### Re: EX16.1

### **Attachment 1**

SmartTrack/GO RER Integration Initial Business Case

Developing Toronto's Transit Network Plan to 2031 June 21, 2016

# INTEGRATED GO RER-SMARTTRACK OPTIONS

INITIAL BUSINESS CASE JUNE 2016



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### Glossary of Terms

| Appraisal                       | Analysis of a program, investment or intervention that has not yet been<br>implemented and focuses on estimated or forecasted evidence.  |
|---------------------------------|--|
| Benefits Case<br>Analyses (BCA) | Reports produced by Metrolinx between 2008 and 2012 focusing on select<br>economic impacts and financial costs of major proposed Metrolinx transit projects.<br>BCAs have subsequently been replaced by the new Business Case framework.   |
| Business Case                   | A suite of evidence on the potential strategic, economic, financial, deliverability<br>and operational impacts of a proposed program, intervention or investment to<br>inform decision-making throughout the project lifecycle. Metrolinx Business Cases<br>are an enhancement and replacement of Metrolinx's former Benefits Case<br>Analyses reports.  |
| Cost Benefit Analysis           | A form of evaluation that focuses on comparing certain economic impacts<br>(generally benefits) to the cost of an investment. Cost Benefit Analysis is used in<br>the Economic section of Metrolinx's Business Case framework and was also used<br>to inform previous Benefits Case Analyses.  |
| Economic Case                   | One component of the Metrolinx Business Case that examines or reviews the impacts of proposed investments or interventions. Economic impacts include transportation user benefits (journey time impacts, road decongestion impacts, safety/accident reductions, etc.), environmental impacts (changes in emissions levels, vibration, etc.), social and community impacts (the distribution of benefits among populations, severance/isolation impacts, etc.), wider economic benefits (agglomeration/productivity impacts, etc.) and public funding impacts (property tax revenues, etc.). The Economic Case generally includes a cost-benefit ratio. |
| Financial Case                  | One component of the Metrolinx Business Case that examines the lifecycle costs<br>and revenues of proposed investments or interventions.   |
| Delivery and<br>Operations Case | One component of a Metrolinx Business Case that examines the impacts of proposed investments or interventions on operations, the delivery of the proposal, potential risks, procurement and related commercial or management issues.   |
| Strategic Case                  | One component of a Metrolinx business case that examines the alignment of proposed programs, investments or interventions with strategic plans and goals. Involves the presentation of transportation planning information, including traffic forecasts, related travel patterns, drivers and interdependencies.   |

### Acronyms

| BCR    | Benefit cost ratio                               |
|--------|--|
| NPV    | Net Present Value                                |
| PV     | Present Value                                    |
| RTP    | Regional Transportation Plan, The Big Move, 2008 |
| GO RER | GO Regional Express Rail                         |
| TTS    | Transportation Tomorrow Survey                   |
| VKT    | Vehicle Kilometres Travelled                     |

### 1.0 EXECUTIVE SUMMARY

In 2015, the Province of Ontario committed funding of \$13.5 billion for extensive rail improvements through the GO Regional Express Rail (RER) program. Metrolinx is currently implementing the program, a change which will bring fast, two-way, all-day GO service to provincially owned rail corridors. Five GO corridors will be upgraded to RER service levels – 15 minutes (or better) service in both directions throughout the day. Trains will be electrified which shortens trip times by up to 20%. Implementing GO RER is expected to add 4,500 weekly train trips and increase GO ridership by 140% over the next fifteen years. GO ridership in 2014 was approximately 54 million annual trips. With the implementation of GO RER on five corridors, ridership is forecast to climb 140 percent to 127 million annual trips. This package of GO enhancements is a step-change for rail service in the Greater Toronto and Hamilton Area, transforming it from what is now largely a commuter service to a true regional rail system, comparable to similar systems in world-class cities across the globe. The full program of GO upgrades, including service, infrastructure, costs and benefits, is presented in the <u>GO RER Initial Business Case</u>.

All seven GO corridors run through the City of Toronto, stopping at 19 stations, and meeting at Union Station. As is evident in the map below, the GO corridors largely run through Etobicoke and Scarborough, providing downtown access opportunities to neighbourhoods located at a distance from the subway. By bringing fifteen minute two-way service to five of the GO corridors (highlighted in darker green on the map), GO RER will bring more flexible travel options for residents and jobs within the City and to the broader region.



#### Figure 1: GO Service in the City of Toronto

The GO RER program, and particularly plans for GO RER within the City of Toronto, sets the context for SmartTrack. SmartTrack proposes utilizing the GO network to provide a more urban transit service than originally contemplated with GO RER. In February 2015, Toronto City Council directed the City Manager to carry out a SmartTrack workplan and requested that Metrolinx include a number of SmartTrack elements in GO RER. SmartTrack includes a number of components including new stations, TTC fares, TTC service integration, frequency improvements on the Kitchener and Stouffville corridors, as well as an LRT along Eglinton Avenue West to the Mississauga Airport Corporate Centre and Pearson Airport.

The SmartTrack proposal triggered more intensive consideration of the potential for GO expansion within Toronto to improve access for residents and greater connectivity of the transit networks. Metrolinx and the City of Toronto are working closely together to advance options that integrate GO RER and SmartTrack. These options leverage planned GO RER investments to deliver additional new riders and added benefits, particularly in Toronto. Separate RER and SmartTrack concepts were deemed too infrastructure intensive and costly as well as a duplication of service and are not being considered further. In March 2016, City Council endorsed focusing analysis on two integrated RER-SmartTrack options, proposing either four to five new stations or seven to eight new stations.

This document presents a plan for integrating GO RER and SmartTrack and provides the business case evidence in support of that plan.



Figure 2: Illustration of the Integrated GO RER-SmartTrack Geography

The GO RER-SmartTrack Initial Business Case analyzes four options for integrating the SmartTrack proposal with the committed GO RER program on the Kitchener and Stouffville corridors.

- Option A: Increased frequencies, 5 new stations
- Option B: Express and local service, 8 new stations
- Option C: Committed RER frequencies, 7-8 new stations
- Option D: Committed RER frequencies, 4-5 new stations

Each of these options assumes an optimized LRT on Eglinton Avenue West. A separate business case process has been undertaken to assess the Eglinton West LRT.

This GO RER-SmartTrack Initial Business Case builds on and expands the analysis completed for the GO RER Initial Business Case in order to determine the impact of SmartTrack on the RER benefits and costs. The RER Initial Business Case analysis is premised on the current fare structure, including existing GO fare structure for GO RER service, TTC fares, and existing transfer policy. The GTHA Fare Integration Strategy will serve as a vehicle for rationalizing GO and TTC Fares and transfer policy as well as address other fare issues across the region. In the absence of a complete and comprehensive regional fare integration strategy, the analysis in this report assumed the existing fare structure as an input. The City of Toronto has conducted analysis assuming TTC fares which is presented in Appendix C of this document.

GO RER is expected to utilize the available and planned track and corridor capacity. In this light, integrated GO RER-SmartTrack options were screened to determine the extent of additional infrastructure that they would require over and above that which is required for GO RER. Through this analysis, it was determined that Options A and B would each require extensive additional track infrastructure, resulting in the need for corridor widening, property acquisition, consequent community impacts, and other deliverability challenges. In light of these findings, Options A and B were screened out and detailed analysis focused on Options C and D.

Strategic Case analysis suggests that GO RER will go a long way towards growing the attractiveness of GO rail as a travel option for Torontonians. Over and above RER, both Options C and D achieve the central objectives of integrating GO RER and SmartTrack in terms of improving access to GO within the City of Toronto. Both options increase ridership about nine to ten percent above GO RER. Because Option C includes more new stations than Option D, it goes further in increasing transit accessibility within Toronto but also lengthens travel times for medium and long distance passengers and imposes greater negative travel time impacts in comparison to Option D.

In terms of the Financial Case, Options C and D are relatively similar in terms of financial performance and affordability. Option C is slightly more expensive to both build and operate, compared to Option D, but the difference is marginal in the context of the larger GO RER infrastructure costs. It should be noted that capital cost estimates are preliminary and may not reflect the full costs of associated structure works required to deliver the stations or comprehensive fleet costs, depending on ongoing operational analysis.

Economic Analysis measures the costs and benefits of a project including benefits such as travel time savings and congestion relief. This lens of analysis monetizes those benefits and then compares them to costs to provide one indication of the extent to which a project is a worthwhile investment. For the GO RER Kitchener and Stouffville corridors benefits such as the dollar value of travel time savings exceed the capital and operating costs by a ratio of approximately 2:1. Economic analysis of the integrated options in the context of the overall analysis suggests that Option C would have a negative impact on the overall GO RER benefit-cost ratio, bringing about a decrease of approximately thirty percent while Option D would have a smaller negative impact, decreasing the GO RER benefit-cost ratio by approximately 18 percent. This suggests that Option D performs better than Option C from an economic perspective.

In summary, based on the full business case analysis, Option D is the best performing option for SmartTrack and GO RER integration. There are a number of next steps required to more fully understand the options. The final number of new stations and their locations are being determined through the outcomes of the new stations analysis. The GTHA Fare Integration Strategy is progressing and learnings from that analysis will need to be incorporated into this work, in particular to understand the impacts of fare integration on ridership. Finally, the construction program to deliver GO RER electrification and service levels is extremely aggressive and it will be important to understand how these options might impact RER delivery.

|   | Option A:                                | Option B:                                    | Option C:  | Option D:   |
|---|--|--|--|---|
| Indicator   | Increased Frequencies, 5<br>new stations | Express and local service,<br>8 new stations | Committed<br>RER<br>Frequencies, 7<br>-8 new<br>stations | Committed RER<br>Frequencies, 4 -<br>5 new stations |
| Total Nominal<br>Capital Costs<br>(\$M 2014, costs<br>do not include<br>escalation,<br>financing costs,<br>lifecycle and<br>operating and<br>maintenance) | \$6,900-7,500                            | \$9,000 -10,600                              | \$1,100-1,700  | \$700 – 1,000                                       |
| Deliverability  | Screened Out - Extent of                 | Screened Out - Extent of                     | Deliverable  | Deliverable with                                    |
| Issues  | infrastructure                           | infrastructure                               | with a   | a minimum of  |
|   | requirements, need for                   | requirements, need for                       | minimum of   | new<br>infrastructure                               |
|   | property acquisition, and                | property acquisition, and                    | infrastructure   | mastructure   |
|   | community impacts is<br>unacceptable     | community impacts is<br>unacceptable         |  |   |

#### Table 1: Deliverability Screening Summary Table

#### Table 2: Business Case Summary Table

|                        | Base Case – GO RER,       | Option C:            | Option D:             |
|------------------------|---------------------------|----------------------|-----------------------|
| Indicator              | Kitchener and Stouffville | Committed RER        | Committed RER         |
| Indicator              |                           | Frequencies, 7-8 new | Frequencies, 4 -5 new |
|                        |                           | stations             | stations              |
| Fit with Strategic     | -                         | Builds on the GO RER | Builds on the GO RER  |
| Objectives             |                           | program to improve   | program to improve    |
|                        |                           | access to GO within  | access to GO within   |
|                        |                           | Toronto              | Toronto               |
| Ridership (annual)     | 28 million                | +2.4M                | +2.8M                 |
| Total Nominal Capital  |                           |                      |                       |
| Costs (\$M 2014, costs |                           |                      |                       |
| do not include         | \$3,600 (does not include |                      |                       |
| escalation, financing  | RFR system costs)         | +\$1,100-1,700       | +\$700 - 1,000        |
| costs, lifecycle and   |                           |                      |                       |
| operating and          |                           |                      |                       |
| maintenance)*          |                           |                      |                       |

| Nominal Annual<br>Operating Costs (\$M<br>2031) | \$140 | +\$8.7                | +\$5.3                |
|---|-------|-----------------------|-----------------------|
| Nominal Annual<br>Revenue (\$M 2031)            | \$210 | +\$11.8               | +\$15.1               |
| Cost Recovery Ratio<br>(2031)                   | 150%  | 149%                  | 155%                  |
| Net Benefits (\$M PV)                           | 4,100 | (\$1,100)             | (\$400)               |
| Impact to GO RER                                | -     | 31% decrease from 2.0 | 18% decrease from 2.0 |
| Kitchener-Stouffville<br>Benefit Cost Ratio     |       | to 1.37               | to 1.64               |

## 2.0 INTRODUCTION

Metrolinx and the City of Toronto have worked closely together to develop options for integrating GO RER and SmartTrack, conduct analysis of those options through the initial business case, and put forward a direction to proceed. GO RER is a committed \$13.5 billion program to expand GO service across the GTHA, including on the Kitchener and Stouffville corridors. SmartTrack proposes upgrading service on the Stouffville and Kitchener Corridors with new stations, TTC fares, TTC service integration, and increased frequency and a rapid transit option on the Eglinton West corridor. The SmartTrack proposal spurred further consideration of options to upgrade and intensify rail service within Toronto and the GO RER-SmartTrack Integration Initial Business Case will develop, present, and analyze these different options for integration. Options have been developed with regard to a number of policy objectives:

- Serving People choice, experience, social equity
- Strengthening Places shaping the City, healthy neighbourhoods, public health and environment
- Supporting Prosperity affordability and supporting growth



#### Figure 3: SmartTrack Geography in the Context of the Transit Network

This work will touch on a number of different aspects of GO RER-SmartTrack integration including rail service and infrastructure and new stations. Evaluation of the options will provide indications of their performance from deliverability, strategic, economic, and financial perspectives. The outcome of this work will be a preferred option supported by the evaluation.

Study Objectives

- Identify promising options for integrated GO RER-SmartTrack options
- Conduct an alternatives analysis and develop a business case on the integrated options
- Ensure ongoing delivery of the funded GO RER program
- Identify a preferred direction for GO RER-SmartTrack integration that provides benefits and is practically feasible
- Make the case for investment in the preferred option indicated by the study

This document will present an overview of the methodology used to develop and analyze options. It will then present a problem statement and go through each integrated GO RER-SmartTrack option. From there, the report will outline business case analysis for the options beginning with a deliverability screen and proceeding to strategic case analysis, economic case analysis, and financial case analysis.

## 3.0 METHODOLOGY

The approach to developing the plan for integrating GO RER and SmartTrack mirrors the approach to developing the full RER program. The work began with the establishing of the study objectives set out in Section 2.0. Based upon these objectives, as well as on a vision and problem statement, the four options were developed. These options were then tested through an analysis of the infrastructure required to build and operate each option. This analysis included developing a sample schedule and, using the station locations, track layouts, and train speeds, mapping out the different train trips and assessing whether the existing tracks were sufficient to accommodate the service or whether and where additional tracks might be required. Based on the results of this analysis, Options A and B were screened because of the extent of new infrastructure, beyond that which is already required for RER. The analysis largely confirmed that GO RER will utilize the majority of capacity on the rail corridors. A full business case was then developed to provide more evidence on how Options C and D perform in relation to the full GO RER program. That business case is presented in this document.

#### Figure 4: Integrated GO RER-SmartTrack Methodology



### 4.0 OPTIONS FOR INTEGRATED GO RER-SMARTTRACK

#### **Options Development**

The work to identify an option for integrating GO RER and SmartTrack has considered a number of elements:

- Service frequency on the Stouffville and Kitchener corridors
- New stations
- Kitchener and Stouffville through service

In developing the options, Metrolinx and the City of Toronto looked at the funded GO RER program as a starting point and worked to incorporate elements of the SmartTrack proposal. The GO RER service concept and infrastructure program was developed through an extensive iterative process of service assessment and capital and operating cost estimates to arrive at an optimal scenario. The SmartTrack proposal identifies an opportunity to further upgrade service on the Kitchener and Stouffville corridors within Toronto, going beyond the committed GO RER program. By highlighting ways that GO RER could better serve the mobility needs of the City of Toronto, the SmartTrack plan initiated a more thorough analysis of the potential to upgrade service and add new stations.

This analysis began with the development of different options to integrate GO RER and SmartTrack. These options attempt to balance improving service for Toronto residents with maintaining a high quality of service for longer-distance commuters. Adding new stations can boost ridership by enticing new passengers who either board or alight at a new station location, but it can also deter some existing riders because of the longer travel times associated with additional station stops. Achieving the optimal balance is a critical component of developing the integrated options.

Fare and service integration are important components of the SmartTrack proposal but are being explored through separate workstreams. As the GTHA Fare Integration Strategy progresses, outcomes will be incorporated into the analysis of RER-SmartTrack integration options. This analysis is premised on the existing fare structure.

#### **Options Summary**

This section describes five options for GO RER-SmartTrack integration.

#### Table 3: Integrated GO RER-SmartTrack Options

| Option   | Service on the Stouffville and Kitchener corridors  | New stations  |
|--|---|---|
| Committed GO RER                                     | <ul> <li>Peak         <ul> <li>6-10 minute service from Unionville – Union<br/>Station – Bramalea*</li> </ul> </li> <li>Off-peak         <ul> <li>15 minute service from Unionville – Union<br/>Station – Bramalea</li> <li>Stouffville and Kitchener service terminate at<br/>Union Station</li> </ul> </li> </ul> | Existing GO stations  |
| A. Increased<br>frequencies, 5 new<br>stations       | <ul> <li>Frequencies doubled from committed GO RER<br/>service concept (5 minute peak service, 7.5<br/>minute offpeak service)</li> <li>Kitchener and Stouffville service connected</li> </ul>  | <ul> <li>5 new stations on<br/>Kitchener, Lakeshore<br/>East and Stouffville</li> </ul> |
| B. Express and local service, 8 new stations         | <ul> <li>20 minute service for each of express service<br/>and local service (10 min combined service);<br/>Unionville – Union Station – Bramalea</li> <li>Kitchener and Stouffville service connected</li> </ul>   | <ul> <li>8 new stations on<br/>Kitchener, Lakeshore<br/>East and Stouffville</li> </ul> |
| C. Committed RER<br>frequencies, 7-8 new<br>stations | <ul> <li>Planned GO RER frequency in the peak</li> <li>Travel time increases for medium and long distance trips, due to new stations</li> <li>Kitchener and Stouffville service connected</li> </ul>  | • 7-8 new stations  |
| D. Committed RER<br>frequencies, 4-5 new<br>stations | <ul> <li>Planned GO RER frequency in the peak</li> <li>Slight travel time increases for medium and<br/>long distance trips</li> <li>Kitchener and Stouffville service connected</li> </ul>  | • 4-5 new stations  |

\* Peak headways are derived by summing all of the service planned for each corridor. For example, on the Stouffville corridor, in the peak period and direction, the service concept calls for 4 trips from Unionville to Union Station and 3 trips from Lincolnville to Union Station, resulting in a total of 7 trips in the peak hour, or roughly 8.5 minute service frequency.

#### **Committed GO RER Service Concept**

The GO RER program commits to electrification of the Stouffville corridor from Union Station to the end of the line, at Lincolnville and to electrification of the Kitchener corridor from Union Station to Bramalea. Electrified service is planned to run every 15 minutes, all day, from Unionville Station on the Stouffville corridor to Union Station and from Bramalea Station on the Kitchener corridor to Union Station.

Layered on top of this core service are longer distance services to Lincolnville and Kitchener. Service to and from Lincolnville is planned at every 20 minutes in the peak period and peak direction and every 60 minutes, bidirectional, in the offpeak. From Kitchener, 30 minute peak direction service is planned in the peak period as well as an additional 30 minute peak-direction service from Mt. Pleasant Station. In the offpeak, Mt. Pleasant will be served by 60 minute bidirectional service, continuing the midday service introduced in 2015. As well, UP Express will continue to provide bidirectional 15 minute service to between Weston, Bloor, and Union Stations which augments GO service.

#### A. Increased frequencies, 5 new stations

Option A focuses on achieving service frequencies significantly over and above what has been planned for GO improvements in both the peak and off-peak. This option would include a limited number of new stations, focusing on those which provide the most benefits.

#### Service summary

- 5 minute frequency in peak and 7.5 minute frequency in the off-peak (doubling GO RER service levels); Unionville Union Station Bramalea
- 5 new stations
  - Stations include Gerrard, Unilever, Bathurst-Spadina, Liberty Village, St. Clair West
- Kitchener and Stouffville through service



#### Figure 5: Option A

#### B. Express and local service, 8 new stations

Option B would change parts of the Kitchener, Lakeshore East, and Stouffville corridors into an express and local service pattern. Eight new stations would be added across those three corridors; express trips would bypass new stations, stopping at existing stations and local trips would stop at all stations including new and existing. This type of service split allows longer distance passengers

to continue to benefit from fast journey times, while also adding a finer-grained service to increase access along the route by adding stations in the City of Toronto. <u>Service summary</u>

- 20 minute frequency for each of express service and local service (10 min combined service); Unionville Union Station Bramalea
- Express service would stop only at existing GO stations; local service would stop at existing stations as well as new stations
- 8 new stations
  - Stations include Gerrard, Don Yard, Bathurst-Spadina, Liberty Village, St. Clair West, Lawrence, Ellesmere, and Finch
- Kitchener and Stouffville through service





#### C. Committed RER frequencies, 7-8 new stations

Option C would preserve the GO RER service concept as defined in the Initial Business Case and would integrate SmartTrack by adding seven to eight new stations, providing increased access to GO within Toronto. In the peak period, GO RER will already provide between five and ten minutes service frequencies between Unionville and Union Station and ten minute frequencies between Mt. Dennis and Union Station. Because of the added new stations, travel times would be increased by up to 35% for some passengers, with people boarding in Markham and Scarborough experiencing the largest percent changes to their journey times.

Service summary

- Greater access to rapid transit within the City of Toronto
- Longer travel times on the Stouffville and Kitchener corridor, due to new stations
- 7-8 new stations: Stations tested include Gerrard, Don Yard, Liberty Village, St. Clair West, Lawrence, Ellesmere, and Finch

• Kitchener and Stouffville through service through Union Station



#### Figure 7: Option C

#### D. Committed RER frequencies, 4-5 new stations

Option D would preserve the GO RER service concept as defined in the Initial Business Case and would integrate SmartTrack by adding four to five new stations, targeting the stations that appear most promising in terms of ridership and benefits. In the peak period, GO RER will already provide between five and ten minutes service frequencies between Unionville and Union Station and ten minute frequencies between Mt. Dennis and Union Station. This option would also include 4-5 new stations which would slightly increase travel times.

#### Service Summary

- Greater access to rapid transit within the City of Toronto
- Slightly longer travel times on the Stouffville and Kitchener corridor, due to new stations
- GO RER will already provide better than 15 minute service in the peak period and 15 minute service throughout the day
- 4 new stations, based on outcomes of the Metrolinx New Stations Analysis. Stations tested include Gerrard, Don Yard, Liberty Village, and St. Clair West
- Kitchener and Stouffville through service

#### Figure 8: Option D



## 5.0 DELIVERABILITY AND OPERATIONS

The deliverability and operations case speaks to the question of whether the options are achievable and documents the engineering and operational issues and challenges. This analysis assumes a baseline of the tracks, grade separations, and Union Station capacity that is required to operate GO RER service, already a significant expansion over today's infrastructure.

Early analysis, including sensitivity testing around train frequencies, suggests that planned GO RER service fully utilizes rail and corridor capacity and that some of the options would require significant infrastructure investments, including a number of new tracks and other infrastructure needs beyond the existing corridor right-of-way and with substantial property requirements and community impacts. As such, two options were screened out through the deliverability and operations case, and two options have been carried forward for full assessment through the other chapters of the business case.

SmartTrack provided an important impetus to further test the planned GO RER service concept and infrastructure to determine if any additional service increases would be possible given existing infrastructure. Ultimately, the analysis provides valuable additional understanding of the extent to which rail capacity is utilized by GO RER service levels.

#### 4.1 Deliverability and Operations Analysis Methodology

The deliverability and operations analysis was conducted by translating the different proposed service levels in each option into infrastructure needs and then assessing the significance of those infrastructure needs. There are several steps to this translation process.

- First, a sample time-table is created based on the proposed service level. For the integrated RER-SmartTrack options, it is important to note that these service levels were layered on top of planned RER service. On the Kitchener corridor, for example, this includes diesel express service from Kitchener and diesel all-stop service from Mt. Pleasant, as well as UP Express service.
- 2. Once a sample time table has been created, it is mapped out onto the track layout, using information about train speeds, station locations, and stopping time at stations. This creates a visual representation of points where, for example, two trains traveling in opposite directions might meet, or where a faster electric train might overtake a slower diesel train. At points where trains meet or cross, a separate track is required for each train to prevent service delay or collision. On corridors with relatively simple bidirectional service, this analysis typically yields requirements for two tracks but on corridors like Kitchener with multiple train technologies and speeds, local and express service, and bidirectional service, more than two tracks are likely required.
- 3. Track requirements for each option can then be compared with the number of tracks planned for GO RER and with the total right-of-way in each rail corridor. This determines

whether (a) a sufficient number of tracks is already planned as part of GO RER, or (b) there is available width in the corridor right-of-way to add additional tracks, beyond what is planned for GO RER. This process would also be applied to bridges and below-grade sections of track, to determine how intensive and disruptive constructing new infrastructure might be.

Further detail on this process is contained in Appendix A.

| Ta | able 4: | Deliverability | Screening | Summary |  |
|----|---------|----------------|-----------|---------|--|
| 0  |         |                |           |         |  |

| Option   | Status              |
|--|---------------------|
| A. Increased frequencies, 5 new stations       | Not Carried Forward |
| B. Express and local service, 8 new stations   | Not Carried Forward |
| C. Committed RER frequencies, 7-8 new stations | Carried Forward     |
| D. Committed RER frequencies, 4-5 new stations | Carried Forward     |

#### 4.1 Description of Screening Triggers

Screening triggers or fatal flaws are impacts considered to be significant enough to screen the option from further study and without identifiable solutions. This section describes screening triggers which were uncovered in early analysis of the options because of impacts to the Kitchener and Stouffville Corridors.

As part of the GO RER program, a fourth track will be constructed on the Kitchener corridor between Bramalea and Union Station which uses the available right-of-way within the corridor. The need to construct additional 5<sup>th</sup> or 5<sup>th</sup> and 6<sup>th</sup> tracks on the southern section of the corridor could likely not be accommodated within the right-of-way and would entail property acquisition affecting approximately 200 to 300 individual properties including commercial, industrial, and residential. It would also likely require rebuilding major infrastructure recently completed in the context of the Georgetown South project including the West Toronto Diamond and the Strachan Grade Separation. Those implications present substantial costs and community impacts and are considered fatal flaws. Options which trigger the need for any additional track on the Kitchener corridor have been screened out.

Like the Kitchener corridor, the double-tracking planned within the RER program will use the available right-of-way within the existing Stouffville corridor. The need for 3<sup>rd</sup> and 4th tracks on the Stouffville corridor would also likely trigger major property acquisition affecting approximately 600 to 700 individual properties including commercial, industrial, and residential to the extent that options which trigger the need for additional tracks were also screened out due to this "fatal flaw."

#### 4.2 Union Station

Currently, Union Station accommodates approximately 30 trains in the peak hour. In the context of the GO RER program, Union Station will be expanded to accommodate 45 to 50 trains in the peak hour which is sufficient to support the RER service concept, a massive step change in service. However, service levels beyond the committed GO RER program will require further investment in Union Station expansion, which would be costly.

#### 4.3 Detailed Option Specific Screening

The following table summarizes additional track requirements for each of the options. Further information on the operational analysis supporting these findings is provided in Appendix A.

| Table 5: | Track Requirements Summary |  |
|----------|----------------------------|--|
|          |                            |  |

|                             | N                    | Number of Tracks Required                                       |                    |  |
|-----------------------------|----------------------|---|--------------------|--|
|                             | Stouffville Corridor | Lakeshore East<br>Corridor (USRC to<br>Scarborough<br>Junction) | Kitchener Corridor |  |
| Current Number of Tracks    | 1                    | 3   | 3                  |  |
| (2016)                      |                      |   |                    |  |
| GO RER                      | 2                    | 4   | 4                  |  |
| Option A: Increased         | 2                    | 5   | 5 (USRC to Airport |  |
| frequencies, 5 new stations |                      |   | Spur)              |  |
| Option B: Express and local | 4                    | 5   | 6 (USRC to Airport |  |
| service, 8 new stations     |                      |   | Spur)              |  |
| Option C: Committed RER     | 2                    | 4   | 4                  |  |
| frequencies, 7-8 new        |                      |   |                    |  |
| stations                    |                      |   |                    |  |
| Option D: Committed RER     | 2                    | 4   | 4                  |  |
| frequencies, 4-5 new        |                      |   |                    |  |
| stations                    |                      |   |                    |  |

#### 4.4 Additional tracks on the Stouffville corridor:

In order to provide local and express service (Option B), two additional tracks are required on the Stouffville corridor, beyond what will be constructed for GO RER. As described in section 4.1, this was determined by mapping out the service and identifying locations where trains would meet or pass each other. Based on an analysis of the service associated with Option B, layered on top of planned GO RER service, there are a number of locations where four trains would be meeting or passing, meaning that four tracks would be required along the corridor from Scarborough Junction to Unionville. Because there is insufficient right-of-way in the existing corridor to construct two additional tracks, this new infrastructure would trigger property acquisition. The extent of this infrastructure, the cost, and the community impact is unacceptable and contributes to the screening of Option B.

**4.5 Additional infrastructure on the Lakeshore East corridor (USRC to Scarborough Junction):** Based on the analysis of service and a mapping out of the service associated with the RER-SmartTrack integration options over and above planned RER service, both Options A and B would trigger the need for an additional track in the Lakeshore East corridor between the USRC and Scarborough Junction.

For Option A the need for the additional track is triggered by the effective doubling of service between Unionville, Union Station and Bramalea that would be operating in this segment. The service pattern results in a much denser train pattern when local and express Lakeshore East trains are taken into account. There are a number of locations along this segment of the corridor where a number of trains meet or cross paths. In the absence of an additional track, trains moving at different speeds might be delayed behind one another to avoid collision while trains travelling in opposite directions might be blocked.

For Option B the need for an additional track is triggered by the different stopping patterns of the local and express Kitchener-Stouffville trains and also the express and local Lakeshore East service. Each unique stopping pattern has a different speed profile and without the additional tracks, the local and express service pattern along with the Lakeshore East service pattern would result in trains meeting or being unable to pass. Similar to Option A, in the absence of additional infrastructure, trains moving at different speeds might be delayed behind one another to avoid collision while trains travelling in opposite directions might be blocked.

#### 4.6 Additional tracks on the Kitchener corridor

Based on an analysis of the higher frequencies set out in Option A, over and above what is planned for GO RER, this option triggers the need for a 5<sup>th</sup> track between the USRC and the Airport Spur. Because the heightened frequencies reduce the amount of time between trains, there is less flexibility to accommodate the many different types of service planned for the Kitchener corridor. In order to ensure that faster train trips are not held up behind slower train trips, the additional track is required.

Because of the local and express service set out in Option B, layered on top of the different services identified in the planned RER service concept, this option triggers the need for 5<sup>th</sup> and 6<sup>th</sup> tracks between the USRC and the Airport Spur. The complexity of what would be five different speed profiles (diesel express service from Kitchener, diesel local service from Mt. Pleasant, UP Express service, and electrified all-stop service from Bramalea) combined with the service traveling in the opposite direction, a 5<sup>th</sup> and 6<sup>th</sup> track would be required in the corridor. Without these additional tracks, there would be numerous points where trains travelling at different speeds or in different directions would meet.

As discussed above, because insufficient space exists within the corridor for these tracks the expansion would require substantial property acquisition, including both a 5<sup>th</sup> track and 5<sup>th</sup> and 6<sup>th</sup> tracks. It would also require major modifications to the recently completed Strachan Grade Separation and the West Toronto Diamond. These impacts are severe and contribute to the screening of Options A, and B from further consideration.

#### 4.7 Sensitivity Testing of Option A

Option A proposes a doubling of GO RER electrified service from every 15 minutes to every 7.5 minutes. As outlined in section 4.1, this was tested by developing a sample time-table and mapping it onto the track layout to identify points where trains would meet and thus require additional tracks. For 7.5 minute frequencies, this analysis indicated that an additional track would be required for both the Kitchener and Lakeshore East.

After it was determined that 7.5 minute frequencies triggered additional tracks, 10 and then 12 minute frequencies were tested. For each of these tests, it was determined that a 5<sup>th</sup> track would be required on the Kitchener corridor to accommodate even 12 minute frequencies, or just one additional train per hour. As discussed above, because the Kitchener corridor accommodates a large number of diverse rail services, each with a unique stopping pattern and speed profile, the capacity of the corridor is fully utilized with the committed GO RER service concept to the extent that even one more train per hour cannot be accommodated.





Figure 10: Infrastructure Requirements for Option B



#### 4.7 Options Being Carried Forward to Further Evaluation

High-level analysis of sample time tables indicates that both Options C and D are workable without additional track requirements. For both of the workable options, the Kitchener corridor requires careful planning. Because GO RER service on the Kitchener corridor will be comprised of a mix of fleet (diesel locomotive, diesel EMU, and electric) types, service (local and express) types, and train speeds, service patterns are complex and delicately balanced. Any changes to that balance, including adding new stations which slows service down, may trigger other counter-balance alterations. Options C and D each include the addition of St. Clair and Liberty Village stations on the Kitchener corridor. In order to accommodate these stops on the local, electrified service, service from Kitchener, planned to run express from Bramalea to Union Station would need to add at least two station stops. With these adjustments, though, Options C and D are feasible.

### 6.0 STRATEGIC CASE

The Strategic Case discusses the extent to which the options under consideration support a larger vision for transportation in the Greater Toronto and Hamilton Area (GTHA), and, given the context of GO RER-SmartTrack integration, of the City of Toronto specifically. This section also includes the problem statement and discussion of how and to what extent the options address the problem statement. It also includes analysis of ridership patterns and markets, travel behaviour, and social equity.

The aim of the Strategic Case is to answer the questions:

- Do the options align with broader policy objectives?
- How do the options fit into the larger context of GO Regional Express Rail?
- To what extent do the options address the problem statement and achieve the vision?
- How do the project options address the problem statement and impact broader travel behaviour?

Because Options A and B were screened out from further consideration through the Deliverability and Operations Case, strategic analysis will focus on Options C and D.

#### **6.1 Policy Objectives**

Metrolinx and City of Toronto policy objectives are compatible and mutually supportive. The Big Move, the regional transportation plan, is explicit in its vision of increasing transit ridership and reducing the distance that people drive each day. Also emphasized in The Big Move, as the first goal, is increasing transportation choices so that people have a wider range of options for getting around. In analyzing the integrated GO RER-SmartTrack options, an important objective for Metrolinx was achieving balance in expanding travel options for Toronto residents while preserving a competitive travel experience for medium and longer distance passengers.

The City of Toronto's key transit objectives include:

- Increase accessibility and choice for residents throughout the City, particularly for lower income residents.
- Provide additional transit capacity and relieve constrained portions of the network, particularly the Yonge Subway and Bloor-Yonge Station.
- Increase transit efficiency by balancing load across the network and resiliency (in terms of providing an integrated network of alternative routes).

The integrated RER-SmartTrack options would increase overall transit ridership and also reduce the distances travelled by car. These options would also increase transportation choices and accessibility, for both Toronto residents who live or work near a new station as well as for suburban GO passengers who would have new options for stations serving additional destinations.

The City of Toronto's Feeling Congested? framework for project evaluation is also an important lens for Strategic Case analysis.

The strategic value of transit investments in Toronto can be viewed and understood through a framework developed through *Feeling Congested?*, the recent review of Transportation Policies in Toronto's Official Plan. The framework focuses on three principles:

- Serving People
- Strengthening Places
- Supporting Prosperity

These three principles are further articulated as eight criteria: Serving People

- **Choice** Develop an integrated network that connects different modes to provide for more travel options
- **Experience** Capacity to ease crowding / congestion; reduce travel times; make travel more reliable, safe and enjoyable
- Social Equity Allow everyone good access to work, school and other activities

Strengthening Places

- **Shaping the City** Develop an integrated network that connects different modes to provide for more travel options
- **Healthy Neighbourhoods** Changes in the transportation network should strengthen and enhance existing neighbourhoods; promote safe walking and cycling within and between neighbourhoods
- **Public Health & Environment** Support and enhance natural areas; encourage people to reduce how far they drive; mitigate negative impacts

Supporting Prosperity

- **Affordability** Improvements to the transportation system should be affordable to build, maintain and operate
- **Supports Growth** Investment in public transportation should support economic development: allow workers to get to jobs more easily; allow goods to get to markets more efficiently

#### **6.2 Vision for Transportation Options**

The \$13.5 billion committed RER program will bring about a transformational shift in travel options throughout the GTHA. Currently, the GO rail network functions largely as a commuter system, bringing people into downtown Toronto in the morning and returning them to their homes in the evening. GO RER is not an incremental change to the current commuter network but a sea-change that will bring electrified, two-way, all-day, 15 minute service to many parts of the region. This upgrade in service will change the way that people consider their travel options – rapid transit will now be readily available for mid-day trips, weekend trips, and also non-downtown work trips. Another anticipated positive impact of substantial upgrades to GO service, particularly on the Stouffville corridor, is relief to crowded the Yonge Subway. This effect was borne out in Metrolinx's analysis through the <u>Yonge Relief Network Study</u>.

The existing GO rail network enables suburban commuters to easily work in downtown Toronto and GO RER will also support the growing number of downtown dwellers commute to suburban employment locations. While the existing GO rail network provides service to Toronto residents who live near a GO station and work downtown, with all-day RER service there is potential to improve integration with TTC so that GO rail service can become relevant to a wider swath of Torontonians, as SmartTrack proposes. GO RER's 15 minute service also goes a long way toward making GO service more competitive with frequent TTC service. Whereas existing GO frequencies of up to 30 minutes in the peak period mean that travelers are bound by schedules, 15 minute service approaches the point where travelers turn up at the station without consulting a schedule, making travel considerably more flexible. The GTHA Fare Integration Strategy aims to further contribute to making GO a more relevant transportation choice for Toronto residents by looking at fares and transfer policy and when that work is complete, outcomes will be incorporated into analysis of these options. Overall, the upgrade of the GO network will go a long way toward making GO a more accessible and relevant transportation option for many Torontonians, especially if coupled with fare and service integration, both of which are components of the SmartTrack proposal.

All seven GO corridors run through the City of Toronto, stopping at 19 stations, including 8 on the Kitchener and Stouffville corridors, and meeting at Union Station. The GO corridors largely run through Etobicoke and Scarborough, providing downtown access opportunities to the neighbourhoods located at a distance from the subway. This includes the Stouffville and Kitchener corridors which are the focus of SmartTrack.

SmartTrack proposes upgrading service on the Stouffville and Kitchener Corridors as a layer over and above the GO RER program, further integrating these rail corridors into the urban rapid transit network and providing enhanced transit accessibility to Toronto residents. To achieve this integration, SmartTrack includes new stations, TTC fares, and increased frequency, as well as an LRT along Eglinton Avenue West and provides an opportunity to improve access to the GO network for Toronto.

It is within this context that the RER-SmartTrack integration options were developed. Through the Strategic Case, they will be evaluated based on how they further improve transit accessibility for Torontonians, beyond what RER will already bring about, while still preserving a high quality of service for suburban travelers. This will be assessed through the problem statement, through an analysis of ridership and travel patterns, and through a look at social equity. Analysis in this business was developed assuming the current fare structure, including existing GO fare structure for GO RER, TTC fares, and existing transfer policy.

#### Problem Statement

As the City of Toronto has grown, the transit network's capacity during the peak periods has proved insufficient to support the demand. In particular, the need to relieve overcrowding on the Yonge Subway line has grown acute. In addition, the distribution of population and employment within Toronto has shifted with concentrations of lower income city residents increasing in outer areas of the city. These residents have relatively poor transit access to major job concentrations due to long journey times and congestion.

Seven GO corridors currently travel through Toronto, but given train schedules and peak-only service on most lines, opportunity exists to improve GO accessibility for Toronto residents. GO RER will go a long way toward addressing these issues by expanding GO service, transforming it to be faster and more frequent through the day.

SmartTrack proposes to go above and beyond GO RER, further increasing the options for moving through the network. SmartTrack is an opportunity to integrate transit services within Toronto, enabling GO corridors to provide new transit capacity for trips to, from, and within the City of Toronto. To this end, SmartTrack proposes to increase use of the Stouffville and Kitchener lines with new stations and improved service frequency, and an integrated fare. This study analyzes different options to integrate SmartTrack with GO RER to continue to serve medium and long distance commuters, as well as meet more of the transportation needs for people wanting to travel to, from, and within the City of Toronto.

#### Problem Statement and Vision Performance Discussion

Options C and D each seek to address the problem statement in different ways.

Option C adds seven to eight new stations within the City of Toronto, making GO service more accessible to Toronto residents and connecting a larger number of origin and destination points. This option would preserve the GO RER service concept with some minor modifications to Kitchener express service. Of the new stations, 2-3 would be between Bramalea and Union Station and 5-6 would be between Unionville and Union Station. These additional stations would increase net ridership and transit accessibility and choice within Toronto but have an impact on travel times, especially for medium and longer distance passengers. For example, passengers travelling between Milliken Station at Steeles Avenue and Union Station would see their trips lengthened by more than 35%. Overall, in Option C, more passengers lose time on their trips than the passengers who save time via the new stations.

Option D adds 4-5 new stations within the City of Toronto. Like Option C, this option would preserve the GO RER service concept with some minor modifications to Kitchener express service. Option D attracts new riders but also imposes some travel time increases – for example, approximately 15% for Milliken passengers travelling to Union Station – but the increases are slight. Because Option D focuses on adding the stations with the most potential for new ridership, it adds marginal travel time to medium and long distance passengers but also saves time for other passengers. However, because fewer new stations are added, Option D does not go as far as Option C in terms of adding new access points to the GO network, resulting in smaller increases to transit accessibility and travel choice for Toronto residents.

Options C and D have different advantages and disadvantages. Option C goes further to increasing travel choice for Toronto residents but at the expense of travel times for medium and longer distance passengers. Option D does not go as far in expanding transit accessibility within Toronto but also better serves medium and longer distance travelers, including those boarding at Toronto stations like Milliken and Agincourt.



Figure 11: Sample Travel Time Comparison of RER with Option C and Option D

#### Experience

Evaluating how a transit project improves a traveller's experience is directly related to how many people choose to take transit, given that they will choose to take transit if it offers a better experience than a different mode of travel. Experience can further be understood in terms of change in travel time between origins and destinations, how many destinations a rider can access using the transit network and the ability to mitigate crowding on transit.

Ridership growth is an important indication of Experience. GO ridership in 2014 was approximately 54 million annual trips. With the implementation of GO RER on five corridors, ridership is forecast to climb 140 percent to 127 million annual trips. On the Kitchener and Stouffville corridors, current ridership is 9 million annual trips and it is forecast to grow threefold to 27 million annual trips with GO RER.

Ridership analysis of the integrated RER-SmartTrack options suggests that they would increase ridership by approximately ten percent over and above what is forecast for GO RER. Options C and D are forecast to attract similar levels new ridership to the system – 2.4 to 2.8 million annual new riders beyond GO RER. Both options would provide relief to Bloor-Yonge station and on Line 1. It should be noted that this analysis assumes the existing fare structure; ridership on the integrated RER-SmartTrack options may increase with fare integration. The City of Toronto has conducted ridership modelling of Options C and D using their new transportation model and assuming a TTC fare on the Kitchener and Stouffville corridors between Mt. Dennis station and Milliken station. Even with a TTC fare, City of Toronto modelling provides similar indications as Metrolinx modelling in terms of relative station performance and the relative performance of Options C and D. Results from these forecasts are included in Appendix C.

#### **Table 6: Ridership and Travel Time Summary**

| Options  | Ridership  |   |  | Travel Time Savings<br>with RER (million<br>minutes)                                 |
|--|--|---|--|--|
| Base Case:<br>Committed GO<br>RER                              | 127 million total<br>27 million, Kitchener   | r + Stouffville   |  | 358.7<br>(Kitchener +<br>Stouffville)  |
|  | Ridership<br>(Boardings and<br>alightings at<br>new stations<br>incl. new and<br>existing riders,<br>Annual) | Ridership (Net<br>new to system,<br>Annual,<br>Incremental to<br>RER) | Percent<br>Change<br>(Incremental<br>to RER) | Transit Rider Travel<br>Time Savings with<br>Integrated Options<br>(million minutes) |
| Option C:<br>Committed RER<br>frequencies, 7-8<br>new stations | 7.1 million  | +2.4 million  | +9%  | 253.9  |
| Option D:<br>Committed RER<br>frequencies, 4-5<br>new stations | 5.1 million  | +2.8 million  | +10%   | 323.9  |

#### Travel Behaviour Discussion

Equally important as knowing the forecast ridership of each option is understanding how the options influence travel behaviour and what factors drive the differences between options.

New stations have a number of influences and impacts. They serve additional locations and attract new riders but also impose new capital and operating cost, increase travel times, and potentially contribute to a loss in upstream passengers. Each new station increases travel time by two to three minutes, although electrification works in the opposite direction, reducing travel times by approximately fifteen to twenty percent.

- For both Options C and D the new stations yield a net increase in GO ridership.
  - Both options cause a net reduction in vehicle kilometres (i.e., less driving overall) in the GTHA because they take car trips off the road by inducing drivers to switch to transit.
  - Both options would yield an increase in GO revenue, on the order of \$10 to 15 million per year in 2031.

- For both options, the new stations cause a net increase in travel time (negative travel time savings) and would reduce the total travel time savings brought about by RER on the Kitchener and Stouffville corridors. For Option C, this effect erodes approximately thirty percent of the time savings; for Option D, it erodes approximately 10 percent of the time savings.
- The package of new stations in Option D yield more favourable results than those in Option C for ridership, time savings, and vehicle kilometres travelled metrics.
- Findings suggest that the new stations attract ridership primarily as destinations not as boarding.
  - Proposed new stations near downtown with significant job clusters nearby are more promising than proposed stations in more residential areas. For example, a Liberty Village station is promising largely due to alightings at the station. Liberty Village is an emerging employment hub and a GO station in the area is extremely attractive to people who work there.
  - Option D is more successful than C because its constellation of new stations is more heavily weighted towards those located near downtown with clusters of jobs surrounding, while Option C includes both stations in residential areas and those around downtown.
- For both Options C and D, the majority of passengers are switching to GO from local transit or GO bus



Figure 12: Chart Showing Previous Travel Modes of New Passengers

- Options C and D attract similar numbers of new passengers, but they are not necessarily the same passengers.
  - Option C attracts more new passengers because of a higher number of new stations but it also deters more existing passengers due to longer travel times.
  - Option D attracts new passengers, mostly those alighting at new downtown stations, but the modest number of new stations does not deter many existing passengers.

#### <u>Choice</u>

The project's impact on choice can be understood both in terms of how many opportunities there are to transfer to other rapid transit lines that serve destinations that people want to travel to (more opportunity is positive), and how many transfers riders need to make to reach their destinations (fewer transfers is assumed to be good).

There are a number of key transit connection points on SmartTrack, including:

- 1. Union (Downtown);
- 2. Eglinton-Mount Dennis;
- 3. Markham Centre (Unionville); and
- 4. Renforth Gateway (at Mississauga Airport Corporate Centre).

All of these points are identified as Mobility Hubs by Metrolinx, and should be planned as important connection points in the future. These hubs act as intermediary points on many transit trips to downtown Toronto and elsewhere in the city, in addition to being important destinations in their own rights.

SmartTrack would connect with a significant number of existing rapid transit lines. Each of the other rapid transit lines currently under study by the City would also connect with SmartTrack.

Currently, Union Station serves as the terminus for all of the GO lines. SmartTrack envisages connecting the Stouffville and Kitchener lines and running a continuous service from Bramalea to Unionville, removing the need to transfer between GO trains for many users.

Both SmartTrack options include all of the stations with connections to other rapid transit lines. Option C, with its additional stations, provides more connections to local bus routes.

The number of connections to major walking and cycling infrastructure is also related to transportation choice. Examples of this type of infrastructure include downtown's PATH system for pedestrians, the Waterfront Trail system or the West Toronto Rail Path. SmartTrack would connect to the PATH at Union Station. The options do not differ significantly in their impacts or ability to connect to any such pedestrian or cycling facilities.

On balance, all options perform equally well with respect to Choice.

#### Social Equity

The impact of a transit investment can be expressed in terms of a change in access to jobs for residents of Neighbourhood Improvement Areas (NIAs) and number of NIA residents served by rapid transit.

SmartTrack would serve a moderate number of disadvantaged residents. Option C, by nature of its additional stations, serves more low income residents.

Access to jobs for residents of NIAs would also increase (measured by the change in jobs accessibility for NIA measure, data is forthcoming).

On balance, all options perform equally well with respect to Social Equity.

#### Table 7: Social Equity

|  | Option C             | Option D             |
|--|----------------------|----------------------|
| Change in Rapid Transit Coverage (Toronto is approximately 640 km <sup>2</sup> ) | +5.2 km <sup>2</sup> | +3.7 km <sup>2</sup> |
| Change in Disadvantaged Residents Served   | +9,900               | +8,000               |



Figure 13: GO Corridors with Existing Station Locations and Neighbourhood Improvement Areas

#### **Strengthening Places**

#### Shaping the City

Transit investments can play a very significant role in the residential development of the city. Rapid transit may be constructed to serve areas of high population density in order to relieve congestion and increase capacity of local transit services, or rapid transit can be built in areas planned for higher population density in order to increase transportation accessibility and thus incent residential development in appropriate areas.

Existing population represents an established market which makes benefits associated with serving it more certain than those associated with serving growth. However, it is still important in the evaluation of a project's impact on Shaping the City to consider how the project would serve residential growth areas to support and guide their development.

SmartTrack serves the key growth areas in the Downtown and Liberty Village. It would also bring a station (Unilever) much closer to the significant growth occurring and planned for the Portlands. The station at Ellesmere in Option C is also close to Scarborough Centre, which has been designated for mixed-use development.

By virtue of its additional station at Ellesmere, Option C provides some additional benefit over the base and Option C with regards to Shaping the City. This benefit may be captured in Option D as well pending the findings of the additional stations assessment.

#### Table 8: Residential Growth

|                        |                                   | Option C               | Option D               |
|------------------------|-----------------------------------|------------------------|------------------------|
| Existing Population    | existing GTHA population          | +24,100                | +20,500                |
|                        | existing GTHA population density  | 4,600                  | 5,600                  |
|                        |                                   | people/km <sup>2</sup> | people/km <sup>2</sup> |
| Service to residential | area of land designated for       | 0.7 km <sup>2</sup>    | 0.5 km <sup>2</sup>    |
| growth areas           | population growth                 |                        |                        |
|                        | proportion of land designated for | 14%                    | 14%                    |
|                        | population growth                 |                        |                        |
| Population Growth      | projected population growth       | +5,300                 | +5,000                 |
|                        | projected increase in population  | +1,000                 | +1,400                 |
|                        | density                           | people/km <sup>2</sup> | people/km <sup>2</sup> |

#### Healthy Neighbourhoods

Just as transit investments can be a powerful force in shaping the city, they can also have long-term detrimental impacts on existing, stable neighbourhoods. A modest proportion of the SmartTrack study area is recognized as stable neighbourhoods, to which adding a station could bring unwanted development pressure and change. Option C is in close proximity to 1.0 km<sup>2</sup> of stable neighbourhoods and Option D is 0.7 km<sup>2</sup> (19% and 20% respectively).

All options perform equally well with respect to Healthy Neighbourhoods.

#### Public Health & Environment

Transit has a very positive impact on public health and the environment due largely to enabling travel by modes other than private automobiles, which contribute significantly to air quality issues and encourage sedentary lifestyles. However, large infrastructure projects like rapid transit may also have detrimental impacts to natural features, which must be avoided or mitigated.

SmartTrack would enable a savings of approximately 500,000 km per day. Option C and Option D perform similarly, with the reduction in vehicle kilometers travelled associated with Option D being slightly greater.

There are some technical challenges with environmental impacts associated with locating a SmartTrack station at Unilever. However, these affect each of Option C and Option D equally.

The Stouffville, Lakeshore East and Kitchener GO corridors pass over a number of river and creek systems presently. None of the options represent significant impacts to any of the systems.

All options perform equally well with respect to public health and the environment.

#### Supporting Prosperity

#### Supports Growth

As with residential growth areas, transit investments can play a very significant role in the employment development in the city. Rapid transit may be constructed to serve areas of high employment density, or rapid transit can be built in areas planned for higher population density in order to increase transportation accessibility and thus incent businesses to locate high density employment like offices in appropriate areas.

Existing employment density can be used as a proxy for what future employment density will be, however this projection is less certain than for population due to how employment growth tends to occur. Different types of employment develop at certain nodes, depending on how economies grow and change – Toronto's Liberty Village is an example of how a dominant sector (technology) has developed very quickly in a relatively small area. This rapid development may not have been predictable 10 or 20 years ago. Strategically, the more important evaluation of a project's impact on supporting growth relates to how the project would serve employment growth areas. For example, the Unilever site has recently emerged as potential significant employment node. Recent proposals have suggested as many as 70,000 jobs could be located on the site. High quality transit options would be required to support such a concentration of employment.

SmartTrack serves the key growth areas within the City including Downtown, Liberty Village, and Unilever as well as the Mississauga Airport Corporate Centre and Markham Centre, significant employment nodes with additional growth potential, outside the City. The Ellesmere Station in Option C would also provide a close connection to Scarborough Centre, an area identified by the Official Plan for mixed-use intensification.

The Finch, Ellesmere and Lawrence stations are located in close proximity to Employment Areas. Although the areas currently contain low density employment uses, this could change over time, particularly with the introduction of regional transit services.

Option C is preferred from the perspective of Supporting Growth.

|                       |                                   | Option C | Option D             |
|-----------------------|-----------------------------------|----------|----------------------|
| Existing Employment   | existing employment               | 19,000   | 12,400               |
| Density               | existing employment density       | 3,600    | 3,400                |
|                       |                                   | jobs/km² | jobs/km²             |
| Service to Employment | area of land designated for       | 1.9 km²  | 1.1 km²              |
| Growth Areas          | employment growth                 |          |                      |
|                       | proportion of land designated for | 36%      | 31%                  |
|                       | employment growth                 |          |                      |
| Projected employment  | projected employment growth       | 30,600   | 28,400               |
| growth                | projected increase in employment  | 5,800    | 7,700                |
|                       | density                           | jobs/km² | jobs/km <sup>2</sup> |

#### Table 9: Employment Growth

#### Strategic Analysis Discussion Summary

GO RER represents a significant improvement in GO service for the GTHA as a whole and for the City of Toronto. Especially when combined with fare and service integration, the GO RER program will substantially improve access to the GO network for Torontonians and its relevancy as a travel option.

Over and above this improvement, there is room to go further, and by adding new stations, both of the integrated RER-SmartTrack options do this. Both Options C and D address the problem statement and further the vision for integrating GO RER and SmartTrack. Option C goes further than Option D in opening up new access points to GO within Toronto and thus performs better with regards to shaping the city and supporting growth. In particular, Option C increases accessibility to the downtown job market from nearby areas lacking rapid transit downtown access, which will promote intensification. The two options also have similar ridership increases, and outcomes with respect to choice, social equity, healthy neighbourhoods, public health and the environment. Option D has a strategic advantage over Option C in that it has less negative impact to medium and long distance commuters and does not deter passengers from those markets from choosing GO by imposing significant additional travel time. Option D does this by focusing on adding the most promising new stations, mostly those near employment clusters. In terms of coming to the optimal balance between local access and regional service, Option D is the strongest performer.

## 7.0 FINANCIAL CASE

The financial case aligns with the *Feeling Congested?* affordability metric and seeks to understand the investment costs and the ongoing operating costs throughout the whole life of the asset. The financial accounts are summarized in the following tables:

| Nominal Dollars   | Base Case GO RER<br>Kitchener+Stouffville | Option C: Committed<br>RER frequencies with<br>slower long-distance<br>service, 7-8 new stations | Option D: Committed<br>RER frequencies, 4-5 new<br>stations |
|---|---|--|---|
| Capital Costs (Rail only, \$M,<br>2014, costs do not include<br>escalation, financing costs,<br>lifecycle and operating and<br>maintenance) | \$3,300                                   | +\$1.1-1.7   | +\$0.7 - 1.0  |
| Nominal Annual Operating<br>Costs (\$M 2031)  | \$140                                     | +\$8.7   | +\$5.3  |
| Annual Incremental<br>Revenue to GO (\$M, 2031)   | \$210                                     | +\$11.8  | +\$15.1   |
| Cost Recovery Ratio (2031)  | 150%                                      | 149%   | 155%  |

#### Capital Cost Caveats:

Detailed capital costs are included in an appendix. The capital costing prepared to date is at a high-level and should be understood with a number of caveats:

- Capital costs broadly align with the New Stations analysis and are presented with appropriate contingency.
- Costs do not include escalation, financing costs, lifecycle, and operating and maintenance costs.
- Corridor infrastructure costs are built from numerous component costs including bridge widening, additional electrification, tracks and signals; each element will require further design and costs are subject to change.
- Property acquisition costs have been estimated for new corridor infrastructure. Further work is required to confirm property requirements and costs for new stations.
- Cost estimates for Union Station, fleet, and other system costs were developed based on high-level assumptions and may change as further analysis is conducted.

#### Financial Analysis Discussion

Options C and D are relatively similar in terms of financial performance. Option C is slightly more expensive to both build and operate, compared to Option D because it involves a larger number of new stations and consequently incur larger costs to build and maintain. Options C and D have similar ridership and because the operating costs for Option C are higher due to additional stations, it has a lower cost recovery ratio as compared to Option D.

## 8.0 ECONOMIC CASE

The economic case measures, quantifies, and monetises transport impacts (benefits) and seeks to compare those benefits with costs to understand relative performance and value-for-money of each investment option. There are other benefits, like ambiance and comfort, which are not monetized or included in the benefit cost ratio. The following benefits were monetized and incorporated into the analysis:

- Travel time impacts (savings and delays to both new and existing users)
- Unperceived vehicle operating cost savings comprised of savings for people who switch from auto to transit
- Fare revenue
- Reduction of emissions, collisions, and congestion due to reduced vehicle-kilometres travelled (VKTs)

| 2014\$ Value  | Base Case GO RER<br>Kitchener+Stouffville<br>(Compared with Do-<br>Minimum Scenario)         | Option C: Committed RER<br>frequencies, 7-8 new<br>stations | Option D: Committed RER<br>frequencies, 4-5 new<br>stations |
|---|--|---|---|
| Total Lifecycle Costs<br>(\$M, PV)  | \$6,900 (does not<br>include system costs;<br>includes RER Do-<br>Minimum Scenario<br>costs) |   |   |
| Incremental<br>Lifecycle Costs (\$M,<br>PV)                                     | \$4,100<br>(Incremental to the<br>GO RER Do-Minimum<br>Scenario)                             | \$1,000-1,600<br>(Incremental to GO RER)                    | \$600-800<br>(Incremental to GO RER)                        |
| Net Benefits (PV)   | \$4,100  | (\$2,200)   | (\$1,100)   |
| Benefit Cost Ratio<br>(Incremental<br>Benefits/Incremental<br>Costs)            | 2.0  | Negative  | Negative  |
| GO RER Kitchener<br>and Stouffville<br>corridors Combined<br>Benefit Cost Ratio | -  |   | 2.0   |
| Impact to Kitchener-<br>Stouffville RER<br>Benefit Cost Ratio                   | -  | 31% decrease to 1.37  | 18% decrease to 1.64  |

#### **Table 11: Economic Information Summary**

#### Table 12: Economic Benefits Breakdown\*

| 2014\$ Value, \$M     | Base Case GO RER<br>Kitchener+Stouffville<br>(Compared with Do-<br>Minimum Scenario) | Option C: Committed RER<br>frequencies, 7-8 new<br>stations | Option D: Committed RER<br>frequencies, 4-5 new<br>stations |
|-----------------------|--|---|---|
| Travel Time Impacts   | \$3,200  | (\$1,200)   | (\$600)   |
| (negative result      |  |   |   |
| indicates delay)      |  |   |   |
| Auto Operating Cost   | \$3,800  | \$20  | \$110   |
| Savings (due to mode  |  |   |   |
| shift from auto to    |  |   |   |
| transit)              |  |   |   |
| Collision Reduction   | \$400  | under \$5M  | \$10  |
| Savings (due to mode  |  |   |   |
| shift from auto to    |  |   |   |
| transit)              |  |   |   |
| Congestion Relief     | \$800  |   |   |
| (due to mode shift    |  | \$10  | \$40  |
| from auto to transit) |  |   |   |
| Environmental         | \$20   | under \$5M  | under \$5M  |
| Benefits              |  |   |   |
| Total Benefits        | \$8,200  | (\$1,100)   | (\$400)   |

\* It should be noted that the City of Toronto has also conducted some economic analysis which is presented in Appendix C of this document.

#### Economic Analysis Discussion

Overall, Option D is a stronger performer than Option C, when assessed through an economic lens. The primary lens through which economic performance was analyzed is through an assessment of each option's impact to the established GO RER benefit-cost ratio. The GO RER benefit-cost ratio is 3.1, meaning that the benefits of the investment, including travel time savings and auto operating cost savings exceed the life cycle costs (including capital and operating) by a factor of three. For the Kitchener and Stouffville corridors, the combined benefit-cost ratio is 2.0. This was calculated by adding up total benefits for Kitchener and Stouffville and dividing by the sum of the total costs for the two corridors. In order to measure the economic impacts of Options C and D, the change to the combined Kitchener and Stouffville benefit-cost ratio was assessed.

Option C has a negative impact and would reduce the RER benefit-cost ratio from 2.0 to 1.37. Option D has a smaller negative impact and would shift the combined benefit-cost ratio from 2.0 to 1.64. For both options, the benefit-cost ratio remains above 1:1. Option C has a stronger negative effect than Option D.



#### Figure 14: Impact of Options C and D to GO RER Kitchener-Stouffville Benefit-Cost Ratios

The net benefits for both Options C and D are below zero, meaning that for both options, the disbenefits outweigh the positive benefits. For both of the options, this is due to travel time penalties associated with the addition of new stations. While a small number of passengers benefit substantially from the new stations, a larger number of passengers incur small time penalties at each added station. In aggregate, the time lost to the larger group of passengers outweighs the smaller number of passengers who would save time.

Options C and D differ in terms of auto operating cost savings. While both options have a similar number of new riders, Option C attracts more City of Toronto residents making shorter trips and deters passengers making longer trips, leading to a smaller reduction in vehicle kilometres travelled. Option D attracts more passengers making longer trips and alighting at new downtown stations. Because Option D adds fewer new stations, it does not deter as many long distance travelers as Option C, leading to a larger reduction in vehicle kilometres travelled, compared to Option C. Accident reduction savings and congestion relief are both related to reduction in vehicle kilometres travelled and thus have comparable patterns to auto operating cost savings, with Option D performing slightly better than Option C.

## 9.0 CONCLUSION AND NEXT STEPS

Based on the analysis in the business case, Option D is the strongest performing option for integration SmartTrack with GO RER. Option D has an advantage in overall ridership and strikes the optimal balance in terms of advancing local access within Toronto while preserving service quality for longer distance passengers. While both options perform less positively through the lens of economic analysis, Option D has a smaller negative impact to the GO RER Kitchener and Stouffville benefit-cost ratio.

Next steps include:

- The number and locations of new stations are being determined through the new stations analysis, which includes business cases on each potential location.
- The GTHA Fare Integration Strategy is progressing and is currently conducting analysis on the different integration options, including ridership and revenue assessments. As a clearer direction emerges on fare integration, the impacts on ridership, particularly at City of Toronto GO stations will be incorporated into overall GO RER analysis and into analysis of the integrated options.
- Work is ongoing to better understand different aspects of Union Station, including a more nuanced understanding of capacity that takes train flows through the entire Union Station Rail Corridor into account. As this work moves forward and is applied to an updated understanding of how GO RER will operate, it will likewise be applied to the integrated RER-SmartTrack options.

### 10.0 APPENDIX

#### Appendix A:

#### Technical Methodology supporting the Deliverability Screening

#### **Operational Feasibility**

Operational feasibility measures the practicality of an option from different angles, such as infrastructure requirements, crewing and fuel options. At the screening phase, infrastructure requirements are deemed the most significant constraints among other considerations. Options will be advanced for further analysis beyond the screening phase if it satisfied the infrastructure requirements, which is explored in detail in the following section.

#### Infrastructure Requirements

Each SmartTrack option has its own infrastructure requirements, such as track and train storage needs. In order to achieve the transportation objectives and deliver within the given timeframe, the key infrastructure constraint is to utilize only the existing and planned infrastructure within the scope of GO RER.

#### **Track Requirements**

To determine track requirements for each option, a preliminary timetable is developed using a list of assumptions that are shared among all options, such as train speed for electrified service and station dwell times.

The timetable is then converted to a time-distance plot, which displays each and every train as a line on the plot based on its schedule and routing. See below for a sample time-distance plot.



A time-distance plot creates a visual assessment of potential conflicts. For example, when two lines intersect, it represents two trains are "meeting" at that specific location; see Zoom-in #1. Trains can "meet" regardless of the direction in which they are travelling. Trains travelling in the same direction may intersect when a faster train overtakes a slower train; see Zoom-in #2. Where train-meet occurs, a minimum of two tracks are required to avoid conflicts. And the more trains meet at a location, the more tracks are required.

When there is insufficient track infrastructure to accommodate all the movements, the schedule of one or more trains can be advanced or postponed to shift the train meet location to where there are sufficient tracks. In some cases, converting trains between an express service and local all-stop service provides more flexibility in altering the train-meet locations. As a last resort, a new siding or an additional mainline track will need to be constructed to accommodate all the movements. The choice between constructing a siding or mainline track is dependent on the frequency and

proximity of the train meet locations. In cases where multiple train-meet locations are in relatively close proximity, it may be more efficient to build an additional mainline track than multiple sidings.

During the assessment, it was determined that some options achieved the goal of increased travel options for Toronto residents, but that increase came at the expense of triggering new infrastructure at one or more locations that are beyond the scope of GO RER.

#### Storage Requirements

Trains need storage when they are out of service, thus the number of train required, or fleet, has a direct impact on storage requirement. Once a timetable is developed for each option, fleet size can be estimated based on the journey time and service frequency. Essentially, the longer the journey time and the higher the service frequency, the more trains are required. While all options involve electrification, which offer journey time savings through train speed improvements, the time saved may not be able to offset additional station stops or higher service frequency in some options. As a result, an expanded fleet can be expected in some options.

It was determined that some options achieved the goal of growing ridership through higher service frequency and additional stations, but that growth came at the expense of expanded fleet and additional storage requirements that are beyond the scope of GO RER.

### Appendix B Integrated GO RER-SmartTrack Options – Incremental Capital Cost Estimates

#### **Introduction**

This document presents capital cost estimates for the integrated GO RER-SmartTrack options. It contains six tables, the first of which presents the portion of committed GO RER capital costs which are attributable to advancing the SmartTrack proposal. The remaining five tables present capital costs, incremental to GO RER, for integrated options A, B, C and D. All costs are in 2014\$ and exclude escalation, financing costs, lifecycle and operating and maintenance.

The costing prepared to date is at a high-level and should be understood with a number of caveats:

- Costs for new stations are built on placeholder costs for average GO stations and do not necessarily reflect the individual designs that may be required for different sites. As such, a range of costs has been provided.
- Corridor infrastructure costs are built from numerous component costs including bridge widening, additional electrification, tracks and signals; each element will require further design and costs are subject to change.
- Property acquisition costs have been estimated for new corridor infrastructure. Further work is required to confirm property requirements and costs for new stations.
- Cost estimates for Union Station, fleet, and other system costs were developed based on high-level assumptions and may change as further analysis is conducted.
- Eglinton rapid transit costs are preliminary and may need to be reassessed with further work. For example, further engineering and design work is required to fully capture utility conflicts and potential utility relocations. Contingency has been allocated in the estimate; however, it may need to be reassessed if there are significant underground utility conflicts.

| Element                                 | GO RER Costs | Common |  |
|---|--------------|--------|--|
| Corridor Costs                          |              |        |  |
| Kitchener<br>Segment<br>(Toronto)       | 2.1          | 1.1    | Includes a fourth track on the<br>Kitchener corridor from Mt. Dennis to<br>the USRC as well as associated bridge<br>reconstruction and grade separations,<br>and electrification |
| Lakeshore East<br>Segment<br>(Toronto)  | 1.3          | 0.5    | Includes fourth track between<br>Scarborough Junction and the USRC<br>as well as associated bridge<br>reconstruction and grade separations,<br>and electrification               |
| Stouffville<br>Segment<br>(Toronto)     |              | 0.6    | Includes double tracking and<br>electrification of the Stouffville<br>corridor from Unionville to  |
| Stouffville<br>Segment (York<br>Region) | 0.9          | 0.2    | Scarborough Junction as well as<br>associated bridge reconstruction and<br>grade separations   |
| Other Corridors                         | 3.1          | NA     | Includes Lakeshore West, Milton,<br>Barrie, and Richmond Hill corridors  |
| System Costs                            |              | -      |  |
| Union Station                           | 0.9          | 0.2    | Two of the twelve Union Station<br>platforms will be used for Kitchener<br>and Stouffville service (~%17)  |
| Fleet                                   | 2.6          | 0.7    | Assumes 13 8-car EMU consists<br>would be required + 20% spare<br>coaches at \$0.044B per 8-car consist  |
| Other Costs                             | 2.6          | 0.4    | Of the 221 route miles for RER, 36<br>miles are common to SmartTrack for a<br>proportion of 16%.   |
| Total                                   | 13.5         | 3.7    |  |

 Table B1: Breakdown of Base GO RER Costs Common to SmartTrack

#### Table B2 Option A: Increased frequency, 5 new stations

|  | Capital Cost (\$B, costs do    |  |
|--|--------------------------------|--|
|  | not include escalation,        |  |
|  | financing costs, lifecycle and |  |
| Element                                    | operating and maintenance)     | Notes  |
| New Stations                               | 0.9-1.5                        | Station locations should be considered<br>representative; specific locations will be<br>recommended through the ongoing new<br>stations analysis. New station infrastructure for<br>5 new stations at Gerrard/Carlaw, Unilever,<br>Bathurst/Spadina, Liberty Village, and St. Clair<br>West. |
| Corridor<br>Infrastructure:<br>Stouffville | 0.0                            | Additional storage tracks required at Unionville to support higher service frequency (\$26M)   |
| Corridor<br>Infrastructure:<br>Kitchener   | 2.9                            | 1 additional track required (5th track) between<br>USRC and the Airport Spur. Additional storage<br>tracks required at Bramalea to support higher<br>service frequency   |
| Corridor<br>Infrastructure:<br>Lakeshore E | 1.1                            | 5th track required on Lakeshore East between<br>USRC and Scarborough Junction  |
| Union Station                              | 0.9                            | Placeholder cost for Union Station upgrades  |
| Fleet                                      | 0.8                            | Assumes additional EMU fleet   |
| Other System<br>Costs                      | 0.3                            | System costs for dispatching office and additional end of line maintenance/storage facilities.   |
| Total                                      | 6.9-7.5                        |  |

### Table B3Option B: Local and Express service with 8 new stations

|  | Capital Cost (\$B, costs do<br>not include escalation,    |  |
|--|---|--|
| Element                                    | financing costs, lifecycle and operating and maintenance) | Notes  |
| New Stations                               | 1.2-1.8   | Station locations should be considered<br>representative; specific locations will be<br>recommended through the ongoing new<br>stations analysis. New station infrastructure for<br>8 new stations at Finch, Ellesmere, Lawrence,<br>Gerrard/Carlaw, Unilever, Bathurst/Spadina,<br>Liberty Village, and St. Clair West. |
| Corridor<br>Infrastructure:<br>Stouffville | 1.0-2.0   | Includes 3rd and 4th Track and associated improvements, as well as full property takings up to Unionville for 2 additional tracks.   |
| Corridor<br>Infrastructure:<br>Kitchener   | 3.9   | 5th and 6th additional tracks on the Kitchener<br>corridor from Strachan Avenue to the Airport<br>spur. Requires major modifications to<br>Strachan Grade Separation and West Toronto<br>Diamond and significant property takings  |
| Corridor<br>Infrastructure:<br>Lakeshore E | 1.1   | 5 <sup>th</sup> track along the Lakeshore East corridor<br>between Scarborough Junction and the Union<br>Station Rail Corridor   |
| Union Station                              | 0.9   | Requires up to two new platforms at Unions<br>Station. Costs provided for Simcoe Station<br>concept - Underground Station with tunnel<br>entrance just to the West side of Union<br>Station. Costs from USRC EP Report based on<br>the completed high level conceptual design  |
| Fleet                                      | 0.5   | Assumes additional EMU fleet   |
| Other System<br>Costs                      | 0.4   | System costs for dispatching office and additional end of line maintenance/storage facilities.   |
| Total                                      | 9.0 -10.6   |  |

### Table B4Option C: Eliminate long-distance express service with 7 new stations

|              | Capital Cost (\$B, costs do<br>not include escalation,<br>financing costs, lifecycle and |  |
|--------------|--|--|
| Element      | operating and maintenance)   | Notes  |
| New Stations | 1.0-1.6  | Station locations should be considered<br>representative; specific locations will be<br>recommended through the ongoing new<br>stations analysis. New station infrastructure for<br>7 new stations at Finch, Ellesmere, Lawrence,<br>Gerrard/Carlaw, Unilever, Liberty Village, and St.<br>Clair West. Bathurst-Spadina was not included<br>as analysis indicates that it will not be workable<br>for Kitchener service. |
| Fleet        | 0.1  | Assumes additional EMU fleet   |
| Total        | 1.1-1.7  |  |

#### Table B5 Option D: Full GO RER with 4 new stations

| Element      | Capital Cost (\$B, costs do<br>not include escalation,<br>financing costs, lifecycle and<br>operating and maintenance) | Notes   |
|--------------|--|---|
| New Stations | 0.7 – 1.0  | Station locations should be considered<br>representative; specific locations will be<br>recommended through the ongoing new<br>stations analysis. New station infrastructure for<br>4 new stations at Gerrard/Carlaw, Unilever,<br>Liberty Village, and St. Clair West. Bathurst-<br>Spadina was not included as analysis indicates<br>that it will not be workable for Kitchener<br>service. |
| Total        | 0.7 - 1.0  |   |

### Appendix C: Modelling Results Prepared Using the City of Toronto's GTA Model

This appendix presents ridership and related information for GO RER on the Kitchener and Stouffville corridors as well as Options C and D. The ridership forecasts were developed using the City of Toronto's GTA model V4.0 for 2031. The modelling assumes a TTC fare for GO RER passengers between Milliken on the Stouffville Corridor and Mt. Dennis on the Kitchener Corridor (the SmartTrack geography). In terms of land use, it uses a low population, medium employment scenario with land use effects generated by SmartTrack. **Table 1: Business Case Summary Table (TTC Fare)** 

| Indicator  | Base Case - GO RER<br>(Kitchener-<br>Stouffville) | Option C with TTC<br>Fare | Option D with TTC<br>Fare |
|--|---|---------------------------|---------------------------|
| Ridership (annual)                                 | 27.4M   | +8.5M                     | +9M                       |
| Nominal Annual<br>Revenue (\$M 2011<br>Equivalent) |   | +\$8.8                    | +\$12.6                   |

\* 2031 Forecast year

\*\* Land Use: Low population, Medium Employment with SmartTrack Influence

\*\*\* Revenue calculation only accounts for GO and TTC/SmartTrack Fares

| Table 2: | Ridership | and Travel | Time | Summary | (TTC Fare) |
|----------|-----------|------------|------|---------|------------|
|----------|-----------|------------|------|---------|------------|

| Options                   | Ridership                                  | Net New Riders | Transit Rider Travel<br>Time Savings<br>Compared to Base<br>RER (million<br>minutes) |
|---------------------------|--|----------------|--|
| GO RER                    | 27.4 million on<br>Kitchener-Stouffville   |                |  |
| Option C with TTC<br>Fare | +26 million* on<br>Kitchener-Stouffville   | +8.5M          | 491.6**  |
| Option D with TTC<br>Fare | +25.1 million* on<br>Kitchener-Stouffville | +9M            | 517.4**  |

\* The Option C ridership captures both TTC paying customers and those using the new stations. This calculation is done by comparing the ridership in the effected corridors before and after

Option C. This incorporates any negative effect to long-distance riders.

\*\*Compares back to 2031 Base RER Concept

#### Table 3: Financial Information Summary (TTC Fare)

| Nominal Dollars<br>(2011\$ Value) | GO RER | Option C with TTC<br>Fare | Option D With TTC<br>Fare |
|-----------------------------------|--------|---------------------------|---------------------------|
| Annual                            |        |                           |                           |
| Incremental                       |        | . 40.0                    | . 412 C                   |
| revenue to GO                     |        | +\$8.8                    | +\$12.6                   |
| (\$M 2011)*                       |        |                           |                           |

\* Revenue calculation only accounts for GO and TTC/SmartTrack Fares

#### Table 4: Economic Benefits Breakdown (TTC Fare)

|   | Option C with<br>TTC Fare | Option D With<br>TTC Fare |
|---|---------------------------|---------------------------|
| <b>Annual Travel Time Benefit</b> (Compared to GO RER), \$M, 2011                           | 131.1**                   | 138**                     |
| <b>Annual Auto Time Savings</b> (back to GO RER) - due to congestion relief from mode shift | 12.8**                    | 26.6**                    |

\* 2031 Forecast Year

\* Assumes a Value of Time of \$16/hour

\*\* This is an annual travel time benefit. This requires a net-present value calculation to be comparable

### **Appendix D: Ridership, Benefits & Economic Analysis Methodology**

#### Introduction

The RER-SmartTrack analysis of alternative options relies upon an estimate of passenger behaviour in response to changes in service. For Options C and D, the primary change to the service is the introduction of new stations on the line. Those stations have both positive and negative effects for transit passengers:

- Passengers who *use* the new stations save travel time. The *station access time* is lower than it would be without the new station, when access would have to be to the next closest station.
- Passengers who *do not* use the new stations experience a travel delay, due to the extra time required for the train trip due to the new station, typically 2-3 min. per station.
- As a result of the travel time savings and delays, some travellers may shift their route or mode of transportation. There will be both gains and losses of RER passengers due to these route and mode shifts. Some passengers are attracted to RER by the new stations and will shift from an all-TTC transit route to an RER trip or a combined RER+TTC trip. Other passengers are *diverted from RER* due to the longer total travel time and will shift from an RER trip to a bus+subway trip or a driving trip.

To account for the impacts of these new stations on passengers, it is helpful to categorize the different types of passengers into five groups, shown in Table 2.

 Table 2: Segmentation of demand into five groups of passengers, each of whom experiences a new station differently. In the table below "downstream" means locations closer to Union Station than the new station site.

|         | Description  | Would<br>ride<br>GO/RER<br>without<br>new<br>station(s)? | Would<br>ride<br>GO/RER<br>with new<br>station(s)? | Delayed<br>by new<br>station(s)? | Accesses/<br>egresses<br>via new<br>station(s)? |
|---------|--|--|--|----------------------------------|---|
| Group A | Existing & unaffected GO/RER riders<br>(e.g., "downstream" or express riders)  | ✓  | ✓  | ×                                | ×   |
| Group B | Existing "upstream" GO/RER riders<br>(affected but do not change<br>behaviour) | ✓  | ✓  | ✓                                | ×   |
| Group C | Shift GO/RER access station (existing but would prefer new station)            | $\checkmark$   | $\checkmark$                                       | ×                                | ✓   |
| Group D | Attracted to GO/RER (shift<br>route/mode due to easier<br>access/egress)       | ×  | $\checkmark$                                       | ×                                | ✓   |
| Group E | Diverted from GO/RER (existing, shift  | ✓  | ×  | ✓                                | ×   |

route/mode due to delay)

We can see that combining these groups in different manners helps us understand what happens to overall GO/RER ridership:

- **C** + **D** = **Gross riders** at the new station(s)
- **D E** = **Net new riders** on the RER/GO system due to the new station(s)
- **B**, **C**, **D**, **E**: all *affected* by addition of new stations, and experience either a positive or negative time impact. The impact is different for each group.

Using this categorization, a set of metrics can be defined that are useful for understanding the impact of the new stations. The metrics are outlined in Table 3 and Table 4. Table 3: Metrics for ridership and benefits, and the approximate associated mathematical formula. See following table for a guide to the notation in the formulas.

| Metric   | Formula   |  |
|--|---|--|
| Gross riders   | $n_{C} + n_{D}$   |  |
| Net new riders   | $n_D - n_E$   |  |
| Transit rider time savings due to new stations   | $n_B \times \Delta t_B + n_C \times \Delta t_C + \frac{1}{2}(n_D \times \Delta t_D - n_E \times \Delta t_E)$  |  |
| <b>Transit rider time "break even"</b><br><b>metric</b> (ratio of "positive" benefits<br>to "negative" benefit. With this<br>metric, a ratio of 1.0 means the two<br>are balanced and give a net zero<br>benefit.) | $\frac{n_{C} \times \Delta t_{C} + \frac{1}{2}n_{D} \times \Delta t_{D}}{-\left(n_{B} \times \Delta t_{B} - \frac{1}{2}n_{E} \times \Delta t_{E}\right)}$ |  |
| Vehicle kilometre travelled (VKT) savings due to new stations  | $n_D \times \operatorname{auto}_D \times d_D - n_E \times \operatorname{auto}_E \times d_E$   |  |
| Net new revenue to<br>Metrolinx/GO due to new<br>stations  | $n_D \times \$_D - n_E \times \$_E$   |  |

Table 4: Notation used in metric formulas.

| Notation          | Meaning  |
|-------------------|--|
| $n_X$             | Number of riders in group X (trips)  |
| $\Delta t_X$      | Change in travel time for group X (weighted min. / trip)                         |
| auto <sub>X</sub> | Percentage of riders who would otherwise switch modes and drive for the trip (%) |
| $d_X$             | Average distance driven for group X (km / trip)                                  |
| \$ <sub>X</sub>   | Average GO fare for group X (\$ / trip)  |

Generally, the primary drivers of benefits within this framework are:

- Positive benefit: very high employment or full-time post-secondary institution within 1 km (i.e., high AM peak alighting activity)
- Positive benefit: a "through" service stopping at the station after letting most passengers off at Union Station
- Positive benefit: new boarding riders within 1km of station
- Negative benefit: high number of upstream passengers with no express service option to bypass the new stations.
- Negative benefit: high delay at station (e.g., on a diesel locomotive-hauled trip)
- Negative benefit: presence of an attractive parallel transit service (e.g., TTC subway)

#### Implementation

Typically, Metrolinx generates these types of metrics using a four-stage travel demand model such as the Greater Golden Horseshoe Model. However, Metrolinx staff find that it is quite challenging to obtain this level of geographic accuracy for GO Transit services within a four-stage model, particularly when trying to study a wide swath of different station sites. Doing this kind of work requires accurate *station-level* and even *zone-level* forecasts of travel behaviour, on both the access and egress end of the trip.

As an alternative, a spreadsheet analysis system was developed to provide estimates of these metrics at each station with a reasonable level of confidence for this type of finer geographic analysis. In a few cases, key numbers were cross-checked using the Greater Golden Horseshoe Model.

An overview of the analysis approach is shown in Figure 1.



Figure 1: Overview of analysis approach

#### Assumptions

A few key assumptions applied within this framework are shown below:

- **RER ridership and annual growth rates:** based on ridership data from the GO Rail 2031 Ridership (Regional Express Rail scenario 5) report, February 2016. This captures the effects of population/employment growth across the region and the effects of the RER service introduction.
- Future real estate development and population/employment growth: generally, based on the assumption that population growth due to development at each "new station" site is similar to the growth at other stations on the line. In two special cases where very major office developments are committed and proceeding close to potential station sites in downtown Toronto, they have been included in the analysis (The Well at Spadina/Front St. W, Globe & Mail Centre at King E/Berkeley).

Developments that are *conditional* on a new station are not typically included in this type of cost-benefit analysis.

- **Transit network assumptions:** based on the inclusion of all committed rapid transit projects: the Toronto-York Spadina Subway Extension, Mississauga Transitway, York Region VIVA on Higway 7 and Yonge St., Eglinton Crosstown LRT, Sheppard E LRT, Finch W LRT, Scarborough Subway Extension, Hurontario LRT, and Hamilton LRT. For local transit, today's network is largely assumed, except for inclusion of several new downtown Toronto routes. For downtown Toronto, the Waterfront streetcar plan was included, based on the concept prior to the recent "reset" of planning.
- **Detailed alightings analysis:** this more elaborate calculation framework was applied for several downtown station sites, specifically all station sites between Lansdowne/Dundas and Gerrard/Pape.
- **Fare integration:** based on today's transit fare structure. There is currently work underway to define potential alternate regional fare structures, but a decision has not yet been made about a preferred structure, and a multi-agency revenue sharing agreement.
- Access modes: are assumed to be fairly similar to today. Drive ("park & ride"), passenger drop-off / carpool ("kiss & ride") and walking are the predominant access modes. Transit access is quite modest, just 4% of trips within the City of Toronto and 9% outside the City of Toronto. Walk access is particularly important for stations within the City of Toronto, making up 23% of all trips.
- Services at downtown stations: at the Unilever and Gerrard E station sites, only passengers who are travelling on the Kitchener and Stouffville lines are considered. (It may be feasible to provide service from several lines passengers who live on Lakeshore East, Lakeshore West or the Richmond Hill lines may also be able to travel directly to these station locations.) All services are considered simultaneously in a separate study on the new stations individually.
- **Independent analysis of new stations**: the new stations are analyzed independently and their riders and benefits are simply added. For the stations under consideration here, this is deemed appropriate.
- Services through Union Station: in the peak period, many Kitchener and Stouffville trains will go out of service after Union Station. Only a partial set of services will operate "through" Union, allowing (say) an Agincourt passenger to access a potential new station at Liberty Village. Many Kitchener/Stouffville stations in the outer ends of the lines will not have any "through" service to access stations beyond Union. For this analysis, it is assumed that 50% of Kitchener and Stouffville passengers have easy access to a train that continues past Union Station in revenue service to access new stations on the other side.

Several of the more detailed ridership and economic assumptions are shown in the following tables.

 Table 5: Table of general benefits and ridership assumptions for RER-SmartTrack analysis.

| Benefits and Ridership Parameters   | Value |      |
|---|-------|------|
| Train Schedule Effects of New Station   |       |      |
| EMU train   | 2.0   | min. |
| 12-car electric locomotive train  | 2.5   | min. |
| 12-car diesel locomotive train  | 3.0   | min. |
| Reduced delay for stations in "slow" track sections   | -0.17 | min. |
| Passenger delay associated with waiting at Union<br>Station, for through trips                                      | 5.0   | min. |
| Travel Time Weighting/Calculations  |       |      |
| Walk Speed  | 5.0   | km/h |
| Walk time weight  | 2.5   | х    |
| Wait time weight  | 2.5   | х    |
| Transfer penalty (surface)  | 12.5  | min. |
| Transfer penalty (to subway)  | 5.0   | min. |
| Line-level average statistics   |       |      |
| Elasticity of ridership w.r.t. in-vehicle time  |       |      |
| Kitchener   | -0.5  |      |
| Stouffville   | -0.8  |      |
| Miscellaneous   |       |      |
| Concession fare factor  | 0.76  |      |
| % of new/lost riders switching from/to auto drive mode  | 20%   |      |
| Annual Growth Rates   |       |      |
| For 2013-2031, including the one-time effect<br>of introducing RER service ("RER" from GO<br>2031 ridership report) |       |      |
| Kitchener   | 4.6%  |      |
| Stouffville   | 4.0%  |      |
| For 2032-2044, based on the "natural" growth<br>rate of ridership ("Do Nothing" from GO 2031<br>ridership report)   |       |      |
| Kitchener   | 3.0%  |      |
| Stouffville   | 1.9%  |      |

| Interpretations to account for RER changes   |     |                         |
|--|-----|-------------------------|
| % of Kitchener outer passengers who use express trains   | 50% |                         |
| % of Kitchener line passengers who can alight at a new station on non-express section          | 90% |                         |
| % of Kitchener passengers whose closest station has a peak service that goes "through" Union   | 50% |                         |
| % of Stouffville passengers whose closest station has a peak service that goes "through" Union | 50% |                         |
| Peak-to-Daily factors  |     |                         |
| Generic  |     |                         |
| Conversion from peak ridership to daily, for a peak-only service                               | 2.0 |                         |
| Conversion from peak ridership to daily, for an all-<br>day 15 min. service                    | 2.9 |                         |
| Conversion from peak ridership to daily, for an all-<br>day 60 min. service                    | 2.4 |                         |
| Line-specific, usually based on RER service  |     |                         |
| Kitchener inner - Bramalea and closer  | 2.9 |                         |
| Kitchener outer - Beyond Bramalea  | 2.0 |                         |
| Stouffville inner - Unionville and closer  | 2.9 |                         |
| Daily-to-Annual factors  |     |                         |
| Generic  |     |                         |
| No weekend service   | 250 | weekday-<br>equivs/year |
| For a weekend 15 min. service  | 300 | weekday-<br>equivs/year |
| For a weekend 60 min. service  | 265 | weekday-<br>equivs/year |
| Line-specific, usually based on RER service  |     |                         |
| Kitchener inner - Bramalea and closer  | 300 |                         |
| Kitchener outer - Beyond Bramalea  | 250 |                         |
| Stouffville inner - Unionville and closer  | 300 |                         |

 Table 6: Table of economic assumptions for RER-SmartTrack analysis.

| Economic Assumptions                   | Value       |                |
|--|-------------|----------------|
| General                                |             |                |
| Project Evaluation Period              | 60          | years          |
| Discount Rate                          | 3.5%        |                |
| Growth Cap – Year all growth set to 0% | 2044        |                |
| Valuation and Growth Rates             |             |                |
| Value of Time                          | \$16.1<br>3 | \$/hr (\$2015) |
| Value of Time Growth Rate              | 1.6%        |                |
| Auto Operating Cost                    | \$0.63      | \$/km (\$2015) |
| Auto Operating Cost Growth Rate        | 0.7%        |                |
| Accident Reduction Benefit             | \$0.08      | \$/km (\$2015) |
| Accident Reduction Benefit Growth Rate | 0%          |                |
| Congestion Reduction                   | 0.01        | hrs/km         |
| Congestion Reduction Growth Rate       | 0%          |                |
| Environmental Benefits                 | \$0.01      | \$/km (\$2015) |
| Environmental Benefit Growth Rate      | 0%          |                |