ridership but very expensive. Physical integration appears to be of greater importance in achieving increased ridership (as evidenced by Toronto’s ridership success compared to historic Melbourne and the Montreal experience, despite not having introduced fare integration).

Service and fare integration are important and complementary means to improving transit’s competitive position relative to the private automobile. Madrid, Montreal and Sao Paulo all initiated their transit integration programs with costly fare integration schemes before implementing physical integration measures that are the primary concern of this chapter. In the case of Montreal and Madrid, fare integration increased operating subsidies to the point that they account for more than half of annual operating costs.

A key Montreal case study finding that is potentially relevant to Toronto is that if the commuter rail fares are similar to Metro (subway) fares, as they have been in inner Montreal zones since 1981, a higher proportion of transit riders will likely choose commuter rail because of its superior service level, assuming that these services have residual capacity available.

Satellite or secondary transit terminals may serve as viable alternatives to site expansion in relieving passenger demand at major hub terminals, such as Union Station, to the extent that they provide superior access to passengers’ final destinations. Based on the cases reviewed, site selection is an important element in the benchmark cities discussed, as it affects the convenience of the connection between the satellite station and major travel destinations, and the convenience of the transfers between transit modes.
While examples such as Montreal and Madrid demonstrate that transit integration can attract more riders to existing rapid transit systems by providing improved access to non-downtown core destinations, no examples were identified where a single satellite station substantially off-loaded a main downtown rail/subway terminal. However, the Melbourne MURL project succeeded in directing substantial traffic away from the overcrowded Flinders Street Station by providing patrons with alternative stations that brought them closer to their destinations in Melbourne's CBD.

Both Melbourne and Madrid established inner city loop routes to improve access to CBD destinations; Melbourne created an upgraded electrified urban rail line in an underground tunnel while Madrid used metro technology.

Madrid, Montreal and Sao Paulo focused on improving integration of various transit modes (metro, rail, and/or local bus and inter-city bus), increasing the extent of the destination areas where transit is competitive with the private automobile.

Both Melbourne and Sao Paulo provide examples of rapid transit expansion achieved by upgrading electrified commuter rail lines to a metro/subway standard using rapid transit equipment to dramatically increase the extent of rapid transit services into growing suburban areas. The differences between the two approaches point to the benefits of fully integrating urban transit systems, as Melbourne’s privatized system has suffered because of limited fare and service integration.

The Melbourne case also demonstrates the potential long term benefits of rapid transit investments for downtown growth and development. Despite concerns that the MURL investment had not been justified, because the expected downtown development and ridership increases had not occurred by 2005, recent developments suggest that the MURL has supported substantial increases in employment and ridership since 2005.

Montreal offers good examples of how improved physical integration of metro and commuter rail services, supported by fare integration has resulted in substantial increases in commuter rail ridership but little to no diversion of passenger demand from downtown terminal stations. However, it is important to note that the scale of the observed increases in total transit ridership associated with improved physical integration identified in Montreal was relatively small at less than three million riders per year between 1986 and 2009.
The secondary transit stations reviewed in the Montreal case study illustrate examples of commuter rail to metro service transfers within a reasonable walking distance (within about 400m or a five minute walk). This suggests that any satellite stations being considered as part of the Union Station 2031 Demands and Opportunities Study must take into account direct transfer linkages between commuter rail and rapid transit (e.g. subway).

Forced transfers at satellite stations to modes not directly linked to subway (or other rapid transit services) result in substantially reduced ridership potential. The Montreal case study (especially Vendome Station) demonstrates that few patrons are likely to transfer from commuter rail to bus or comparable slow local transit services.

What the case studies unfortunately are unable to make apparent is the role of fare integration on transfers between modes. In Toronto there is physical integration between TTC and GO but not yet fare integration. None of the cases provide data that would allow a “before-after” analysis of the impacts of fare integration, save for the Montreal case, which suggests that service integration is paramount, in that the effects of fare integration without service integration and improved physical integration are very small.
5 Model Development and Base Case Model Analysis

5.1 Model Development

5.1.1 Overview

The GGHM has been used by Metrolinx to produce 2031 travel demand forecasts in support of the development of The Big Move Regional Transportation Plan and for more recent studies such as the GO Electrification Study. To maintain consistency with these previous studies, the Union Station 2031 Demands and Opportunities Study utilizes the base GGHM framework incorporating agreed-to input scenarios that reflect the latest land use allocation and, transit service assumptions and specific trip distribution adjustments, in the assessment of transportation system options.

Concurrent with the Union Station 2031 Demands and Opportunities Study, the Toronto Transit Commission is undertaking the Downtown Rapid Transit Expansion Study that uses the City of Toronto’s travel demand forecasting model (GTAM - Greater Toronto Area Model) to assess future transit ridership.

To maintain consistency between the Union Station 2031 Demands and Opportunities Study model input assumptions and the Downtown Rapid Transit Expansion Study model input assumptions, the Downtown Modelling Working Group (DMWG) was established. The DMWG meetings provided a forum to discuss and agree on land use forecasts, transit network assumptions and specific model parameters including Employed Labour Force estimates by area and fare structure within the models. The DMWG Team included representation from Metrolinx, TTC, Ontario Ministry of Transportation (MTO), Region of York, and City of Toronto.

5.1.2 Base 2031 Land Use Forecasts

Given the need to reconcile land use assumptions utilized by Toronto with the Greater Toronto Area Model (GTAM) and by MTO and Metrolinx with the GGHM, it was necessary to compare data on a common geographic basis. Table 15 provides a summary of the differences between the traffic zones structures used in each model for regional municipalities.
The zone structure used in the GGHM uses the 2006 TTS zones, whereas the GTAM uses the 1996 TTS zone structure.

**Table 15 – Land Use Allocation to Zone Systems**

<table>
<thead>
<tr>
<th>Municipality</th>
<th>96 TTS (GTAM) Zone</th>
<th>01 TTS (GTAM Zone)</th>
<th>06 TTS (GTAM) Zone</th>
<th>Convertible to GTAM</th>
<th>Convertible to GGHM</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Toronto</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Durham</td>
<td>✓</td>
<td>✓</td>
<td>N/A</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>York</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Peel</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Halton</td>
<td>✓</td>
<td>✓</td>
<td>N/A</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hamilton</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

N/A – Not Available

Since the majority of the land use data that was available for Toronto is convertible to the 2001 TTS traffic zone system, it was agreed that all land use data should be converted to a common 2001 system for review by the DMWG.

The regional municipalities were contacted and the most recent 2031 land use forecasts were obtained and the land use allocations were converted to the 2001 TTS traffic zone system. A summary of the 2031 Places to Grow population and employment forecasts for the GTHA is presented in **Table 16**.

**Table 16 - 2031 Places to Grow Population and Employment Forecasts**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Toronto</td>
<td>2,446,000</td>
<td>1,338,800</td>
<td>3,080,000</td>
<td>1,640,000</td>
</tr>
<tr>
<td>Durham Region</td>
<td>539,500</td>
<td>185,000</td>
<td>960,000</td>
<td>350,000</td>
</tr>
<tr>
<td>York Region</td>
<td>857,500</td>
<td>407,700</td>
<td>1,500,000</td>
<td>780,000</td>
</tr>
<tr>
<td>Peel Region</td>
<td>1,119,100</td>
<td>555,700</td>
<td>1,640,000</td>
<td>870,000</td>
</tr>
<tr>
<td>Halton Region</td>
<td>422,700</td>
<td>190,500</td>
<td>780,000</td>
<td>390,000</td>
</tr>
<tr>
<td>Hamilton Region</td>
<td>487,100</td>
<td>183,300</td>
<td>660,000</td>
<td>300,000</td>
</tr>
<tr>
<td>Total GTHA</td>
<td>5,872,000</td>
<td>2,861,000</td>
<td>8,620,000</td>
<td>4,330,000</td>
</tr>
</tbody>
</table>

**5.1.3 Alternate City of Toronto Land Use Forecast Scenarios and Model Sensitivity Analysis**

The City of Toronto, as part of the Places to Grow conformity exercise, reviewed alternate land use forecasts to incorporate more recent planning directions. In order to assess the implications of the alternative City of Toronto 2031 land use forecasts...
on travel demands into and out of the city, a series of travel demand model runs were undertaken using both the GTAM and GGHM framework. The alternative City of Toronto land use scenarios included in the travel demand sensitivity analysis are summarized in Table 17.

Table 17 - Alternate 2031 City of Toronto Land Use Scenarios

<table>
<thead>
<tr>
<th>Model</th>
<th>Population</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>GGHM (MTO Land Use)</td>
<td>3,080,000</td>
<td>1,640,000</td>
</tr>
<tr>
<td>City of Toronto’s Initial LU Estimates</td>
<td>2,966,300</td>
<td>1,916,900</td>
</tr>
<tr>
<td>City of Toronto’s Flash Forward</td>
<td>2,881,500</td>
<td>1,834,300</td>
</tr>
<tr>
<td>City of Toronto’s Flash Forward Plus</td>
<td>2,914,900</td>
<td>1,888,000</td>
</tr>
<tr>
<td>Flash Forward Plus Secondary Study Areas (including Waterfront)</td>
<td>2,967,900</td>
<td>1,887,300</td>
</tr>
<tr>
<td>Flash Forward Plus Waterfront Only</td>
<td>2,914,900</td>
<td>1,887,300</td>
</tr>
<tr>
<td>FF+ 200k</td>
<td>3,080,000</td>
<td>1,888,000</td>
</tr>
<tr>
<td>DRTES Land Use</td>
<td><strong>3,075,300</strong></td>
<td><strong>1,834,300</strong></td>
</tr>
</tbody>
</table>

The DMWG review of the alternate City of Toronto population and employment forecasts resolved that the DRTES land use forecasts would be used for both the TTC and Metrolinx studies. A summary of the DRTES land use forecast for the City of Toronto and PD1 are presented in Table 18.

Table 18 - DRTES 2031 Land Use Forecasts

<table>
<thead>
<tr>
<th>Planning District 1 (PD1)</th>
<th>Population</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest of Toronto</td>
<td>2,763,300</td>
<td>1,212,600</td>
</tr>
<tr>
<td>City of Toronto</td>
<td><strong>3,075,300</strong></td>
<td><strong>1,834,300</strong></td>
</tr>
</tbody>
</table>

The 2031 population and employment forecasts for the regional municipalities (from Places to Grow) in conjunction with City of Toronto DRTES population and employment forecasts are presented in Table 19. These land use forecasts are to be used only in the assessment of travel demands for the ongoing transportation studies, as the City of Toronto and regional municipalities are taking part in the Places to Grow compliance process.

The key difference between the initial 2031 Places to Grow land use forecast and the 2031 land use forecast used in the Union Station 2031 Demands and Opportunities Study is the additional 194,000 employment opportunities allocated.
to the City of Toronto (See Table 16 and Table 17). The majority of the City of Toronto’s additional employment is allocated to Planning District 1.

Table 19 - GTHA 2031 Population and Employment Forecasts

<table>
<thead>
<tr>
<th>Municipality</th>
<th>2006 Population</th>
<th>2006 Employment</th>
<th>2031 Travel Demand Analysis Land Use Population</th>
<th>2031 Travel Demand Analysis Land Use Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toronto</td>
<td>2,445,900</td>
<td>1,338,800</td>
<td>3,075,000</td>
<td>1,834,000</td>
</tr>
<tr>
<td>Durham Region</td>
<td>539,500</td>
<td>185,000</td>
<td>900,000</td>
<td>350,000</td>
</tr>
<tr>
<td>York Region</td>
<td>857,500</td>
<td>407,700</td>
<td>1,500,000</td>
<td>780,000</td>
</tr>
<tr>
<td>Peel Region</td>
<td>1,119,100</td>
<td>555,700</td>
<td>1,640,000</td>
<td>870,000</td>
</tr>
<tr>
<td>Halton Region</td>
<td>422,700</td>
<td>190,500</td>
<td>780,000</td>
<td>390,000</td>
</tr>
<tr>
<td>Hamilton Region</td>
<td>487,000</td>
<td>183,300</td>
<td>660,000</td>
<td>300,000</td>
</tr>
<tr>
<td>Total GTHA</td>
<td>5,871,900</td>
<td>2,860,900</td>
<td>8,615,000</td>
<td>4,524,000</td>
</tr>
</tbody>
</table>

The travel demand model sensitivity analysis undertaken by the City of Toronto and TTC using the alternate land use forecasts, and documented in DMWG meeting minutes, indicate that travel demands and resulting GO Rail transit ridership are generally similar for both the GTAM and GGHM assignments, indicating that neither model was significantly sensitive to the alternate City of Toronto land use scenarios.

5.1.4 Transit Network Review

The GGHM transit network used for the Union Station 2031 Demands and Opportunities Study reflects full build out of The Big Move, whereas a GGHM - GO Reference Network, excluding uncommitted elements of The Big Move was developed for the Metrolinx GO Electrification Study.

The GTAM transit network used as the base case for this study was more reflective of the GGHM - GO Reference Network used in the GO Electrification Study than the other networks referenced. Therefore, a detailed review of the transit networks to assess consistency of assumptions was limited to the GO Electrification - GO Reference Network and the GTAM transit network.

The DMWG review indicated the following transit network assumptions that were consistent between the GTAM and GGHM:

- Doubling of GO Train service;
- Transit City initiatives including the Eglinton line;
- Waterfront street car initiatives;
- GO 2020 initiatives; and
Union Station 2031 Demands and Opportunities Study

- Mississauga BRT.

In addition, the TTC subway system and feeder bus network for both models were reviewed and updated, where possible, for consistency.

5.1.5 GTAM and GGHM Parameters Review

Both the GTAM and GGHM are four stage models using an EMME/3 platform. Both models generally incorporate similar modelling procedures. However, the recently developed GGHM includes updated assumptions that can result in inconsistencies in travel demand forecasts when compared to the GTAM. To address specific deficiencies, the DMWG included a review of the following specific model parameters to improve model consistency and understanding of possible differences between the models.

5.1.5.1 Employed Labour Force

The Employed Labour Force (ELF) rates for the GGHM are based on 2001 census data and related to a land use allocation model to project the ELF rates to 2031, accounting for changes in age profile related to four occupational groups.

The model is designed to use a “linkage-based” approach involving the labour force being matched to the employment forecasts as part of the trip generation balancing process. Any imbalance between trip productions and trip attractions as part of the trip generation process results in the productions (population based) being balanced to the attractions (employment based).

The GTAM uses a trip generation balancing procedure that balances both the trip productions and trip attractions to the average of the difference. Thus, the GGHM trip generation balancing procedure results in a higher number of trip attractions to major employment areas such as Planning District 1 than the GTAM trip balancing procedure.

5.1.5.2 Fare Structure

The GGHM – GO Reference network used in the Electrification Study does not include transit fare-integration. No time penalties have been assigned to a trip that changes transit service from trip origin to trip destination. For the purpose of this study, fare integration was provided in the GGHM network. The GTAM provides fare integration for those trips across municipal boundaries, as there are no time penalties assigned to such trips.

5.1.5.3 GO Passenger Daily to Peak Hour Conversion Factor

The DMWG review of 2001 and 2031 participation rates for Planning District 1 as confirmed in discussion with Metrolinx and IBI staff, indicated that the forecast 2031 participation rates were lower than the observed 2001 conditions. To address
the forecasted low participation rate, the daily peak period factor was increased by 20% to reflect the increased employment opportunities in downtown Toronto.

5.1.6 GTAM and GGHM Transit Assignment Review

As noted previously, the model framework for both the GTAM and GGHM are generally similar with minor variances in trip generation balancing routines, fare integration and model time periods, as the GGHM is a daily model and the GTAM is an a.m. peak hour model. To assess the differences between the GGHM and GTAM frameworks, a comparison of 2031 a.m. peak period GO Rail passenger and Subway passenger ridership at selected Central Area screenlines was undertaken.

This review was done using the 2031 City of Toronto Flash Forward Plus land use scenario (population of 2,881,514 and employment of 1,834,275) and similar transit networks (GGHM - GO Reference Network and GTAM 2031 network). A summary of this comparison is presented in Table 20.

Table 20 - 2031 a.m. Peak Period GO and Subway Passengers Assignment Summary

<table>
<thead>
<tr>
<th>Central Area Screenlines</th>
<th>GO Rail Passengers Inbound</th>
<th>Subway Passengers Inbound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2031 GTAM</td>
<td>2031 GGHM</td>
</tr>
<tr>
<td>West Boundary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East of Bathurst</td>
<td>66,500</td>
<td>48,000</td>
</tr>
<tr>
<td>North Boundary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South of Bloor</td>
<td>27,200</td>
<td>35,000</td>
</tr>
<tr>
<td>East Boundary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>West of Bayview</td>
<td>42,000</td>
<td>54,100</td>
</tr>
<tr>
<td>Total Inbound</td>
<td>135,700</td>
<td>137,100</td>
</tr>
<tr>
<td>% Difference</td>
<td>+1.1%</td>
<td></td>
</tr>
</tbody>
</table>

The 2031 a.m. peak period transit assignment comparison of GO Rail passengers inbound to the Central Area of the City of Toronto indicates a very close correlation whereas the GGHM subway passenger inbound assignment is over 17% higher than the GTAM assignment. Any future comparison of GGHM and GTAM transit ridership volumes needs to recognize the different modelling assumptions noted in this section.
5.2  

*Base Case Analysis*

5.2.1  

**2031 Land Use Forecasts**

The DRTES land use forecast was used to develop the Union Station Base Case Analysis. A summary of the DRTES land use forecast for the City of Toronto and PD1 are presented in Table 21.

Table 21 - GTHA 2031 DRTES Population and Employment Forecasts

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Population</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Toronto</td>
<td>3,075,000</td>
<td>1,835,000</td>
</tr>
<tr>
<td>Durham Region</td>
<td>960,000</td>
<td>350,000</td>
</tr>
<tr>
<td>York Region</td>
<td>1,500,000</td>
<td>780,000</td>
</tr>
<tr>
<td>Peel Region</td>
<td>1,640,000</td>
<td>870,000</td>
</tr>
<tr>
<td>Halton Region</td>
<td>780,000</td>
<td>390,000</td>
</tr>
<tr>
<td>Hamilton Region</td>
<td>660,000</td>
<td>300,000</td>
</tr>
<tr>
<td><strong>Total GTHA</strong></td>
<td><strong>8,615,000</strong></td>
<td><strong>4,525,000</strong></td>
</tr>
<tr>
<td><strong>Planning District 1 (PD1)</strong></td>
<td><strong>312,000</strong></td>
<td><strong>622,000</strong></td>
</tr>
</tbody>
</table>

5.2.2  

*Transit Network Review*

5.2.2.1  

*Transit Network Assumptions*

A Union Station Base model network was developed based on the GGHM RTP framework network provided by Metrolinx to compare alternative transportation systems and their impacts on Union Station boardings and alighting.

The main transit service features assumed in the Base network include the following:

- **Two-way All-day Service**: GO Service is assumed to operate all day both inbound and outbound. Regional Rail Service has varying speeds dependant on assigned transit time function, and headways of at least two trains per hour.

- **Express Rail Service**: Express Rail Service is assumed on the Milton, Lakeshore West, Lakeshore East, Georgetown, and Richmond Hill GO Lines, in addition to the Regional Rail Service options. Express Rail is assumed to have a default speed of 80 km/h except for the service operating between Bloor Street and Union Station, where speeds are assumed to be 40 km/h. A five minute boarding time penalty is applied at all interceptor stations.

- **Additional lines**: The Bolton, Seaton and Havelock lines are incorporated into the Union Station 2031 Base Network.
• **Additional stations:** Additional stations on the Eglinton LRT were assumed at GO Georgetown, Barrie, and Richmond Hill lines. The Barrie GO line also assumes a station on the Bloor Subway at Lansdowne.

• **North Toronto Subdivision via Summerhill:** The Union Station Base model does not include the North Toronto Subdivision via Summerhill.

• **Downtown Rapid Transit (DRT) Line:** The Union Station Base model does not include the Downtown Rapid Transit Line.

• **Boarding Penalties:** A ten minute boarding time penalty at Union Station was applied to simulate the congestion on the platforms and in the stairwells, as well as the time it takes to transfer/walk between modes (such as GO to Subway). The assumed ten minute penalty is consistent with previous TTC transit planning studies within PD1.

The based network did not include the Air Rail Link as this line provides limited peak hour capacity and is designed to serve air passengers rather than commuters. Also the base network did not include VIA Rail services for the same reason.

A summary of the key transit system assumptions incorporated into the Union Station Base GGHM network are illustrated in Figure 26.

**Table 22** provides a summary of how the Union Station Base differs from the networks assumed in The Big Move 25 Year Plan, the recently completed GO Electrification Study and the ongoing Toronto DRTES project.
Figure 26 - Union Station Base Network

Table 22: Union Station 2031 Base Transit Network Assumptions Compared Those for Other Current Studies

<table>
<thead>
<tr>
<th>GO Rail Service Level</th>
<th>GO Electrification Study</th>
<th>Toronto DRTES Base Case</th>
<th>The Big Move 25-Year Plan</th>
<th>Union 2031 Study Base Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Level</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Electrification Study Reference Case (2x)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>New Lines (Bolton, Seaton, Havelock)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Express Rail on five lines (faster, more frequent)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Existing Rapid Transit Projects

<table>
<thead>
<tr>
<th>Committed Rapid Transit Projects</th>
<th>GO Electrification Study</th>
<th>Toronto DRTES Base Case</th>
<th>The Big Move 25-Year Plan</th>
<th>Union 2031 Study Base Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mississauga Transitway, Züm, VIVA</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Toronto-York Spadina Subway Extension</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Toronto “Five in Ten” LRT plan (Transit City)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Unfunded Rapid Transit Projects

<table>
<thead>
<tr>
<th>Local Transit Initiatives</th>
<th>GO Electrification Study</th>
<th>Toronto DRTES Base Case</th>
<th>The Big Move 25-Year Plan</th>
<th>Union 2031 Study Base Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remainder of Transit City</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Downtown Rapid Transit line</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Yonge North subway extension</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>The Big Move “25 Year Plan”</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Local Transit Initiatives</th>
<th>GO Electrification Study</th>
<th>Toronto DRTES Base Case</th>
<th>The Big Move 25-Year Plan</th>
<th>Union 2031 Study Base Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toronto Waterfront East streetcar</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
5.2.3 **GO-to-GO Transfers**

The model Union Station Base network is coded such that all GO lines either begin or terminate at Union Station. This results in all passengers having to alight from the GO train, regardless if they are destined for Union Station or continuing on with their trip. The reality is that some lines (such as Lakeshore West to Lakeshore East and vice versa) carry passengers through Union Station so that passengers do not need to physically alight the train and therefore do not affect the capacity at Union Station. To account for this “model generated transfer”, an alighting record system (EMME macro) was developed to track all a.m. peak period trips that arrive at Union Station via a GO Service, in which passengers alight at Union Station, then board a different GO Service, and depart Union Station.

For example, in the framework network transit assignment provided by Metrolinx, of the 229,000 peak period alightings at Union Station, there are 41,429 peak period GO-to-GO transfers. This means that in the model in which all GO lines either begin or terminate at Union Station, even patrons utilizing this connectivity will be included in the total inbound ridership figures and ultimately contribute to the total 229,000 peak period alightings at Union Station. To address the overstatement of the “model generated” GO-to-GO transfers, it was agreed by Metrolinx that 70% of these 41,429 peak period patrons (29,000) can be removed from the 229,000 peak period alightings figure. The 70% assumption which applies to all options reflects the assumption that the eventual Express Rail service design will optimize “through-routing” of trains to match the pattern of through passenger travel. This would allow 70% of through passengers to stay on board their trains. This further assumes that little “double berthing” of two trains at a single platform will occur in the future. Double berthing has been proposed to optimize track-side capacity but this would prevent through-routing of trains on these platforms.

In this case, the a.m. peak period 2031 Union Station passenger alightings are forecasted to be approximately 200,000. When compared to the 2006 Union Station a.m. peak period passenger alightings of approximately 60,000 alightings, the 2031 base forecasts represent an approximately 3.3 times growth.

The application of the ten minute boarding penalty at Union Station together with reduced speeds on GO Rail service from south of Bloor Street to Union Station further reduces the forecast 2031 Union Station passenger alightings to approximately 139,000, which reflects a 2.3 times growth from the 2006 Union Station passenger alightings.

It is also important to note that the Union Station passenger alightings increased from approximately 60,000 in 2006 upwards to 72,000 by 2009. The comparison of
the adjusted forecast 2031 Union Station alightings of approximately 139,000 to the observed 2009 alightings indicates that the growth of GO Rail alightings at Union Station is slightly less than double.

5.2.4 Trip Table Review and Adjustment

The initial model 2031 results indicated that there was a significant growth in ridership on Lakeshore East GO service. This significant growth in ridership is due in part to the Region of Durham’s forecasted high population to employment activity rate that results in fewer trips within the region and more trips destined to the City of Toronto, specifically Planning District 1. The forecast of a future imbalance between Durham’s resident labour force and local employment appears to be a questionable assumption, given past trends.

A review of historical and existing travel patterns between the Region of Durham and PD 1 was undertaken using observed travel patterns from the 1986 to 2006 TTS database. The TTS data indicated that for the 1986 and 1991 time frames, of all the trips destined to PD 1, trips from the Region of Durham comprised about 3%. By 1996 and 2006, trips from the Region of Durham destined to PD 1 comprised 4% and 5% respectively of all trips destined to PD 1 with no evidence of a substantial upward trend in downtown travel orientation from Durham Region.

The original 2031 model a.m. peak period trip tables indicate that trips from the Region of Durham, as a percentage of all trips destined to PD 1, would represent 10%, or a doubling of the existing travel characteristics. This significant change in the Region of Durham’s share of trips destined to PD 1 is not consistent with the forecast travel characteristics to PD 1 from the Regional Municipalities of Peel, Halton and York, as the forecast population to employment activity rates for these regions remain similar to existing conditions. Therefore, in order to maintain consistency within the model framework, the trip table was adjusted, using a Fratar approach, such that the total 2031 a.m. peak period trips from the Region of Durham would remain at approximately 5% of total trips destined to PD 1.

Table 22 provides an overview of the proportion of trips to PD 1, from the Region of Durham, before and after the trip table adjustment.
Prior to this adjustment, the original network assigned over 100,000 a.m. peak period passengers inbound to Union Station on the Lakeshore East GO Service for the 2031 planning horizon. The assignment of the adjusted trip tables resulted in a 2031 a.m. peak period ridership of approximately 75,000 passengers on the Lakeshore East GO service.

5.3 Assignment Review

The Union Station base 2031 a.m. peak period transit person assignment results reflect the DRTES land use, the revised trips tables, and the transit network assumptions identified in the Transit Network Review section. The alightings at Union Station by individual GO service, as well as resulting Subway volumes, are used as a basis for assessing transportation system options to off-load passengers from Union Station. A summary of the 2031 a.m. peak period GO passenger alightings at Union Station by GO service is presented in Table 23.

Table 22 - Region of Durham Proportion of 2031 a.m. Peak Period Total Trips Destined to PD 1

<table>
<thead>
<tr>
<th>2031 a.m. Peak Period Total Person Trip Table</th>
<th>2031 a.m. Peak Period Total Trips Destined To PD 1</th>
<th>2031 a.m. Peak Period Total Trips From Durham Region PD 1</th>
<th>Percentage of total PD1 trips from Region of Durham</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original GGHM Trip Table</td>
<td>490,400</td>
<td>51,400</td>
<td>10.5%</td>
</tr>
<tr>
<td>Adjusted GGHM Trip Table</td>
<td>489,400</td>
<td>25,900</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

Table 23 - Union Station Base GO Alightings by Line at Union Station - 2031 a.m. Peak Period

<table>
<thead>
<tr>
<th>Name</th>
<th>Alightings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stouffville</td>
<td>6,000</td>
</tr>
<tr>
<td>Havelock</td>
<td>800</td>
</tr>
<tr>
<td>Milton (Express Rail to Cooksville, commuter rail beyond)</td>
<td>15,300</td>
</tr>
<tr>
<td>Georgetown (Express Rail to Brampton, commuter rail beyond)</td>
<td>22,000</td>
</tr>
<tr>
<td>Lakeshore W (Express Rail)</td>
<td>27,200</td>
</tr>
<tr>
<td>Bolton</td>
<td>700</td>
</tr>
<tr>
<td>Seaton</td>
<td>2,400</td>
</tr>
<tr>
<td>Lakeshore E (Express Rail)</td>
<td>42,700</td>
</tr>
<tr>
<td>Barrie</td>
<td>8,700</td>
</tr>
<tr>
<td>Richmond Hill (Express Rail to RHC/Langstaff, commuter rail beyond)</td>
<td>24,600</td>
</tr>
<tr>
<td><strong>Less stay on train</strong></td>
<td><strong>11,100</strong></td>
</tr>
<tr>
<td><strong>Net a.m. Peak Period GO alightings at Union Station</strong></td>
<td><strong>139,300</strong></td>
</tr>
</tbody>
</table>
While it is important to avoid unnecessary trips to Union Station by modifying GO services, it is also important to ensure that critical sections on the Subway do not become overloaded due to the measures taken to reduce congestion at Union Station. A peak period subway capacity of 60,000\textsuperscript{12} passengers is assumed in the peak direction. The 2031 a.m. peak period passenger flows on the Bloor/Danforth, Yonge, and University Subways, presented in Table 24, indicate that the Base Case scenario would result in subway volumes exceeding capacity on the Bloor / Danforth subway east of Yonge Street (WB) and west of Main-Danforth (WB). The assigned volumes are under the capacity threshold on the University Subway Line; however, the section of the Yonge Subway south of Bloor is above the subway capacity threshold.

Table 24 - Union Station Base 2031 a.m. Peak Period Subway Passenger Forecasts

<table>
<thead>
<tr>
<th>Bloor/Danforth</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>West of University (EB)</td>
<td>47,700</td>
</tr>
<tr>
<td>West of University (WB)</td>
<td>25,400</td>
</tr>
<tr>
<td>East of Yonge (EB)</td>
<td>19,900</td>
</tr>
<tr>
<td>East of Yonge (WB)</td>
<td>71,400</td>
</tr>
<tr>
<td>West of Main/Danforth (EB)</td>
<td>13,400</td>
</tr>
<tr>
<td>West of Main/Danforth (WB)</td>
<td>63,700</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yonge</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>North of Bloor (SB)</td>
<td>51,200</td>
</tr>
<tr>
<td>North of Bloor (NB)</td>
<td>29,300</td>
</tr>
<tr>
<td>South of Bloor (SB)</td>
<td>65,800</td>
</tr>
<tr>
<td>South of Bloor (NB)</td>
<td>14,200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>University</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>North of Bloor (SB)</td>
<td>28,400</td>
</tr>
<tr>
<td>North of Bloor (NB)</td>
<td>13,700</td>
</tr>
<tr>
<td>South of Bloor (SB)</td>
<td>32,300</td>
</tr>
<tr>
<td>South of Bloor (NB)</td>
<td>8,500</td>
</tr>
</tbody>
</table>

\textsuperscript{12} This assumes that the a.m peak hour capacity is approximately 36,000 (at 0.60 peak hour factor) or 33,000 (at 0.55 factor).
5.4 **Screenline Analysis**

In order to assess 2031 a.m. peak period transit demands at specific locations within the Focus Study Area an Outer Cordon and Inner Cordon were established with each cordon represented by a west, north and east screenline. The screenline 2031 a.m. peak period passenger flows at volume locations for both the Inner and Outer cordons are shown in Figure 27. The results from the screenline analysis of 2031 a.m. peak period transit flows, presented in Table 25, indicate that 95% of the trips into the downtown area are destined to PD 1.

The 2031 a.m. peak period Union Station passenger alightings for the Union Station base represent approximately 38% of the total 2031 a.m. peak period inbound transit passengers crossing the inner cordon.

**Table 25 - 2031 a.m. Peak Period Transit Inner and Outer Cordon Screenline Passenger Summary**

<table>
<thead>
<tr>
<th>Inner Toronto Screenline Analysis</th>
<th>Inbound</th>
<th>Outbound</th>
</tr>
</thead>
<tbody>
<tr>
<td>West screenline (inbound)</td>
<td>130,400</td>
<td>51,800</td>
</tr>
<tr>
<td>East screenline (inbound)</td>
<td>151,700</td>
<td>28,900</td>
</tr>
<tr>
<td>North screenline (inbound)</td>
<td>86,000</td>
<td>48,100</td>
</tr>
<tr>
<td><strong>All screenlines (inbound)</strong></td>
<td>368,100</td>
<td>128,800</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outer Cordon Screenline Analysis</th>
<th>Inbound</th>
<th>Outbound</th>
</tr>
</thead>
<tbody>
<tr>
<td>West screenline (inbound)</td>
<td>126,700</td>
<td>51,000</td>
</tr>
<tr>
<td>East screenline (inbound)</td>
<td>140,200</td>
<td>20,600</td>
</tr>
<tr>
<td>North screenline (inbound)</td>
<td>81,000</td>
<td>38,000</td>
</tr>
<tr>
<td><strong>All screenlines (inbound)</strong></td>
<td>347,900</td>
<td>109,600</td>
</tr>
</tbody>
</table>
Figure 27 - Inner and Outer Cordon Screenline Locations

5.5 System Analysis Process
The Union Station 2031 model and the related 2031 a.m. peak period transit assignment provide a base to which each Transportation System Option to off-load passengers can be compared and analyzed. For each Transportation System Option, a systematic process (EMME macro) was developed to make the appropriate network changes to the Union Station Base, assign the transit trip table and tabulate the passenger flows on selected GO Service and subway sections.

The transit network changes for each Transportation System Option carried forward are discussed in Section 8, together with a more detailed analysis. A summary of the System Analysis Process is presented in Figure 28.
This comparative analysis of the relative performance of each system option is based on the reassignment of the total transit O-D matrix produced by the GGHM for the base case network. This analysis approach is intended to assess the extent to which each of the alternative rapid transit service scenarios would be expected to affect demand levels at Union Station and on sections of the TTC Subway system, assuming no change in total transit trip making.

Additional analyses beyond this study will be required to assess the effect of the individual rapid transit service options on trip distribution patterns and total transit ridership, given that the various options will affect the relative attractiveness of transit as an option and might be expected to influence overall trip distribution patterns. For example, Transportation System Option 4B, described later in the report, will impose a forced transfer on commuters travelling from homes in the Georgetown and Milton Corridors to the Downtown core area, which would be expected to increase transit and total average travel times and influence travel (O-D) patterns. It will be necessary to re-run the full GGHM to assess the extent to which this option would influence total demand levels and total transit ridership.
6 Transportation System Option Development

6.1 Overview

Preliminary demand estimates prepared in support of the development of The Big Move resulted in the following statement in The Big Move report:

“Over the next 25 years, Union Station will see a quadrupling of passenger traffic in the morning peak hour as a result of the expansion of the regional rapid transit network. Improvements to tracks, platforms, and passenger circulation will be needed to accommodate the new services proposed in the Regional Transportation Plan.”

The initial review of the 2031 model a.m. peak period GO Rail alightings at Union Station indicated that the alightings could be three to four times more than the observed 2006 alightings. However, the benchmarking exercises documented in Section 3 suggest that demand levels are likely to be lower than forecast. Nevertheless, peak direction passenger demands at Union Station will likely more than double by 2031.

To accommodate this forecast increase in demand at Union Station, an initial series of transportation system policy and physical options / themes were developed that would assist in off-loading GO Rail passenger demand at Union Station. These initial transportation system options / themes included:

- Using existing and committed Rail / Subway Interchange Stations;
- Consideration of satellite GO Station opportunities at Liberty Village and Cherry Street;
- Using the CP North Toronto Subdivision corridor (North Toronto Subdivision via Summerhill) with a major GO Station interfacing with the Summerhill Subway Station;
- GO Rail services integrated with GO station access with the proposed Downtown Rapid Transit (DRT) Line at key locations; and
- New GO CBD tunnel located in the Queen or King Street corridor.

13 The Big Move, pp 25 in discussion Big Move #3.
Prior to undertaking detailed travel demand analysis, it was decided that these transportation system options / themes be reviewed in context of Metrolinx, TTC and the City of Toronto studies being undertaken concurrent to the Union Station 2031 Demands and Opportunities Study.

6.2 Transportation System Option Workshop

In order to understand the range of implications associated with the policy and physical infrastructure improvements of the initial transportation system options, a workshop was held with the following agencies on Wednesday September 20, 2010:

- Metrolinx Policy, Planning and Innovation
- Metrolinx Corporate Infrastructure
- Metrolinx Operations
- City of Toronto Community Planning
- City of Toronto Transportation Planning
- TTC Service Planning
- External Transportation Specialists
- Metrolinx/TTC/City of Toronto Project Consultants

The workshop was structured to provide an overview of the studies underway, as well as initial thoughts regarding travel demands. These sessions were followed with an Evaluation and Discussion for each of the transportation system options, using a POWER format that discusses the following attributes:

- Positives
  - What are the strengths, advantages, and attributes that make sense?
- Enhancements
  - How can the positives be made better?
- Objections
  - What are the weaknesses, disadvantages, and attributes that don’t make sense
- Remedies
  - How can the concerns or objections be addressed?
6.2.1 System Option 1 - Existing/Committed Rail/Subway Interchange Stations

This is considered the “minimal” option, which utilizes the existing network with new GO Rail/Subway interchange stations. Some existing interchange stations, such as Bloor/Dundas West, are to be improved with better physical connectivity (Figure 29).

Figure 29 - System Option 1 - Existing/Committed Rail/Subway Interchange Stations

- Advantages
  - Concept includes several improvements that should be combined with all options.

- Disadvantages
  - Does not address Lakeshore GO Rail passenger demands and offloads more passengers onto already crowded subway system.
6.2.2 **System Option 2 – Satellite Stations**

This option proposes new interceptor stations in the Liberty Village and Cherry Street areas, possibly providing short turn service for the GO Georgetown, Milton and Barrie corridors, and connecting to the TTC streetcar network as illustrated in Figure 30.

**Figure 30 - System Option 2 – Satellite Stations**

- **Advantages**
  - Potential to offload passenger demands from Union Station.
  - Potential building opportunities and land use integration.

- **Disadvantages**
  - Major issues related to land availability, operations, zoning, physical and environmental impediments.
  - Stations are not located near majority of passenger destinations or employment opportunities.
  - Requires termination of some or all trains at satellite stations, making it more difficult for passengers to arrive at their destinations.
6.2.3 **Option 3 - North Toronto Subdivision via Summerhill**

This option utilizes the North Toronto Subdivision via Summerhill east of the Georgetown corridor, connecting to existing Dupont and Summerhill Subway Stations (Figure 31).

**Figure 31 - Option 3 - North Toronto Subdivision via Summerhill**

- **Advantages**
  - Minor integration with Yonge/University/Spadina Subway, and provides potential for some redevelopment.

- **Disadvantages**
  - Does not directly address the Union Station passenger off-load issue as this option provides a new market for GO passengers.
  - Land availability challenges at Summerhill Station and railway corridor issues (need for additional tracks for GO Service).
  - May compound subway capacity concerns.
### 6.2.4 **System Option 4 – GO / Downtown Rapid Transit Integration**

This option includes the Downtown Rapid Transit Line, with interchange stations with GO corridors (Figure 32).

**Figure 32 - System Option 4 – GO / Downtown Rapid Transit Integration**

- **Advantages**
  - Effectively addresses the Union Station Passenger loading issues as the DRT can serve both GO and TTC passenger demands.
  - Provides passengers with alternative options to reach their destinations.

- **Disadvantages**
  - Questionable viability and feasibility given significant costs, property impacts and construction issues.
  - Issues related to land availability, operations, zoning, physical and environmental impediments.
6.2.5 **System Option 5 – New GO CBD Terminal**

This option proposes a Queen Street tunnel, exclusively for Express Rail service for the Milton, Georgetown, Lakeshore East and Richmond Hill corridors. Interceptor service will be provided at Queen and Osgoode subway stations, and additional service will serve Union Station. An overview of System Option 5 is presented in Figure 33.

Figure 33 - System Option 5 – New GO CBD Terminal

- **Advantages**
  - Effectively addresses Union Station passenger loading issues
  - Services GO Rail passenger destinations.
  - Can be integrated with express rail electrification plans

- **Disadvantages**
  - Major costs and construction, property, operational and feasibility issues.
  - Major issues related to land availability, operations, zoning, physical and environmental impediments.
6.2.6 **System Option 6 – Second Terminal at Union Station**

This system option that was introduced at the workshop includes constructing a tunnel under existing Union Station and developing a second GO Rail passenger station east of the existing station, around Yonge Street. The Lakeshore West and Lakeshore East GO Services would have exclusive use of the tunnel and second station. An overview of System Option 6 is presented in Figure 34.

**Figure 34 - System Option 6 – Second Terminal at Union Station**

- **Advantages**
  - Effectively addresses the Union Station Passenger loading issues for both passengers and trains.
  - Makes use of established corridors.
  - Majority of passengers within walking distance of their destinations.
  - Can be integrated with express rail electrification plans

- **Disadvantages**
  - Adds to surrounding pedestrian congestion around Union Station.
  - Significant tunnelling, property and construction issues.
6.3 **Summary of Workshop Discussion**

The workshop provided a forum for several transit planning and operation specialists to review the initial baseline transportation system options that could address opportunities to offload varying levels of forecast 2031 a.m. peak period passenger loads at Union Station.

A summary of the major directions arising from the workshop discussion, to assist the Project Team in the screening and evaluation of the Transportation System Option being considered to address the forecast passenger loads at Union Station, include:

- Transportation System Option 1, proposed rail / subway integration of stations, should be considered for any options carried forward for detailed analysis.

- Transportation System Option 2, satellite stations at Liberty Village and Cherry Street, has potential to off load passenger loads at Union Station but does not effectively accommodate GO Rail passenger employment destinations. The proposed stations also pose planning, property and infrastructure issues that may limit their effectiveness.

- Transportation System Option 3, proposed GO service on the Toronto North Corridor and connection to the Summerhill Subway Station, does not address the Union Station passenger loading issue.

- Transportation System Option 4, proposed GO / Downtown Rapid Transit Line integration, can be effective in offloading passengers from Union Station.

- Transportation System Option 5, proposed GO Downtown Tunnel and CBD Terminal, can be effective in offloading passengers from Union Station.

- A new Transportation System Option 6 connecting to the Yonge-University Subway line north of Union Station, provides an opportunity to address Union Station capacity needs.

Other key points raised at the Workshop for consideration in subsequent analysis stages include:

- Fare integration must be examined as part of the solution in order to encourage passengers to use alternative transit services;

- The last few hundred meters of walking distance to the final destination has an impact on transit choices, thus location of new GO stations must be in close proximity to existing and planned major employment centres;
Satellite stations can only be effective if GO Train services can be short turned, where there is frequent GO service and where there is frequent high order transit services interfacing with the GO services; and

Most major international centres with a similar size to the City of Toronto have more than one major transit interchange station to provide efficient transit passenger accessibility and transit system flexibility.
7 Transportation System Options Screening Assessment

7.1 Overview

To meet the objectives of the Union Station 2031 Demands and Opportunities Study, which is to off load GO Rail passenger demands from Union Station and maintain efficient transit service to existing and future GO Rail passengers destined to downtown Toronto, the following Primary Evaluation / Screening Criteria and defined measures were developed to screen the base Transportation System options:

- **Ability to Off-load Union Station**
  - The amount of Union Station passenger reduction that could occur in comparison to the Union Station Base Case.

- **Ability to Serve GO Rail Market / Planning District 1 (PD 1) Employment Growth**
  - The number of employees within 700m from Union Station and Interceptor stations.

- **Ability to Integrate with TTC Service and Address TTC Concerns**
  - Directness of transfer (distance and time) between GO and TTC transit services.

- **Consistency with GO 2020**
  - Consistency of planned train service, passenger service and feasibility of implementation.

The screening of the base Transportation System Options, using available data and professional judgement, in addition to the above noted Evaluation / Screening Criteria, allowed the Project Team to determine which Transportation System Options would be carried forward for a more detailed system analysis and evaluation.
7.2 Screening Assessment
The screening analysis used Base Case travel demand forecasts from the GGHM to assess Union Station passenger demands and system information obtained through the Transportation System Option Workshop, meetings with other Metrolinx/GO study teams (Electrification Study and USRC Infrastructure Study) as well as meetings with TTC and City of Toronto staff regarding travel demand analysis.

In addition to the travel demand forecast review, each Transportation System Option was measured against the Evaluation / Screening Criteria in order to identify which Transportation System Options should be carried forward to the more detailed evaluation stage.

As noted in Section 6, the committed rail and subway interchange stations identified in Transportation System Option 1 were included in Transportation System Option 2 through Option 6.

A summary of the screening for Transportation System Options 2 and 3 are presented in Table 26 with the screening results for Transportation System Options 4 and 5 presented in Table 27. For comparative purposes, Transportation System Option 6 is presented with Transportation System Option 5 in Table 28.

7.3 Carry Forward Transportation System Options Short List
Although Option 2 has potential for off loading passengers from Union Station, the screening analysis identified that Transportation System Option 2 (satellite stations) not be carried forward for further analysis and evaluation as Option 2 does not efficiently serve the existing and future employment areas in the CBD and does not provide for effective integration with TTC services in comparison to Options 4, 5 and 6.

The feasibility review for proposed satellite stations at Liberty Village and Cherry Street (Transportation System Option 2) indicates the following considerations:

- Liberty Village Area Satellite Station
  - Liberty Village Area is served by Georgetown / Milton / Barrie GO lines and this section of GO Rail network has been planned to provide eight tracks between Parkdale Avenue and Union Station. This track design provides two Milton corridor tracks, two Barrie corridor tracks and four Georgetown South Corridor tracks.
  - Presently, GO Transit is designing and building a rail corridor subway under Strachan Avenue for the eight planned tracks.
  - The present and planned track design limits the availability of lands within the Right of Way that could be used to provide for a new station
in this area and to accommodate the short-turning of trains in this location.

- The Bathurst North Yard location offers more land for a satellite station and is closer to the CBD. However, it is unlikely that all three Georgetown, Milton, and Barrie GO services could be short turned at this location.

- Cherry Street Area Satellite Station

  - The current rail corridor in the Cherry Street area is served by six tracks. Four tracks serve the Lakeshore East and Stouffville GO services and two tracks serve the Richmond Hill GO service.

  - If a station was developed to service all six tracks, then three island GO platforms with pedestrian tunnels would be required. Station platforms meeting these requirements would require an additional sixty-three feet of right of way within the rail corridor.

  - Relocating the tracks to run around these platforms would impact downstream roadways for about 1,500 feet to the east and 900 feet to the west, impacting roadway bridge crossings of the Don River and Don Valley Parkway.

  - In order to short turn trains, additional lands would be required beyond that identified for station platforms.

  - The existing Don Yard on the south side of the rail corridor has been previously identified as a fundamental element in GO Transit plans to expand the train service over time and is unlikely to be available for a satellite station.

  - Development of a Cherry Street station would result in issues related to VIA train service, the Canadian National Railway (CNR) freight service on the Lakeshore Line, and Ontario Northland Railway (ONR) train service on the Richmond Hill Line operations that must be taken into consideration. A Cherry Street station would require track, switch and signal modifications and would likely create a bottleneck for trains approaching the USRC.

Notwithstanding the results of the screening analysis and supporting feasibility review, Option 2 could provide potential interim improvements prior to the implementation of any of the longer term Transportation System Option improvements, such as GO service in dedicated tunnels connecting with the proposed DRT. Therefore the concept of the Satellite Station is maintained as part of Transportation System Option 4, discussed in Section 8 and specifically related to the North Bathurst Yard potential satellite station. Although a Cherry Street
Union Station 2031 Demands and Opportunities Study

A satellite station is not part of Transportation System Option 4, transit access to the Cherry Street area is somewhat accommodated through the inclusion of a Richmond Hill GO Station integrated with the DRT along the Queen / King Street corridor.

Transportation System Option 3 was also not recommended as an alternative that should be carried forward for further analysis and evaluation as this option does not efficiently serve the GO passenger market in the Toronto CBD. In addition, it does not offload Union Station demand, and has the potential to increase demand on the overcrowded Yonge and University subway lines.

The Option 3 rail feasibility review noted that the North Toronto Subdivision via Summerhill houses the Canadian Pacific Railway (CPR) mainline track between Montreal and Toronto and on to Western Canada and the United States. This review indicated that the CPR has mandated rights for freight service along the Summerhill corridor. The rail corridor could possibly accommodate Milton GO service on the south side of the corridor without major complications. Accommodating Georgetown GO service would have significant impacts on the GO Weston sub-grade separation whereas the Barrie GO service may require over-track grade separation in order to access the CP corridor.

*The screening analysis identified that Transportation System Options 4, 5 and 6 sufficiently meet the Primary Evaluation Criteria to be carried forward for further analysis and evaluation as these Transportation System Options offload Union Station demand, service the GO passenger market, support the Big Move vision and, depending on the option, provide various levels of improved integration with TTC services.*
## Table 26 - Screening Analysis for Transportation System Option 2 and Option 3

<table>
<thead>
<tr>
<th>Primary Evaluation Criteria</th>
<th>Description</th>
<th>Option 2 Satellite Stations</th>
<th>Option 3 North Toronto Subdivision Summerhill Subway Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>General System Description</td>
<td>Satellite stations are located west of Union Station (Exhibition; King Street; or Bathurst) and at Cherry Street east of Union Station.</td>
<td>Milton &amp; Georgetown GO Service directed to CP North Toronto Subdivision with interceptor Stations at Dupont and Summerhill Subway Stations.</td>
<td></td>
</tr>
<tr>
<td>1. Ability to off-load Union Station</td>
<td>Union Station passenger reduction to The Big Move base case (number or proportion)</td>
<td>There would be large potential to off load Union Station. However this option requires GO Trains to be short-turned at new stations and large numbers of GO passengers to walk to their destination or transfer to rapid transit (e.g. subway).</td>
<td>Minimal off loading of passenger demands at Union Station. The new stations would not serve the primary GO market (within 1300 m of Union Station).</td>
</tr>
<tr>
<td>2. Ability to serve GO Rail Market / PD1 Employment Growth</td>
<td>Number of employees within 700m from Union Station and Interceptor Stations</td>
<td>Proposed satellite station sites located too far from Primary GO Market / not competitive with Union Station Site.</td>
<td>Proposed Option does not serve the Downtown Core market. This option would extend GO services to new markets but not into the Downtown employment area.</td>
</tr>
<tr>
<td>3. Ability to integrate with TTC service and address TTC Concerns</td>
<td>Directness of transfer (distance / time)</td>
<td>Possible integration with Bathurst and planned Cherry Street Streetcars (but not with rapid transit options).</td>
<td>Increases ridership demand to existing overcrowded Yonge and University Subway stations. Integration at Dupont Subway may be possible but there is limited potential east of University/Spadina Line due to property constraints.</td>
</tr>
<tr>
<td>4. Consistency with GO 2020 Plan</td>
<td>GO Rail Passenger Market and GO Rail Service</td>
<td>Does not efficiently serve GO Passenger Market in CBD. GO services are required to be short turned at satellite stations; large number of transfers, inconvenient for riders.</td>
<td>Does not efficiently serve GO Passenger Market in CBD. GO service implementation and cost issues using the North Toronto Subway, which is the main line for CP freight service between Montreal and to/from USA and Western Canada.</td>
</tr>
<tr>
<td>SCREENING</td>
<td>DO NOT CARRY FORWARD</td>
<td>DO NOT CARRY FORWARD</td>
<td></td>
</tr>
</tbody>
</table>
Table 27 - Screening Analysis for Transportation System Option 4 and 5

<table>
<thead>
<tr>
<th>Primary Evaluation Criteria</th>
<th>Description</th>
<th>Option 4 GO/DRT Integration</th>
<th>Option 5 New GO CBD Tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>General System Description</td>
<td>Downtown Rapid Transit (DRT) Line service connecting to Lakeshore West, Milton / Georgetown / Barrie and Richmond Hill GO lines.</td>
<td>Construction of a new tunnel below the Queen Street / King Street Corridor potentially allowing Milton and Georgetown GO service to connect with Lakeshore East GO and interfacing with the University and Yonge Subways.</td>
<td></td>
</tr>
<tr>
<td>1. Ability to off-load Union Station</td>
<td>Union Station passenger reduction to The Big Move base case (number or proportion)</td>
<td>Diversion of GO passengers from Union Station is dependant on the relative speed/convenience of the DRT.</td>
<td>Diverts significant passenger loads from Union Station by providing a more direct routing to high density CBD employment districts near King/Bay.</td>
</tr>
<tr>
<td>2. Ability to serve GO Rail Market / PD1 Employment Growth</td>
<td>Number of employees within 700m from Union Station and Interceptor Stations</td>
<td>If DRT is located under the Queen Street / King Street corridors, this line would serve the majority of GO’s Union Station market. Requires appropriate inter-modal stations to be constructed, linking GO and TTC services.</td>
<td>Corridor is located in the heart of GO’s market area and PD1 employment centre.</td>
</tr>
<tr>
<td>3. Ability to integrate with TTC service and address TTC Concerns</td>
<td>Directness of transfer (distance / time)</td>
<td>Direct links between TTC and GO systems provide TTC and GO passenger alternative routings to CBD.</td>
<td>Direct links between TTC and GO systems, providing TTC and GO passenger alternative routings to CBD.</td>
</tr>
<tr>
<td>4. Consistency with GO 2020 Plan</td>
<td>GO Rail Passenger Market and GO Rail Service</td>
<td>Efficiently serves GO Passenger Market in CBD and maintains planned GO Service improvements. Requires additional GO stations. High cost with significant construction feasibility, and operational issues.</td>
<td>Efficiently serves GO Passenger Market in CBD but requires significant GO Train service adjustments, electrification train services, additional GO Stations and requires effective fare integration. High cost with significant construction feasibility, and operational issues.</td>
</tr>
</tbody>
</table>

SCREENING | CARRY FORWARD | CARRY FORWARD |
Table 28 - Screening Analysis for Transportation System Options 5 and 6

<table>
<thead>
<tr>
<th>Primary Evaluation Criteria</th>
<th>Description</th>
<th>Option 6 New Tunnel and Doubling of Union Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>General System Description</td>
<td>Construction of a new tunnel below existing Union Station serving the Lakeshore West and Lakeshore East GO Services. Includes the provision of a new GO Station slightly east of the existing Union Station (possibly at Yonge Street).</td>
<td></td>
</tr>
<tr>
<td>1. Ability to off-load Union Station</td>
<td>Union Station passenger reduction to The Big Move base case (number or proportion)</td>
<td>Diverts significant passenger loads from existing Union Station, moving Lakeshore GO passengers to new GO station.</td>
</tr>
<tr>
<td>2. Ability to serve GO Rail Market / PD1 Employment Growth</td>
<td>Number of employees within 700m from Union Station and Interceptor Stations</td>
<td>Corridor is located at the southerly edge of the GO Rail passenger market area and PD1 employment centre.</td>
</tr>
<tr>
<td>3. Ability to integrate with TTC service and address TTC concerns</td>
<td>Directness of transfer (distance / time)</td>
<td>Indirect linkage between new GO station and TTC subway requiring improved pedestrian PATH system.</td>
</tr>
<tr>
<td>4. Consistency with GO 2020 Plan</td>
<td>GO Rail Passenger Market and GO Rail Service</td>
<td>Efficiently serves GO Passenger Market in CBD but requires significant GO Train service adjustments, electrification train services, additional GO stations and requires effective fare integration. High cost with significant construction feasibility issues.</td>
</tr>
<tr>
<td>SCREENING</td>
<td>CARRY FORWARD</td>
<td></td>
</tr>
</tbody>
</table>
8 System Option Evaluation

8.1 Overview
The initial screening of the Transportation System Options indicated that the following three system option themes be carried forward for detailed analysis:

- GO / DRT Integration
- GO CBD Tunnel – Queen Street Corridor
- GO CBD Tunnel and Doubling of Union Station

Within each of these Transportation System Options, sub-options have been created and reviewed to assess specific issues raised at the Workshop, to address impacts of additional stations on selected subway lines, or to address transfer distance between GO and TTC stations.

The following discussion provides a description of each Transportation System Option analysed and the results of the comparative system evaluation related to specific criteria.

8.2 Definition of Themes for Detailed Analysis

8.2.1 Option 4 Theme - (GO/DRT Integration)
The Option 4 Theme reflects GO/DRT Integration and consists of the following three alternative options:

- Option 4A-1 includes full DRT from Bloor/Dundas West to Pape Avenue with limited stops;
- Option 4A-2 includes full DRT from Bloor/Dundas West to Pape Avenue with regular stop spacing; and,
- Option 4B includes central and east sections of the DRT with the provision of a Bathurst North Yard Station where GO Barrie, Georgetown, and Bolton Lines would be short-turned, requiring GO Rail passengers from these lines to alight at the Bathurst North Station.

Graphical summaries of the three options are presented in Figure 35, Figure 36 and Figure 37 respectively, along with a general description of the differences
between the option and the Union Station Base network which does not provide for the DRT.

Figure 35 - System Option 4A-1 (Full DRT with Limited Stops)

Note: Option 4A-1 differs from the Union Station Base in that there is now a Downtown Rapid Transit Line allowing GO riders direct access to the new rapid transit line from the GO Lakeshore West, Barrie, Georgetown, Bolton, Milton, and Richmond Hill Lines. The DRT line provides also allows access to the Yonge and University Subway at Osgoode and Queen Stations.
Note: Option 4A-2 provides for a DRT line along the same alignment as is assumed for Option 4A-1, but this option assumes additional DRT stations allowing local access at Howard Park Avenue, Strachan Avenue, Spadina Avenue, Parliament Street, Carlaw Avenue, and Gerrard Street.
Note: Option 4B is identical to Option 4A-1 east of Osgoode Station. West of Osgoode DRT shifts southward, intersects with the Bathurst North Yard and continues west to Exhibition GO Station. Unlike Option 4A, the GO Barrie, Bolton, and Georgetown services are not permitted to continue to Union Station and are short-turned at Bathurst North Yard.

8.2.2 Option 5 Theme – Queen Street GO Tunnel

The Option 5 Theme assumes the provision of a GO tunnel located under Queen Street with GO Stations integrated with Osgoode Station (University Subway line) and Queen Station (Yonge Subway line). This option assumes electric powered locomotives, or EMUs, would be utilized within the tunnel and service would be continuous for most Express Rail lines (GO Milton, Georgetown, Richmond Hill, and Lakeshore East lines). Within the tunnel, Express Rail routes would operate at similar travel speeds to those assumed for the DRT in Option 4A-1.

Regional Rail Service would continue to Union Station, but passengers would be able to transfer to the Electrified Express Rail services at stations at both ends of the Queen Street Tunnel, assuming that such stations can be developed. Note that the demand analysis recognized that passengers using the Barrie GO would not be able to transfer at the Queen Street Tunnel due to alignment constraints.
Option 5A-2, the option that best represents this theme, is shown in Figure 38 below.

A sensitivity analysis of variations of the Option 5 theme was undertaken to assess the impacts of reducing passenger transfers between GO stations and TTC stations on the Bloor-Danforth and Yonge-University Lines by including time delay (boarding) penalties at transfer stations to reflect the walking distances between these stations and other factors such as congestion that would make specific transfers less attractive. The results of the sensitivity analysis showed minimal variations in demand levels at Union Station among the options tested. Option 5A-2 assumed five minute boarding time penalties at Main/Danforth and Bloor/Dundas West stations and resulted in fewer transfers from the GO System to the Bloor-Danforth Subway. This resulted in lower levels of demand on the Bloor-Danforth and Yonge-University subway lines, compared to the sub-options that did not include these transfer penalties.

Figure 38 – System Option 5A-2

Note: Option 5A-2 assumes five minute boarding penalties at the Danforth/Main Station and Bloor/Dundas West Station to reflect the transfer times between stations as well as comparable transfer penalties at Osgoode and Queen Stations in the Downtown.
Option 6 Theme – New Tunnel Under / Near Existing Union Station

The Option 6 Theme builds on maintaining service to the existing employment areas serviced by GO with the provision of a new GO Tunnel that would allow for continuous Lakeshore West and East GO services.

The two options being considered include:

- **Option 6A** - Lakeshore West and Lakeshore East GO Services shift underground in a tunnel and divert north as they approach Union Station, with the tunnel interfacing with Osgoode Station on the University Subway Line and Queen Street Station on the Yonge Subway Line. The proposed rail tunnel and station locations are presented in Figure 39.

- **Option 6B** - Lakeshore West and Lakeshore East GO Services shift underground in a tunnel as they approach Union Station. This tunnel would be placed under the existing Union Station and would interface with a new GO Station located slightly east of the existing Union Station, possibly at Yonge Street. The proposed rail tunnel and station locations are presented in Figure 40.

Figure 39 – System Option 6A

Note: Option 6A differs from the Union Station Base in that it requires the development of a tunnel connecting Lakeshore West and Lakeshore East GO services north of Union Station at Queen Street. This option provides
continuous GO service between Lakeshore West and Lakeshore East, in addition to direct GO/TTC connectivity at Queen and Osgoode Stations.

Figure 40 – System Option 6B

Note: Option 6B includes the development of a tunnel located under Union Station providing for continuous Lakeshore East and Lakeshore West GO service. A new GO station located east of existing Union Station would be integrated with TTC transit service.

8.3 Analysis and Evaluation

The evaluation framework was structured to undertake a comprehensive analysis of each Transportation System Option by measuring how each option addresses the following evaluation criteria:

- Ability to Off-Load Union Station Passenger Demands,
- Ability to Serve the GO Rail Market/ PD 1 Employment,
- Ability to Integrate New TTC Subway Services Providing System Flexibility and Redundancy,
- Consistency with GO 2020 Plan,
- Ease of Interagency Coordination and Approvals,
- Ability to Promote New Development,
• Magnitude of Construction Issues,
• Affordability of Capital Costs,
• Risk / Sphere of Influence Control, and
• Ability to maintain Reasonable Passenger Flows on the Subway.

The analysis weighting for each evaluation criterion was rated in terms of three levels:

• Best meets the criterion objectives.
• Meets some of the criterion objectives.
• Meets few of the criterion objectives.

It is noted that equal weighting is used for all evaluation criteria except for the Ability to Off-Load Union Station Passenger Demands, where the study team assumes a double-weighting for this criterion as this is the main objective of the Union Station 2031 Demands and Opportunities Study.

The following discussion provides an overview of the evaluation findings with the detailed description of the evaluation process and findings presented in the Appendix.

8.3.1 Ability to Off-Load Union Station Passenger Demands

This evaluation criterion measures to what degree each Transportation System Option reduces total transit passengers alightings at Union Station in order to assess peak direction capacity requirements. The 2031 “Net Passengers at Union Station” value for each option is compared to the estimated “Net at Union” alightings in the Union Station Base of 139,000.

The Evaluation Measures used are:

• Best meets the objectives – reduces Union Station Passengers between 25% and 60%
• Meets some of the objectives – reduces Union Station passengers by 60% or more. This level of offloading is deemed undesirable as it would offload passengers to a level that would make ongoing capacity plans for Union Station redundant.
• Meets few of the objectives – reduces Union Station Passengers less than 25%

An agency of the Government of Ontario
Transportation System Options 4B, 6A and 6B reflect Union Station passenger reductions of approximately 34%, 47%, and 42%, respectively, and are therefore considered to best meet some of the evaluation criterion objectives.

Transportation System Option Theme 5 offloads the number of passengers at Union Station by (63% - 67%) and is considered to meet some of the evaluation criterion objectives as it would result in an underutilized Union Station.

Transportation System Option 4A-1 and Option 4A-2 are considered to meet few of the evaluation criterion objectives as these options off-load less than 20% of the passenger demand from Union Station.

8.3.2 Ability to Serve the GO Rail Market within 700m of Existing/New GO/TTC Stations

This evaluation criterion reviews the extent to which new/existing GO/TTC stations serve the forecast employment within 700m of the stations located within PD1.

The Evaluation Measures used are:

- Best meets the objectives – 75% or more of forecast employment growth located within 700m of new GO and/or GO/TTC stations.
- Meets some of the objectives – 50% to 75% of forecast employment growth located within 700m of new GO and/or GO/TTC stations.
- Meets few of the objectives – 50% or less of forecast employment growth located within 700m of new GO and/or GO/TTC stations.

Transportation System Options 4A-2, 4B and 5A-2 best meet the evaluation criterion objectives of serving forecast employment growth located within 700m of new GO and/or GO/TTC stations.

8.3.3 Ability to Integrate New TTC Subway Services Providing System Flexibility and Redundancy

This evaluation criterion measures the directness of access to new TTC infrastructure (Subway and DRT stations) of each Transportation System Option. It must be noted that the Main/Danforth and Bloor/Dundas West connections are not included in the measure as they are part of all options being considered.

The Evaluation Measures used are:

- Best meets the objectives – more than five GO Train services and three new GO Stations are integrated with new TTC services (i.e. DRT).
• Meets some of the objectives – more than five GO Train services and two new
  GO Stations are integrated with new TTC services (i.e. DRT).

• Meets few of the objectives – less than five GO Train services and less than two
  new GO Stations are integrated with new TTC services (i.e. DRT).

Transportation System Options 4A-1, 4A-2 and 5A-2 best meet the criterion
objectives, as both Option Themes 4 and 5 reflect direct GO services connecting to
TTC stations and services.

Transportation System Option 4B meets some of the objectives, with eight of the
GO services accessing the DRT and the provision of two new GO Stations.

Transportation System Option 6A and 6B provide the least new GO access to the
TTC Transit System and therefore do not meet the objectives of this criterion.

8.3.4 Consistency with GO 2020

This evaluation criterion measures the consistency of Transportation System
Options to the GO service improvements identified in the GO 2020 plan.

The Evaluation Measures used are:

• Best meets the objectives – consistent with GO 2020 Plan.

• Meets some of the objectives – significant changes to GO 2020 Plan.

• Meets few of the objectives – not consistent with GO 2020 Plan.

Transportation System Options 4A-1, 4A-2, 4B and 6B most closely maintain
existing GO passenger travel patterns but would still require significant changes to
the GO 2020 Plan.

Transportation System Options 5A-2 and 6A are not consistent with the GO 2020
Plan as these options include major transit tunnels (GO) and would require electric-
powered locomotives. While the tunnel proposed under Union Station is not in the
GO 2020 Plan it is not expected to substantially affect the alignment of planned or
existing GO services. The same can not be said for the tunnel assumed in Option
6A.

8.3.5 The Ease of Interagency Coordination and Approvals

This evaluation criterion measures the relative ease of agency coordination and approvals, and the
inherent risk with an increased number of approvals required to construct a Transportation System
Option. It is assumed that the City of Toronto is involved in the coordination and
approval process for all of the Transportation System Options.
The Evaluation Measures used are:

- Best meets the objectives – requires Metrolinx approvals.
- Meets some of the objectives – requires Metrolinx and TTC approvals.
- Meets few of the objectives – requires Metrolinx, TTC and other agency approvals.

Transportation System Option 6B best meets the evaluation criterion objectives, as the planning and construction activities are limited to lands owned by Metrolinx.

The remaining Transportation System Options meet some of the above evaluation criterion objectives as they require both Metrolinx and TTC coordination and approvals.

**8.3.6 The Ability to Promote New Development**

This evaluation criterion measures the ability to promote new development by reviewing the amount of forecast employment located in the Focus Area within 700m of new and existing GO stations and GO/TTC stations access. It is assumed that GO stations with higher forecast employment levels have more potential to promote new development.

The Evaluation Measures used are:

- Best meets the objectives – 100,000 employees or more.
- Meets some of the objectives – more than 50,000 employees but less than 100,000 employees.
- Meets few of the objectives – 50,000 employees or less.

All Transportation System Options except Option 6B provide access to over 50,000 employees and therefore meet some of the evaluation criterion objectives.

**8.3.7 The Magnitude of Construction Issues**

This evaluation criterion measures the magnitude of construction issues based on a preliminary review of engineering feasibility and challenges to construct each option.

The Evaluation Measures used are:

- Best meets the objectives – land (property) is the only constraint.
- Meets some of the objectives – land (property), rail corridor and tunnelling constraints need to be addressed.
• Meets few of the objectives – land (property), rail corridor and major tunnelling constraints need to be addressed.

None of the Transportation System Options achieves the “best meet” evaluation measure, as all options include land and rail corridor issues as well as tunnelling (DRT or GO tunnels) of varying lengths.

Transportation System Options 4B and 6B meet some of the evaluation criterion objectives as the length of tunnelling for these options is less than what is required for the other options.

8.3.8 GO/DRT Capital Costs
This evaluation criterion measures the order of magnitude construction costs that can be anticipated with each Transportation System Option. Tunnelling information related to soils, utilities and property is largely unknown, and requires that the cost analysis be undertaken at a very high level. The following therefore represents a comparative analysis between Transportation System options.

The Evaluation Measures used are:

• Best meets the objectives – lower order of magnitude construction costs relative to transportation system options reviewed.
• Meets some of the objectives – medium order of magnitude construction costs relative to transportation system options reviewed.
• Meets few of the objectives – higher order of magnitude construction costs relative to transportation system options reviewed.

Transportation System Option 6B best meets the evaluation criterion objectives as the order of magnitude construction costs are lower than the other options due in part to a shorter length of tunnel and more knowledge of soils and utilities under Union Station.

The order of magnitude construction costs for Transportation System Options 4A-1 and 4A-2 are considered high due to the DRT tunnelling costs and station construction costs at Queen Street and Richmond Hill GO/ DRT stations. Order of magnitude costs are high for Transportation System Option 5A-2 due to the length of tunnel and station construction costs at Queen Street GO, Osgoode TTC/GO, Queen TTC/GO and Richmond Hill GO.

Transportation System Options 4B and 6A are considered to have order of magnitude costs somewhere between the low and high benchmarks as there is less tunnelling and fewer GO/TTC stations required for these options.
8.3.9 **Risk/Sphere of Influence Control**

This evaluation criterion measures the risk and approval uncertainty that Metrolinx could experience for each Transportation System Option. The measure is intended to offer a factor of safety to the evaluation criteria. It was derived by averaging the impacts of the following three evaluation criteria to provide an overview of the level of risk that could be experienced when pursuing specific Transportation System Options:

- Ease of Interagency Coordination and Approvals,
- Magnitude of Construction Issues, and
- GO/DRT Construction Costs.

The Evaluation Measures used are:

- Best meets the objectives – higher number of “Best Meets” occurrences than the other options.
- Meets some of the objectives – higher number of “Meets Some” occurrences than the other options.
- Meets few of the objectives – higher number of “Meets Few” occurrences than the other options.

Transportation System Option 6B rates as the option with the least risk as Metrolinx controls the approval process and this option also represents lower order of magnitude costs than the alternative options. Option 6B therefore best meets the evaluation criterion objectives.

Transportation System Options 4B and 6A reflect a medium risk due in part to lower construction costs related to tunnels and stations, and these options are therefore defined as meeting some of the evaluation criterion objectives.

Transportation System Options 4A-1, 4A-2 and 5A-2 represent options with the highest risk and therefore these options meet few of the evaluation criterion objectives.

8.3.10 **The Ability to Maintain Reasonable Passenger Flows on the Subway**

This evaluation criterion measures the forecast 2031 peak period passenger flows in relation to subway passenger capacity at selected sections along the University Subway, Yonge Subway, Bloor-Danforth Subway, and the DRT/Queen tunnel. The assumed peak period passenger capacity of the subway system is 60,000 passengers in the peak direction.

The Evaluation Measures used are:
- Best meets the objectives – Volume/Capacity less than or equal to 0.80.
- Meets some of the objectives – Volume/Capacity greater than 0.80 and less than 1.1.
- Meets few of the objectives – Volume/Capacity 1.1 or greater.

Transportation System Option 4A-1, 4A-2 and 4B indicate that the selected TTC Subway / DRT sections would operate at or near capacity and therefore meet some of the evaluation criterion objectives.

Transportation System Options 5A-2, 6A, and 6B indicate that selected TTC Subway / DRT sections would operate beyond the passenger capacity of the Subway Transit System and therefore meet few of the evaluation criterion objectives.

**8.4 Transportation System Option Evaluation Summary**

The Transportation System Option Evaluation Summary presented in Table 29 provides an overview of the rating for each Transportation System Option with respect to each evaluation criterion. The number of checkmarks illustrates how well the criterion meets the objective. Three checkmarks indicate that it meets the objectives, two indicate that it meets some of the objectives and one checkmark indicates that the Transportation System Option meets only few objectives.
Table 29- Checkmark Matrix of Evaluation Criterion by Transportation System Option

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Option 4A-1 GO/DRT Integration, DRT Limited Stations</th>
<th>Option 4A-2 GO/DRT Integration, DRT Additional Stations</th>
<th>Option 4B Bathurst N Yard + Modified DRT</th>
<th>Option 5A-2 Queen St. Tunnel Limited Stations</th>
<th>Option 6A Lakeshore Service to Queen St.</th>
<th>Option 6B Lakeshore Service Under Union Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>New GO Stations at Eglinton, Dundas, DRT with Full DRT</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>New GO Stations at Eglinton, Dundas, DRT with Full DRT</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Georgetown/Barrie end at Bathurst N Yard + DRT to Exhibition</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Express Rail Service Milton/Georgetown/LE/RH</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>New Stations at Osgoode-University/Queen-Yonge</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>New Union Station, Satellite at Bay St.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Ability to Offload Union Station**
- **Ability to Serve GO Rail Market / PD 1 Employment**
- **Ability to Integrate New TTC Subway Services Providing System Reliability and Redundancy**
- **Consistency with GO 2020**
- **Ease of Interagency Coordination and Approvals**
- **Ability to Promote New Development**
- **Magnitude of Construction Issues**
- **GO/DRT Capital Costs**
- **Risk/Sphere of Influence Control (See *)**
- **Ability to Maintain Reasonable Passenger Flows on Subway**

**RECOMMENDATION**

- CARRY FORWARD

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- v Meets Few Criteria
- vv Meets Some Criteria
- vvv Best Meets Criteria

Evaluations with * are used to tally “Risks” count.
In order to distinguish between sub-options within a Transportation System Option Theme, the following numeric ranking process identifies a numeric value, reflecting how well each option meets the evaluation criteria objectives of the study, and also presents a summary of the ranking results in a colour sequence.

- Best meets evaluation criteria objectives. - Numeric value of 3
- Meets some evaluation criteria objectives. - Numeric value of 2
- Meets few evaluation criteria objectives. - Numeric value of 1

The highest total score within each Transportation System Option theme provides a basis for carrying forward the specific option for further study.

The evaluation results for each Transportation Option Theme are presented in the following discussions, including both a numeric ranking and a summary of how well the option meets the evaluation objectives.

**8.4.1 Option 4 Theme – GO/DRT Integration**

Option 4B, which provides for the short turning of GO Barrie, Bolton, and Georgetown services at Bathurst North Yard in conjunction with a DRT between the Bathurst North Yard and the Bloor-Danforth Subway, results in the highest evaluation score for the theme and does not have any evaluation criterion rated as “meets few of the evaluation criterion objectives”. A summary of the evaluation ranking is provided in Figure 41. Based on the evaluation ranking, Transportation System Option 4B is recommended to be carried forward for further study.

Figure 41 - Summary Evaluation of Transportation System Option 4
8.4.2  Option 5 Theme – Queen Street GO Tunnel

The Transportation System Option 5 Theme reflects the provision of a Queen Street tunnel serving GO Milton, Georgetown, Richmond Hill, and Lakeshore East services with no provision for the DRT. Transportation System Option 5A-2 is recommended to be carried forward for further study, as it includes the most reasonable operational assumptions (transfer penalties at all three major transfer points), even though it does not perform as well as Option 4B (Figure 42).

Figure 42 - Summary Evaluation of Transportation System Option 5 (Compared to Option 4B)

8.4.3  Option 6 Theme – New Tunnel Under / Near Existing Union Station

Transportation System Option 6 reflects the provision of either a GO tunnel interfacing with Osgoode and Queen Subway stations (Option 6A) or a GO tunnel under existing Union Station (Option 6B). This option also includes a potential new GO Station located east of existing Union Station. The GO tunnels would provide service for interconnection of Lakeshore West and Lakeshore East GO services. Option 6B meets most of the evaluation criterion objectives for four criteria, whereas Option 6A fails to meet many of the evaluation criterion objectives.

Based on the evaluation ranking summary presented in Figure 43, Transportation System Option 6B is recommended to be carried forward for further study.
Figure 43 - Summary Evaluation of Transportation System Option 6 (Compared to Options 4 and 5)
Final Network Assessment

9.1 Overview
The Transportation System Option Evaluation process identified that the following system options be carried forward for further analysis:

- Transportation System Option 4B;
- Transportation System Option 5A-2; and,
- Transportation System Option 6B.

This section provides an overview of the extent to which each option reduces 2031 GO passenger loads at Union Station, discusses engineering feasibility and operational concepts, and identifies the Transportation System Options recommended for further study by Metrolinx.

9.2 Transportation System Option 4B
The 2031 a.m. peak period passenger demand analysis indicates that Transportation System Option 4B would offload upwards of 52,000 GO Rail passengers from Union Station at Bathurst North Yard Station. This station is integral to Option 4B as it allows the GO Georgetown, Barrie and Bolton Rail services to be short turned at this location. GO passengers will then either transfer to the proposed Downtown Rapid Transit (DRT) Line or walk to their destination from the Bathurst North Yard potentially through an extended PATH system.

9.2.1 Bathurst North Yard Station
An initial feasibility review of Transportation System Option 4B operations indicates that although there are eight tracks in the corridor approaching the Bathurst North Yard, there is not sufficient property at the Bathurst North Yard to enable four train services to be terminated at this location. It is also important to note that the Strachan Street subway is presently under design and construction to accommodate eight tracks and therefore this subway defines the ultimate number of rail tracks in this corridor.

The GO Barrie, Bolton and Georgetown services are operated on the north side of the corridor and are best suited to enter and be short turned at this terminus. From an operations perspective, these GO services can return to their outer destinations without crossing over other train services and thus will not impact track capacity.
The location of the Milton GO service tracks requires Milton GO service to cross over all the other tracks entering the Bathurst North Yard Station. This track crossover situation would significantly reduce track capacity. Therefore, the track alignment suggests that Milton GO Service is better suited to terminate at Union Station.

The Airport Rail Link (ARL) has been planned to operate on the north side of Union Station and therefore will continue to terminate at Union Station. Similarly, it is assumed that VIA service would continue to terminate at Union Station as part of Transportation System Option 4B.

An overview of the Bathurst North Yard Station track layout is presented in Figure 44, with a concept rendering of the Bathurst North Yard Station interfacing with the DRT presented in Figure 45.

Figure 44 - Bathurst North Station Track Layout

Source: AECOM
9.2.2 Exhibition GO Station / DRT Interface

In conjunction with a Bathurst North Yard Station interfacing with the proposed DRT, Option 4B provides for the DRT to continue west, terminating at Exhibition GO Station. Extending the DRT to Exhibition GO Station provides an opportunity for some Lakeshore West GO passengers to transfer to the DRT service, further reducing passenger volumes at Union Station and providing an alternative to Union Station for Lakeshore West GO passengers in the event of operational / maintenance issues.

9.2.3 Richmond Hill GO Station / DRT Interface

The Richmond Hill GO line does not have sufficient corridor right-of-way to provide new station platforms in the location where the Richmond Hill GO Station interfaces with the proposed DRT.

A feasibility review of the proposed Richmond Hill GO Station interfacing with the DRT suggests significant corridor right-of-way constraints as a typical GO station.
platform cannot be constructed within the existing corridor. It might be possible, however, to provide two side platforms, 16 feet wide, on either side of the corridor, assuming the necessary land can be acquired. Station integration with the DRT would have to be provided vertically between the rail corridor and DRT corridor below.

9.2.4 Summary of Transportation System Option 4B Analysis

Transportation System Option 4B, in addition to offloading a significant number of GO rail passengers from Union Station in year 2031, appears to be feasible based on a preliminary engineering and operational review. Thus Transportation System Option 4B is recommended to be carried forward by Metrolinx for more detailed planning and engineering studies.

9.3 Transportation System Option 5A-2

The 2031 a.m. peak period passenger demand analysis indicates that Transportation System Option 5A-2, utilizing a Queen Street tunnel, would offload upwards of 121,000 GO Rail passengers from Union Station. The Queen Street tunnel option assumes Express Rail service for the GO Milton, Georgetown, Barrie, Richmond Hill and Lakeshore East services.

9.3.1 Queen Street GO Tunnel

A tunnel located under Queen Street would ideally be designed to allow Express Rail service from the north-west (GO Milton and Georgetown lines), north-east (Richmond Hill GO) and the east (Lakeshore East GO) corridors to operate underground with connections to the University Subway Line (Osgoode Station) and the Yonge Subway Line (Queen Station).

An engineering feasibility review indicates that at the west side of the Queen Street tunnel, the tunnel portal could start between Lansdowne Avenue and Queen Street. Once underground, the tunnel would curve back to the Queen Street alignment. Although the current track alignments suggest that there would be considerable difficulties enabling the Barrie GO service to access the tunnel, it is assumed that these alignment issues might be addressed with further engineering studies.

The required width of the Queen Street tunnel depends on the type of train service being provided. If full GO service were provided for each corridor, a minimum of two tracks would be required for each service. If the future GO service interlines the Milton and Georgetown GO Lines with Lakeshore East GO Line, and interlines the Barrie GO Line with the Richmond Hill GO Line service, then a total of six tracks would be required. Station platforms would be required in the vicinity of subway interface stations located at Osgoode Station and Queen Station.
The Lakeshore East GO Rail service would most likely enter the tunnel portal between the Dundas Street and Queen Street subway bridges. It is important to note that starting the tunnel portal between Dundas Street and Queen Street significantly impacts five subway road bridges between Pape Avenue and Queen Street.

The Richmond Hill GO Line is currently located under Queen Street and therefore could enter through a tunnel under Queen Street, with track alignment changes.

9.3.2 Summary of Transportation System Option 5A-2
Transportation System Option 5A-2 offloads a significant number of GO rail passengers from Union Station. However, the engineering feasibility review indicates that there are significant engineering challenges to be addressed with the proposed tunnel design including:

- The depth and width of tunnel;
- Location of tunnel portals and track alignments;
- GO rail track alignment into tunnel, including Barrie GO service;
- Station design interface with University and Yonge Subway Lines; and,
- Tunnelling impacts associated with Lakeshore East GO Service, especially related to roadways, the Don Valley Parkway and Don River.

Based on the engineering feasibility review, construction and operational issues, and high capital cost constraints noted in the evaluation process, it is recommended that Transportation System Option 5A-2 not be carried forward for further study by Metrolinx. While Option 5A-2 succeeds in diverting the largest number of passengers from Union Station in 2031, to the extent that 2031 Union Station demands would be lower than today, this is not seen as justifying further consideration of this option.

9.4 Transportation System Option 6B
The 2031 a.m. peak period passenger demand analysis indicates that Transportation System Option 6B, utilizing a GO rail tunnel under Union Station, including a new GO station located near Yonge Street, would offload upwards of 59,000 GO Rail passengers from Union Station. The new tunnel assumes that only interlined Lakeshore West and Lakeshore East GO services would use the tunnel and GO rail passengers would be discharged at the new GO Station located near Yonge Street.

9.4.1 New GO Tunnel and New Station
The proposed GO rail tunnel located underneath existing Union Station would generally extend from Bathurst Street to Cherry Street, a distance of approximately 2.3 miles (3.7 km). The proposed tunnel could provide upwards of three approach tracks to the new station and upwards of four tracks at the station platform.
The engineering feasibility review indicates that the location of the tunnel portals and entrance grades at each end of the tunnel would be important in developing the shortest tunnel, while also clearing existing Union Station and TTC LRT structures and reducing impacts to existing subway roads.

At the west end of the tunnel, the following specific engineering challenges need to be addressed in providing the new GO tunnel:

- The existing corridor is full at the John Street roadway subway; and,
- There is rail over rail grade separation located in the middle of the rail corridor east of Bathurst Street.

The new GO Station located in the vicinity of Yonge Street would have pedestrian links to the existing Union Station as well as links and access to the existing on-street pedestrian network and possibly to an expanded PATH network, linking to the existing PATH system and TTC services.

An overview of the new rail tunnel and its interface with the new GO station is presented in Figure 46.

**Summary of Transportation System Option 6B**

Transportation System Option 6B, in addition to offloading a significant number of GO rail passengers from Union Station, is feasible based on a preliminary engineering and operational review. Thus, Option 6B is recommended to be carried forward by Metrolinx for more detailed planning and engineering studies following the completion of the Union Station 2031 Demands and Opportunities Study.
Figure 46 – New GO Station and Possible Station Access

A. LOCATION PLAN

B. DETAILED TRAINSHED/GO TUNNEL VIEW
10 Findings/Conclusions and Recommendations

10.1 Overview of Problem – Future Union Station Demand Levels

The revised 2031 a.m. peak period Base demand model forecast for GO Rail passenger demand at Union Station suggests that the station will have to accommodate approximately 140,000 peak direction GO patrons in the a.m. peak period by 2031 (in 20 years). This volume (139,300 alighting passengers) is more than double 2006 demand but less than the three to four times growth suggested in earlier RTP forecasts. The forecast of inbound GO Rail traffic disembarking at the station is estimated to be 2.3 times the a.m. inbound volume carried in 2006 (60,000). This indicates less of a capacity problem at Union Station by 2031 than initially predicted, however, the region will continue to grow post 2031 and relief will eventually be required.

The Union Station Base forecast was prepared following a detailed review of earlier Metrolinx forecasts, including accounting for through travel on the GO system in order to isolate only those riders who would actually disembark at the station.14 Two “benchmarking” exercises were carried out to validate the model based forecasts by preparing independent estimates developed using GO Rail Passenger Count and Transportation Tomorrow Survey trend data, as documented in Section 4.15

The base demand forecasts produced as part of this study suggest that peak direction demands at Union Station can be expected to slightly more than double by 2031. Based on the interim findings of the USRC Track Capacity Study, it appears that the recent and planned improvements to GO Rail infrastructure and operations will double the number of peak hour train movements to/from Union Station. Therefore, GO Transit should be able to accommodate projected peak direction (inbound a.m.) passenger demands to Union Station by 2031 (for the next 20 years). However, the Base demand model forecasts also suggest that GO Rail a.m. outbound ridership from Union Station (“counter-peak” direction traffic) will

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14 The GGH model outputs assume that all patrons passing through Union station actually transfer at the station, rather than being “through routed”.

15 Benchmarking exercises were carried out assuming both the continuation of recent trends in GO ridership growth by corridor and estimates of total downtown travel increases and the maximum potential increases in total transit market shares and GO to total transit shares, based on trends in these indicators.
increase from less than 1,000 passengers in the peak period to more than 13,000 by 2031. This growth of counter-peak travel demands in association with two-way passenger traffic to and from Union Station GO platforms over the next 20 years can be expected to have serious implications for the functioning and capacity of stair-cases and passageways prior to 2031.

The forecasts of peak and off-peak direction travel demands imply substantial increases in crowding and reductions in service levels. This creates pedestrian congestion, which affects patrons both within the station and on the trains, including platforms, stairs, and passageways leading to/from platforms (as seen at Bloor-Yonge Station with the TTC Subway).

10.2 Alternative Options to Offload 2031 Passenger Demands at Union Station

Alternative Transportation System Option themes were developed to reduce or “offload” the projected 2031 Union Station a.m. peak period GO passenger demands at Union Station including:

- **Transportation System Option 1**
  - Improved integration between GO Rail and TTC Rapid Transit services at existing and committed rail / subway interchange stations. This concept assumed the planned development of a mobility hub at Dundas West/Bloor Station, and improvements to existing transfer facilities at other locations, such as at Main/Danforth.

- **Transportation System Option 2**
  - Consideration of Satellite GO Station opportunities at Liberty Village and Cherry Street.

- **Transportation System Option 3**
  - Utilization of the CP North Toronto Subdivision corridor with new GO stations interfacing with the Dupont and Summerhill Subway Stations.

- **Transportation System Option 4**
  - GO Rail services integration with the proposed Downtown Rapid Transit (DRT) Line at key locations. Two sub options were developed. Option 4A reflects GO station integration with DRT stations. Option 4B reflects a new GO station at the Bathurst North Yard, integrated with the DRT and the short turning of GO Georgetown and Barrie services.

- **Transportation System Option 5**
  - New GO CBD Tunnel located in the Queen Street and/or King Street corridor (in place of the DRT) and serving stations on the Yonge-University-Spadina subway lines.
Transportation System Option 6

- Development of a shorter tunnel to carry Lakeshore GO Rail patrons to integrated GO/TTC stations on the Yonge-University-Spadina Subway lines north of Union Station.

Prior to undertaking detailed travel demand analysis, a preliminary long list of Transportation System Option Themes was reviewed in the context of Metrolinx, TTC and City of Toronto studies being undertaken concurrently with the Union Station 2031 Demands and Opportunities Study. In order to understand the range of implications associated with the policy and physical infrastructure improvements of the initial transportation system options, a workshop was held with a wide range of transportation and planning agencies on Wednesday September 20, 2010, as documented in Section 6.2.

The workshop provided the team with an opportunity to review the historical facts and trends, documented in Section 3 of the study, as well as the lessons learned from the case studies carried out as part of the Precedent Analysis, documented in Section 4. The workshop also reviewed the local planning context considering the findings of recent and/or ongoing studies being carried out by Metrolinx/GO Transit, TTC and the City of Toronto.

The workshop was the first stage of a three stage process of Transportation System Option development, refinement and evaluation, and it provided useful insights into the potential advantages and disadvantages of each option, which guided the rest of the option development and evaluation process. Section 6.3, Summary of Workshop Discussion, provides an overview of the results of the workshop discussions, including comments on each of the options presented that were then incorporated into the next stages of the evaluation process.

In addition, the Workshop raised general issues/concerns for consideration in subsequent analysis stages, including:

- Fare integration must be part of the solution in order for passengers to use alternative transit services (e.g., transfer from GO to TTC).
- The last few hundred meters of walking distance to the final destination has an impact on transit choices, thus location of new GO stations must be in close proximity to existing and planned major employment centres.
- Satellite stations can only effectively off-load Union Station if GO Train services can be short turned at these locations, there is frequent GO service,
and if there is frequent high capacity transit service connecting the satellite GO stations to the primary employment areas in the Central Business District.

- Most major international centres, comparable in size with the City of Toronto, have more than one major transit interchange station to provide efficient transit passenger accessibility and transit system flexibility.

Following the workshop, an additional Option (6B) was added to the Transportation System Option 6 Theme, which assumes a GO Rail tunnel would be constructed under Union Station with the addition of a new underground station immediately east of Union Station.

10.3 Screening Evaluation of Base Transportation System Options

The second stage of Transportation System Option development included a high level screening evaluation process (See Section 8). The screening evaluation process was designed to identify a short-list of Transportation System Options for detailed analysis and considered the following “primary evaluation criteria”:

- Ability to off-load Union Station,
- Ability to serve GO Rail Market/PD1 Employment Growth Area
- Ability to integrate with TTC service and address TTC concerns, and,
- Other related comments/issues (to capture broader concerns raised at the workshop).

This screening assessment resulted in a recommendation that Transportation System Options 2 and 3 not be carried forward for detailed analysis and that System Option 1 be included as part of all other Transportation System Option Themes.

Transportation System Option Themes 4, 5 and 6 were identified as appropriate to be carried forward for a detailed system evaluation.

10.3.2 Option 1 – GO TTC Station Integration

It was determined that the improvements identified in Transportation System Option 1 should be included in all subsequent options, as these elements were viewed as positive and more or less committed in The Big Move. Therefore, Option 1 was not further evaluated. Both the Precedent Analysis (Section 5) and the analysis of alternatives indicated that improved physical integration of GO Rail and TTC Subway systems would improve connectivity, consequently reducing travel times and offering other service benefits to the public. However, on their own, the specific improvements identified would not significantly reduce demands at Union Station.
10.3.3 **Option 2 – Satellite Stations**

Transportation System Option 2 was not carried forward, as the satellite station options at Liberty Village and Cherry Street do not effectively serve future GO Rail passenger employment destinations and current GO patrons. This Option Theme also includes planning, property and infrastructure issues that limit the effectiveness of the proposed satellite stations.

It was noted during the workshop discussions that Transportation System Option 2 could provide potential interim improvements prior to the implementation of any longer term Transportation System Option improvements. The concept of the Satellite Station was retained as part of a variation on Transportation System Option 4, discussed in Section 8 and specifically related to the Bathurst North Yard.

Also, although a Cherry Street satellite station is not part of Transportation System Option 4, transit access to the Cherry Street (East Bayfront) area could potentially be accommodated with the construction of a new station that integrates service between the Richmond Hill GO Line and the proposed DRT line in the Queen Street / King Street corridor.

10.3.4 **Option 3 – North Toronto Sub – Summerhill Station**

Transportation System Option 3, with proposed GO service on the Toronto North corridor and connection to the Dupont and Summerhill subway stations, does not address the Union Station passenger loading issue and was therefore not carried forward for further evaluation.

10.3.5 **Option 4 – GO/DRT Integration**

Transportation System Option 4, which includes GO service connecting to the Downtown Rapid Transit (DRT) Line, was carried forward for more detailed evaluation analysis. This option addresses the following primary evaluation criteria:

- Effective in off-loading passengers from Union Station;
- Serves the GO Rail Market / PD1 Employment Growth Area;
- Meets The Big Move Vision with provision of Express Rail service; and,
- Integrates with TTC services.

10.3.6 **Option 5 – GO CBD Tunnel (Queen Street)**

Transportation System Option 5, which provides for a new GO tunnel under Queen Street and potentially allows Milton and Georgetown GO services to connect with the Lakeshore East and Richmond Hill GO services (including station interface with the University-Yonge-Spadina subway lines), was carried forward for
more detailed evaluation analysis as this option addresses the primary evaluation criteria:

- Effective in off-loading passengers from Union Station;
- Located in the heart of the GO Rail Market / PD1 Employment Growth Area;
- Meets The Big Move Vision with provision of Express Rail service; and,
- Provides direct integration with TTC stations and services.

10.3.7 **Option 6 – Lakeshore East and West Tunnel and Station**

Transportation System Option 6, which provides for either a new tunnel connecting to Osgoode and Queen subway stations or a new GO tunnel under existing Union Station connected to a new GO Station east of existing Union Station, was carried forward for more detailed evaluation analysis as this Option Theme addresses the following primary evaluation criteria:

- Effective in off-loading passengers from Union Station;
- Located at southerly edge of the GO Rail Market / PD1 Employment Growth Area;
- Generally supports The Big Move Vision with provision of Express Rail service; and,
- Provides indirect integration with TTC stations and services.

10.4 **Transportation System Options Evaluation**

The third stage of the Transportation System Option development included a detailed evaluation of the following three options:

- GO / DRT Integration,
- GO CBD Tunnel – Queen Street Corridor; and,
- Lakeshore East and West Tunnel and Second Terminal directly east of Union Station.

Within each of these transportation system options, sub-options were developed and reviewed to assess specific issues raised at the Workshop, to address impacts of additional stations on selected Subway lines and to address transfer distance between GO and TTC stations.
The evaluation framework was structured to undertake a comprehensive analysis of each Transportation System Option by measuring how they address the following evaluation criteria:

- Ability to Off-Load Union Station Passenger Demands;
- Ability to Serve the GO Rail Market/ PD 1 Employment Area;
- Ability to Integrate New TTC Subway Services, providing System Flexibility and Redundancy;
- Consistency with GO 2020 Plan;
- Ease of Interagency Coordination and Approvals;
- Ability to Promote New Development;
- Magnitude of Construction Issues;
- GO / DRT Capital Costs;
- Risk / Sphere of Influence Control; and,
- Ability to maintain Reasonable Passenger Flows on the Subway.

10.4.1 Transportation System Options Evaluation Summary

10.4.1.1 Option 4 Theme - (GO/DRT Integration)
The Option 4 Theme reflects GO/DRT integration and consists of the following three alternatives:

- Option 4A-1 includes the full DRT from Bloor/Dundas West to Pape Avenue;
- Option 4A-2 includes the full DRT from Bloor/Dundas West to Pape Avenue with additional stops on the DRT; and,
- Option 4B includes the central and east DRT sections connected to a Bathurst North Yard where the GO Georgetown, Barrie and Bolton GO Lines would be short-turned, requiring all GO Rail passengers from these lines to alight at the Bathurst North Yard Station.

The detailed evaluation of the Option 4 theme reveals that option 4B has the highest evaluation score for the theme sub-option, and therefore best meets the majority of evaluation criterion objectives.

Based on the evaluation ranking, it was recommended that Transportation System Option 4B be carried forward for further network assessment.
**10.4.1.2 Option 5 Theme – Queen Street GO Tunnel**

The Option 5 Theme reflects the provision of a GO tunnel located under Queen Street with GO Stations integrated with Osgoode (University Subway) and Queen Subway Stations (Yonge Subway). This transportation system option theme assumes that electric-powered locomotives, or EMUs, would be utilized within the tunnel and that service would be continuous for Express Rail lines (Milton, Georgetown, Richmond Hill, and Lakeshore East GO Lines) with travel speeds similar to a subway within the tunnel. Regional Rail Service would continue to Union Station, but passengers would be able to transfer to Express Rail service at the Queen Street Tunnel. The Barrie GO service would not permit transfers at the Queen Street Tunnel due to alignment constraints.

The Transportation System Option 5 Theme reflects the provision of a Queen Street tunnel serving Milton, Georgetown, Richmond Hill, and Lakeshore East GO services with no provision for the DRT.

*Based on the evaluation ranking, it was recommended that Transportation System Option 5A-2 be carried forward for further network assessment.*

**10.4.1.3 Option 6 Theme – New Tunnel Under / Near Existing Union Station**

The Option 6 Theme builds on maintaining service to the existing employment areas serviced by GO, with the provision of a new GO Tunnel that would allow for continuous Lakeshore West and East GO services. The two options considered are:

- Option 6A - Lakeshore East and West GO Services are placed are tunnelled underground as they approach Union Station, with the tunnel interfacing with Osgoode Station on the University Subway Line and Queen Street on the Yonge Subway Line.

- Option 6B - Lakeshore East and West GO Services are tunnelled underground as they approach Union Station and interfacing with a new underground GO station located to the east of Union Station.

The proposed GO tunnels would provide for the interconnection of Lakeshore West and Lakeshore East GO services. Option 6B better meets most of the evaluation criterion objectives when compared to Option 6A.

*Based on the evaluation ranking, it was recommended that Transportation System Option 6B be carried forward for further network assessment.*
10.5 Final Network Assessment

The Transportation System Option Evaluation process identified that the following system options be carried forward for further analysis:

- Transportation System Option 4B,
- Transportation System Option 5A-2, and,
- Transportation System Option 6B.

In relation to the system options noted above, this section provides an overview of the extent the Transportation System Option reduces 2031 GO passenger loads at Union Station, discusses engineering feasibility and operational concepts, and also identifies the Transportation System Options recommended for further study by Metrolinx.

10.5.1 Transportation System Option 4B

The 2031 a.m. peak period passenger demand analysis indicates that Transportation System Option 4B would off-load upwards of 52,000 GO Rail passengers from Union Station. A Bathurst North Yard Station is integral to Option 4B, as the station allows the GO Georgetown, Barrie and Bolton Rail services to be short turned. GO passengers can either transfer to the proposed Downtown Rapid Transit (DRT) Line or walk to their destination from the Bathurst North Yard. Due to track alignment issues, the Milton GO service would continue to Union Station. The initial network feasibility review did not identify any major engineering challenges for Option 4B.

10.5.1.1 Summary of Transportation System Option 4B Analysis

Transportation System Option 4B, in addition to off-loading a significant number of GO rail passengers from Union Station in 2031, appears to be feasible to implement based on a preliminary engineering and operational review. Thus, it is recommended that Transportation System Option 4B be carried forward by Metrolinx for more detailed planning and engineering studies following completion of the Union Station 2031 Demands and Opportunities Study.

10.5.2 Transportation System Option 5A-2

The 2031 a.m. peak period passenger demand analysis indicates that Transportation System Option 5A-2, utilizing a Queen Street tunnel, would off-load upwards of 121,000 GO Rail passengers from Union Station. The Queen Street tunnel option assumes Express Rail service for the GO Milton, Georgetown, Richmond Hill and Lakeshore East Regional Rail services. The engineering feasibility review, however, indicates that there are significant engineering challenges to be addressed with the proposed tunnel design, including:
The depth and width of tunnel;

- Location of tunnel portals and track alignments;

- GO rail track alignment into tunnel, including Barrie GO service;

- Station design interface with University Subway and Yonge Subway; and,

- Tunnelling impacts associated with Lakeshore East GO Service, especially related to roadways, the Don Valley Parkway and the Don River.

### 10.5.2.1 Summary of Transportation System Option 5A-2

Although Transportation System Option 5A-2 off-loads a significant number of GO rail passengers from Union Station, the engineering feasibility review noted significant engineering and tunnelling design challenges and related issues, including difficult construction issues, operational concerns and high capital cost constraints. Therefore, it is recommended that Transportation System Option 5A-2 not be carried forward for further study by Metrolinx.

### 10.5.3 Transportation System Option 6B

The 2031 a.m. peak period passenger demand analysis indicates that Transportation System Option 6B, utilizing a GO rail tunnel under Union Station, including a new GO station located near Yonge Street, would off-load upwards of 59,000 GO Rail passengers from Union Station. The new tunnel assumes that only interlined Lakeshore West and Lakeshore East GO services would use the tunnel and GO rail passengers would be discharged at the new GO Station located near Yonge Street.

### 10.5.3.1 Summary of Transportation System Option 6B

Transportation System Option 6B, in addition to off-loading a significant number of GO Rail passengers from Union Station, appears to be feasible from a preliminary engineering and operational review. Thus it is recommended that Option 6B be carried forward by Metrolinx for more detailed planning and engineering studies following the completion of the Union Station 2031 Demands and Opportunities Study.

### 10.6 Next Steps

The Union Station 2031 Demands and Opportunities Study provided the planning review and analysis base necessary to be able to recommend that Transportation System Options 4B and 6B be carried forward for further study, including an Engineering Overview Study followed by a business case, Environmental Assessment and Preliminary Design Study. The following discussion provides an overview of the range of issues to be reviewed as part of these studies.
10.6.1  
**Transportation Demand Analysis Refresh**

As noted in Section 5.5, additional analyses beyond this study will be required to assess the effect of each of the short listed rapid transit service options on trip distribution patterns and total transit use, given that the various options will affect the relative attractiveness of transit and might be expected to influence overall trip distribution patterns (and total transit ridership).

It is therefore recommended that the full GGHM model be re-run for Transportation System Options 4B and 6B to assess the extent to which each option would influence total demand levels and total transit ridership.

10.6.2  
**Engineering Overview Study**

The Engineering Overview Study would review specific implementation issues including a range of impacts, risks and cost estimates for Transportation System Options 4B and 6B. The purpose of the Engineering Overview Study would be to document engineering and planning details, as well as provide a better understanding for each Transportation System Option, including the operating plan, engineering and property details such as defining route alignment, station locations, preliminary geotechnical review, construction costs, implementation timing, property and real estate issues.

The final Engineering Overview Report would provide Metrolinx with a level of detail that would allow for further discussions with the City of Toronto and TTC, in order to quantify potential benefits and implementation strategies of each of the Transportation System Options.

The tasks that would form the Engineering Overview Study include the following:

- **Route alignment**
  - Review tunnel alignment and track design issues.
  - Assess probable locations for portals to the tunnel.
  - Develop Alignment profiles to avoid obstacles underground and around station sites.
  - Assess probable train service possibilities.

- **Station possibilities**
  - Develop a preferred set of station interfaces with the tunnel.
  - Determine depth of stations linked to other transit modes (DRT).
  - Develop platform and track layouts for stations.
  - Develop preliminary pedestrian linkages to existing transit systems.
Preliminary Geological understandings
- Research previously gathered geological information for length of tunnel.
- Determine tunnel construction capability based on geology information.
- Define probable construction issues based on geology information.

Obstructions/Obstacles along route
- Research underground utilities along or crossing tunnel route including pipes, wires, road subways, rivers, TTC crossings, other tunnels etc.
- Define depth of buildings and other structures that the tunnel passes beside or under

Real estate issues along the route
- Research land ownership and other pertinent details that could impact ability to install tunnel.

Potential Impacts to existing land use
- Research existing land use and known future plans.
- Communicate with Planning and Approval Agencies.

Possible potential benefits of alignment
- Engage stakeholders to identify community and transportation benefits of proposed GO services and stations.

10.6.3 Union Station / New Station Pedestrian Analysis
The 2031 a.m. peak period demand analysis indicates a significant increase in off-peak direction GO passenger usage. The increased off-peak direction flows are expected to have serious implications for the functionality of the platforms and the capacity of stair wells and passageways within existing Union Station and any new GO Station.

To address and confirm the nature, extent and timing of these impacts, a pedestrian flow study is required to ensure that existing Union Station and any new GO Station can efficiently accommodate the forecast pedestrian movements both within the stations and along the pedestrian passageways to TTC stations and major employment destinations.

It is of note that the City of Toronto has commissioned a study to assess pedestrian demands through Union Station (which focuses on earlier GO Rail forecasts of future peak direction demands) to explicitly include the expected growth of off-peak direction ridership on the GO system. This ongoing work should provide a starting point for Metrolinx's assessment of the implications of growing two directional
ridership at Union Station in the short (5 year), medium (10 year) and longer (20-25 year) term.

10.6.4 Environmental Assessment and Preliminary Design

The engineering details documented in the Engineering Overview Study would form the base to undertake an Environmental Assessment (EA) study that develops a preferred Transportation System Option based on a detailed evaluation process which identifies the environmental impacts of construction and future operations on the surrounding community. The Environmental Assessment study will provide, as well as garner, information to/from the general public, municipalities, and provincial agencies on the evaluation of alternatives and the selection of a preferred Transportation System Option.

A preliminary design report (PDR) would be prepared for the preferred Transportation System Option that details the main features of the preferred alignment, the GO / TTC integrated stations, and tunnel features where applicable. The PDR would include a preliminary estimate of construction and property costs for the preferred Transportation System Option. The cost estimates would represent a refinement of the cost estimates developed as part of the Engineering Overview Study, as project details identified during the Environmental Assessment process reflect the preliminary design.

The Environmental Assessment report would form the basis for defining the basic specifications for a detailed design and construct assignment that would follow a Ministry of the Environment approved Environmental Study Report (ESR).