Interim Report

METROLINX

GO RAIL OPTIONS BENEFITS CASE ASSESSMENT

May 2010

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Study Objectives

In 2006 the Province of Ontario created the Greater Toronto Transportation Authority, later renamed to Metrolinx in December 2007. The primary responsibility of the new organisation is to provide leadership in the planning, financing and development of the Greater Toronto and Hamilton Area's (GTHA) multi-modal transportation network and to conform to the objectives and vision set out in the Province's Greater Golden Horseshoe Growth Plan.

Building on the Province's $11.5 billion MoveOntario 2020 funding commitment for rapid transit expansion in the GTHA, Metrolinx developed the Regional Transportation Plan (RTP) to improve mobility throughout the GTHA Region. The final RTP, entitled The Big Move, was approved by the Metrolinx Board of Directors in November 2008.

As the rapid transit projects contemplated in the RTP move closer to implementation, a Benefits Case Analysis will be prepared for each project. The purpose of the Benefits Case Analysis is to undertake a comparative evaluation of feasible options for a specific transit project to assist decision makers in selecting a preferred option for implementation.

This study assessed enhanced commuter rail services in the GTHA. In the Lakeshore East corridor the principal enhancement has been the extension of all day services to Bowmanville. In the other four corridors – Milton, Barrie, Richmond Hill and Stouffville – the study examined the impact of a significant increase in peak service frequencies, to six trains per hour, the provision of two way peak and off-peak service. New stations were also included in the analysis, including the extension of the Richmond Hill line to Bloomington Road. These enhancements to GO Rail services were identified in the RTP as being among the 15 top priority transit projects for early implementation

The major objective of the study has been to assess the provision of new all-day, two way off-peak and weekend services on the Milton, Barrie, Richmond Hill and Stouffville lines. These have been assumed to operate at two trains per direction per hour on all lines, including the Lakeshore East line.

It has been assumed that services are provided by diesel-powered locomotives and bi-level coaches similar to those currently providing GO commuter rail services. Current signalling systems, which are assumed to allow a maximum service frequency of six trains per hour, have also been assumed. A summary of the options can be found in Table 1.

Metrolinx is currently carrying out a broader study on the potential merits of the electrification of the GO Rail network. The GO Transit System Electrification Study is expected to be completed in 2010.

Table 1: Summary of Options

Options	Barrie	Lakeshore East	Milton	Richmond Hill	Stouffville
Power Source	Diesel	Diesel	Diesel	Diesel	**Results Pending**
Coach Type	Bi-level	Bi-level	Bi-level	Bi-level	
Train length	10 coaches	10 coaches	10 coaches	10 coaches	
Number of trains (2031)	14	14	11	11	
Maximum number of peak hour trains (inbound)	6	6	6	6	
Peak hour capacity – 2031 inbound	9,510	9,510	9,510	9,510	
Minimum travel time – inbound, express, minutes	89	62	48	47	
Minimum travel time – inbound, all stations, minutes	98	73	60	55	
Capital costs ($ million)[1]	958	623	910	856	
Annual incremental operating costs in 2031 ($ million)[2]	94	79	54	56	

[1] The capital costs presented in this report should be considered indicative and represent point in time estimates for the purpose of project evaluation and project selection. The costs will be refined as projects move into design, procurement and implementation, and are therefore not intended for budgeting purposes. The costs include the costs of additional rolling stock.

[2] The estimates of the operating costs of proposed services are, as are the estimates of capital costs, "rough order of magnitude" estimates for the purposes of this assessment. They will need to be refined as services move towards implementation.

Principal Findings

The assessment of options is based on the Multiple Account Evaluation (MAE) methodology used by Metrolinx for other Benefits Case Analyses for other priority projects. The ridership forecasts underpinning the assessment have been produced for the AM peak period from a model which mirrors the GO Rail Direct Demand Model. Off-peak ridership forecasts have been derived as a proportion of peak ridership based on the current experience on the Lakeshore Line and on other North American and European experience.

The MAE framework provides a systematic identification and analysis of broader public policy implications and criteria of an option, not only costs and user benefits. The MAE framework is based on a number of evaluation "accounts" that together address the most significant project performance and policy considerations for a specific project:

- Transportation User Benefits;
- Financial Impacts;
- Environmental Impacts;
- Economic Development Impacts; and
- Socio-Community Impacts.

The assessment compares each option to the Base Case, essentially the continuation of current services in each corridor. Incremental impacts, costs or benefits generated by each option are identified. The analysis is done over a 30-year period (2009-2038). In order to compare the options on a "like-for-like" basis the monetised values are discounted to today's value at a real discount rate of 5% and expressed in net present values in 2008 dollars.

Table 2 summarises the results from the MAE.

Table 2: Multiple Account Evaluation Summary

	Barrie	Lakeshore East	Milton	Richmond Hill	Stouffville
Transportation User Account					
Transportation User Benefits (PV $m)	2,598	662	2,130	1,441	
Qualitative User Benefits	✓✓	✓✓	✓✓	✓✓	
Financial Account					
Costs (PV $m)	1,505	1,104	1,230	1,118	
Benefits less Costs (PV $m)	1,093	(442)	900	323	
Benefit :Cost Ratio	1.7:1	0.6:1	1.7:1	1.3:1	
Environmental Account					
GHG Emissions (PV $m)	16	4	14	10	
Qualitative Environmental Impacts	✓	✓	✓	✓	**Results Pending**
Economic Development Account					
Economic Impacts During Construction (PV $m)	545	351	528	482	
Long-term Economic Impacts (PV $m)	113	26	94	69	
Development Potential	✓	✓	✓	✓	
Social Community Account					
Land Use Shaping	✓✓	✓✓	✓✓	✓✓	
Health	✓✓	✓✓	✓✓	✓✓	
Accessibility	✓✓	✓✓	✓✓	✓✓	

The analysis shows that in three corridors – Barrie, Milton and Richmond Hill – the options appraised, of higher frequency peak period services, new all-day, two-way services and some new stations, generate benefit:cost ratios of 1.7:1, 1.7:1, and 1.3:1, respectively.

In the Lakeshore East extension to Bowmanville the benefit:cost ratio is less than 1:1, with costs outweighing benefits. This assessment includes only those benefits accruing to areas served by the extension from Oshawa to Bowmanville. Analysis of the spatial distribution of benefits showed that these were 71% of total corridor benefits, with the other 29% of benefits being generated from areas west of Oshawa from some changes in service frequencies in peak and off-peak periods and faster journey times from an increased number of express services. A separate Benefits Case Analysis has been completed for the balance of the Lakeshore East and West corridors between Hamilton and Oshawa, which examined the potential benefits and impacts of electrified, express rail service.

It is in the Barrie, Milton and Richmond Hill corridors where the proposed service changes are most effective in attracting people out of their cars and reducing automobile usage. In these corridors the time savings to continuing auto users almost equal the total time savings to transit users. These corridors also generate the largest reductions in greenhouse gas emissions from reduced auto use, with annual savings by 2031 amounting to 33,000 tonnes in the Barrie corridor, 30,000 tonnes in the Milton corridor and 20,000 tonnes in the Richmond Hill corridor.

There are positive economic development benefits generated by the proposed capital expenditures in each corridor. Benefits during the construction period are related to expenditure during the period. GDP benefits range between $351 million on the Bowmanville extension and $545 million on the Barrie line.

In the longer term, there will be on-going economic benefits arising largely from reduced expenditure on vehicle operation. Annual (2031) GDP benefits from these sources range between $37 million on the Lakeshore East extension to Bowmanville and $113 million on the Barrie line.

Enhanced GO Rail services in each corridor, including all-day and weekend services, will make these corridors more attractive residential locations and some uplift in residential land values can be expected. A score of ✓out of ✓✓✓ is given since in each corridor the peak frequency is limited to six diesel trains per

hour. Higher frequency services and electrified services would have greater impacts on land values.

Under the Social Community Account the changes in services and resulting changes in lifestyles in each corridor have been given scores of ✓✓out of ✓✓✓. Again higher frequency services could be expected to have a greater impact. In each corridor the service enhancements will improve regional connectivity between Urban Growth Centres (UGCs) identified in the Greater Golden Horseshoe Growth Plan and will make aspirations for population growth more achievable.

1 Introduction

1.1 *Introduction to Study*

In 2006 the Province of Ontario created the Greater Toronto Transportation Authority, later renamed to Metrolinx in December 2007. The primary responsibility of the new organisation is to provide leadership in the planning, financing and development of the Greater Toronto and Hamilton Area's (GTHA) multi-modal transportation network and to conform to the objectives and vision set out in the Province's Greater Golden Horseshoe Growth Plan.

Building on the Province's $11.5 billion MoveOntario 2020 funding commitment for rapid transit expansion in the GTHA, Metrolinx developed the Regional Transportation Plan (RTP) to improve mobility throughout the GTHA Region. The final RTP, entitled The Big Move, was approved by the Metrolinx Board of Directors in November 2008.

As the rapid transit projects contemplated in the RTP move closer to implementation, a Benefits Case Analysis will be prepared for each project. The purpose of the Benefits Case Analysis is to undertake a comparative evaluation of feasible options for a specific transit project to assist decision makers in selecting a preferred option for implementation.

This study is a contribution to Metrolinx' assessment of its 15 highest priority transit expansion schemes as identified in the Regional Transportation Plan (RTP), entitled the Big Move. It has undertaken benefits case assessments of enhanced GO commuter rail services in five corridors. The enhancements include higher peak period frequencies in both, peak and counter-peak, directions, the introduction of two-way, all-day rail services in each corridor and the extension of rail services beyond current terminal stations in some corridors.

The study has been undertaken by a joint team from Halcrow, Hatch Mott MacDonald and Delcan. Halcrow has been responsible for the study management and the overall benefits case assessment, Hatch Mott MacDonald and Delcan have been responsible for the 'engineering' elements of the study, identifying the measures needed to increase capacity in each corridor to allow higher frequency services and preparing the estimates of capital and operating and maintenance costs.

The principal objectives of the study have been to assess the Benefits Case for:

- Higher frequency services and extensions of commuter rail services to select locations currently served by GO Transit's Train-Bus services, including Bloomington on the Richmond Hill Corridor and Bowmanville on the Lakeshore East Corridor; and

- Two-way, all-day services on lines which currently have mainly peak-period, peak-direction rail services.

The study assessed options in five corridors – Milton, Barrie, Richmond Hill, Stouffville and Lakeshore East. The assessment is based on transportation demand model forecasts for 2021 and 2031 and considers the effects of the service enhancements over the period to 2038.

1.2 Introduction to Report

Chapter Two sets out the planning context into which the rail enhancements would fit and summarises the planning projections which inform the appraisal. It draws on the RTP, GO Transit's GO 2020 Strategic Plan, which provides the basis for the 2021 service levels assumed in this study, the Growth Plan for the Greater Golden Horseshoe and the planning projections to 2031 derived on the basis of that growth plan.

Chapter Three introduces the development of the options assessed in each corridor.

Chapter Four introduces the transportation modelling undertaken to give ridership forecasts and provide the basis for the estimation of the user benefits of each option. It also briefly describes the approaches to estimating the principal impacts of the different options.

Chapters Five to Nine follow the same formats. For each corridor in turn they set out the service enhancements assessed, the engineering works and their costs needed in each corridor, and summarise the findings of the Benefits Case Assessments.

- Chapter Five – Barrie Corridor
- Chapter Six – Bowmanville Corridor
- Chapter Seven – Milton Corridor
- Chapter Eight – Richmond Hill Corridor
- Chapter Nine – Stouffville Corridor (Results Pending)

2 Planning Context

2.1 Regional Transport Plan

The RTP for the Greater Toronto and Hamilton Area (GTHA) was approved by the Metrolinx Board in November 2008. This contains a vision, goals and objectives, and an investment strategy for transportation in the GTHA area over the next 25 years. The aim of the RTP is to achieve a transportation system for the GTHA that is effective, integrated, and multi-modal.

The first of the nine "Big Moves" in the RTP is to 'Build a Comprehensive Regional Rapid Transit Network', with expanded GO Rail services as well as numerous subway, light rail transit and bus rapid transit corridors at the heart of the improved network. The RTP also identified 15 top priority transit projects for early implementation, including the following GO Rail projects:

- Express Rail on the Lakeshore Line from Hamilton to Oshawa, and
- Improvements to existing GO Rail services and extension of the GO Rail service to Bowmanville.

In the context of this study, 'Improvements to existing GO Rail services' has been further defined to focus on the development of all-day, two-way services, in addition to the extension of the Lakeshore East corridor to Bowmanville. The GO Lakeshore Express Rail project is the subject of a separate benefits case analysis that has been completed for Metrolinx.

In years 16 to 25 of the RTP, additional Express Rail services are proposed, including to Cooksville on the Milton Line and to the Richmond Hill/Langstaff Gateway.

The RTP suggests that over the 25 years, Union Station will see a quadrupling of passenger traffic in the morning peak hour as a result of this expansion of the regional rapid transit network, with improvements to tracks, platforms, and passenger circulation needed to accommodate the services proposed in the RTP.

Also contributing to the growth in transit ridership over the RTP period is the proposal for a region-wide integrated ticketing and transit fare system which would allow users to pay a seamless, integrated fare for all transit systems across the region.

2.2 GO 2020

GO Transit's *GO 2020* Strategic Plan sets the strategic direction to the year 2020 presenting a new vision for the future of transit in the region.

GO 2020's first objective is to deliver a high-quality interregional transit service throughout the Greater Golden Horseshoe. By 2020 GO ridership to the Toronto core, served by Union Station, will more than double, and GO ridership outside the Toronto core will triple. To meet this increased demand, *GO 2020* includes a 2020 service plan and a capital program covering all parts of the GO network.

The *GO 2020* service plan includes all-day, two-way operations on all existing lines and enhanced peak period services. To provide sufficient capacity for these service improvements, significant capital investments will be required in all corridors for track expansion and signalling system improvements to increase capacity and operational effectiveness.

The service level improvements for 2021 in each corridor, in chapter five to nine, are based on the *GO 2020* service plans, modified slightly to extend all-day, two-way service to the terminus of each corridor.

2.2.1 Growth Plan for the Greater Golden Horseshoe

The 2006 Growth Plan designated 25 Urban Growth Centres (UGCs) in the Greater Golden Horseshoe of which 17 are in the GTHA.

The nine UGCs of greatest relevance to the GO Rail lines covered in this study are as follows:

Urban Growth Centre	GO Rail facility
Downtown Toronto	Union Station
Downtown Pickering	Lakeshore East line
Downtown Oshawa	Lakeshore East line
Markham Centre	Stouffville line
Richmond Hill/Langstaff Gateway	Richmond Hill line
Newmarket Centre	Barrie line
Downtown Barrie	Barrie line
Etobicoke Centre	Milton line
Downtown Milton	Milton line

With the exception of Downtown Barrie, which is outside the boundaries of the RTP, the other eight UGCs noted above are also designated as Mobility Hubs (Anchor Hubs) - in the Regional Transportation Plan. These mobility hubs, at key intersections in the regional rapid transit network, provide trip makers with access to the system and support high density development. These mobility hubs will provide:

- Locations where transportation modes will come together, including local transit service, cycling and pedestrian networks, and car-share drop-off areas;
- Locations for major destinations such as office buildings, hospitals, educational facilities and government services; and
- Amenities for trip-makers such as waiting areas, information centres, cafés, restaurants and other services.

2.3 Land Use Projections for the Greater Golden Horseshoe

The population and employment projections reported in Land Use Projections for the Greater Golden Horseshoe, February 2008 were developed to serve the Greater Golden Horseshoe Model and they take account of the Greater Golden Horseshoe Growth Plan land use designations and intensification targets including Urban Growth Centres. These projections underpin the demand forecasts reported here.

Much of the travel demand catchments for the five corridors being assessed here fall within the Greater Toronto Area. Population and employment data for 2001 and projections for 2031 for the Greater Golden Horseshoe area and for the regions within the Greater Toronto Area are set out in Table 2-1 below.

For the Greater Golden Horseshoe and Greater Toronto areas as a whole, population and employment totals are forecast to increase by approximately 50% to 2031. The populations in many of the regions of the Greater Toronto Area served by GO Rail lines are forecast to increase even more, by approximately 100% in Halton and York, for example. In contrast, employment in Toronto, which generates most current GO Rail trips, is forecast to grow by only 14%.

Table 2-1: Land Use Projections for the Greater Golden Horseshoe

Region	Population			Employment		
	2001	2031	% growth	2001	2031	% growth
Toronto	2,590,000	3,080,000	19%	1,440,000	1,640,000	14%
Durham	530,000	960,000	81%	190,000	350,000	84%
York	760,000	1,500,000	97%	390,000	780,000	100%
Peel	1,030,000	1,640,000	59%	530,000	870,000	64%
Halton	390,000	780,000	100%	190,000	390,000	105%
Greater Toronto Area	**5,300,000**	**7,960,000**	**50%**	**2,740,000**	**4,030,000**	**47%**
Greater Golden Horseshoe	**7,790,000**	**11,502,000**	**48%**	**3,818,000**	**5,564,000**	**46%**

3 Options Assessed

3.1 Current Services and Ridership

The current services and ridership levels in each corridor are summarised in Table 3-1. This data relates to a morning peak hour only, taken to be arrivals at Union Station between 0730 and 0830 hours. There are either two or three services per peak hour on each line, except on the Lakeshore East line where there are three express and two all stations services.

Table 3-1: Current Rail Services and Passenger Loadings, AM peak hour

Description	Lakeshore East		Milton	Barrie	Richmond Hill	Stouffville
	Express	Local				
AM peak hour inbound service	3	2	3	2	2	2
October 2008 AM peak hour inbound max. line loading	6,420	3,150	5,700	3,740	2,600	4,150
Train length – cars	10	10	12	10	10	10
Seating capacity at peak load point	4,755	3,170	5,720	3,170	3,170	3,170
Peak load as % of seating capacity	135%	99%	100%	118%	82%	131%

The services are well utilised, with morning peak hour peak loads varying between 82% and 135% of seating capacity on different lines.

In recent years, GO Rail services have played a prominent role in facilitating growth in downtown Toronto. Table 3-2 summarises trips into Planning District 1 – downtown Toronto - by mode based on Transportation Tomorrow Survey (TTS) results from 1986, 1996, and 2006.

Trips by the two main modes (local transit and auto) were no higher in 2006 than they had been in 1986. On the other hand, over the same period, GO trips have grown by 38,000 (160%) while other trips (mostly walk) have grown by 11,000 (55%).

Table 3-2: AM Peak Period Trip Estimates to Downtown Toronto (PD1), x1000 (TTS Surveys)

Mode	1986	1996	2006
GO Related	24	38	62
Local Transit	160	131	153
Auto Related	114	127	112
Other	20	25	31
Total	**318**	**321**	**358**

3.2 Development of Options

The options assessed in these corridors relate principally to higher frequency services in peak periods, extensions of rail services to serve new stations, and to the provision of two-way, all-day services in each corridor.

The purpose of this BCA is to evaluate the GO Rail improvements identified as top 15 priority projects in the RTP, which involve expanded, all-day service on the Milton, Barrie, Richmond Hill and Stouffville corridors, as well as the extension of the Lakeshore East line to Bowmanville. Longer-term investments identified in the RTP, including Express Rail services on the Milton and Richmond Hill corridors, are beyond the scope of this analysis. As such, the study has assumed that current technologies continue to apply in each corridor. It has been assumed that the current type of rolling stock is hauled by diesel locomotives rather than electrification; and that the current signalling technology remains. Based on the limitation of current signalling technology, a conservative limit on maximum service frequencies of six trains per direction per hour was assumed.

Metrolinx is currently carrying out a broader study on the potential merits of the electrification of the GO Rail network. The GO Transit System Electrification Study is expected to be completed in 2010.

For each corridor, the service improvements assessed, referred to as the "Do Something" scenario, include the following:

- Peak period service frequencies – increased peak direction frequencies are assumed in each corridor. By 2031, assumed maximum service frequencies of six trains per hour (three express and three local) are assumed for each corridor. In the counter-peak direction we assume at least two trains per hour in each corridor.

- Off-peak period services – off-peak services of two or three trains per hour in each direction in each corridor are assumed.

- Stations served – in each corridor new stations are assessed – see Table 3-3 – and some stations are relocated.

Table 3-3: New Stations

Corridor	New stations
Barrie	Allandale, Innisfil, Downsview (replaces existing York University Station)
Bowmanville	Oshawa 1 and 2 (replaces existing Oshawa Station), Courtice Road, Bowmanville
Milton	Bloor
Richmond Hill	Bloomington, Stouffville (Gormley)

The options are appraised against a Do Minimum which is the continuation of existing services in each corridor. Thus the appraisal measures the incremental costs incurred and the benefits obtained from enhancing service levels from current levels to those assumed for 2021 and 2031.

The extensions to existing commuter rail services make use of existing rights of way, with the exception of the extension to Bowmanville where it is assumed a new section of track in Oshawa will connect to the CP track alignment following the recommendation of the Oshawa East Track Extension and New Rail Maintenance Facility study completed April 2009.

Some system-wide issues, notably in relation to Union Station and maintenance yards, are raised by these options.

GO 2020 and the RTP both refer to Union Station which is expected to remain the downtown Toronto focus of GO Rail services. *GO 2020* refers to GO ridership to the Toronto core served by Union Station more than doubling by 2020. To accommodate this growth in demand 'efficient use of all platforms in an integrated operation, along with expanded and improved tracks, platforms, waiting areas, and customer services, will be required'.

In this work, it has been assumed that in the forecast years Union Station will be able to accommodate the forecast train movements and passenger movements for both forecast years in a reasonably efficient way, without undue delay or crowding, but further analysis will be required to substantiate this assumption. No allowance has been made for any costs incurred in adapting Union Station to accommodate the services assumed here.

Two studies are currently underway by Metrolinx related to this issue. The first is focused on determining the demands on Union Station platform and track capacity and the Union Station Rail Corridor (USRC) rail and signal capacity, and quantifying the growth in platform space required and developing a staging plan for the next five to 25 years. The second is a broader and related study to examine GTHA system-wide options beyond Union Station for meeting the additional 2031 demand and capacity needs. These studies will be coordinated with the broader GO Transit System Electrification Study.

Similarly, at this stage it has been assumed that suitable maintenance facilities can be provided for the enhanced fleet of locomotives and rolling stock. GO Transit have determined that a new maintenance facility additional to Willowbrook is now required and current plans envisage a facility in the Whitby area. A cost estimate of $73 million, plus engineering and project management costs at 31.75%, is allowed for a facility in the Feasibility Study for Oshawa East Track Extension and New Rail Maintenance Facility, 2009, undertaken by AECOM for GO Transit. This cost has been included in this study by adding $20 million to the capital costs in each corridor as a means of spreading the capital cost of the facility across the network to be served.

The options assessed in each corridor are described more fully in Chapters five to nine.

4 Approach to Assessment of Options

4.1 *Metrolinx BCA Template*

The assessments reported here follow the assessment template established by Metrolinx for evaluating transit project options. The principal impacts quantified and given money values are: capital costs and operating costs, including impacts on bus operating costs; transportation user benefits in the forms of travel time savings, auto operating cost savings and safety benefits; fare revenues, and greenhouse gas emissions.

Other impacts – including environmental impacts, wider economic and social community impacts and land value uplift – are also addressed in either qualitative or quantitative terms.

This chapter introduces the approaches to the measurement of the different impacts. The cost estimates, demand forecasts and other estimates reported here have been developed specifically for this study, and may differ from those contained in other documents such as the RTP.

4.2 *Capital Costs*

Capital costs are high-level estimates drawing on a number of sources. The infrastructure works required in each corridor to accommodate the proposed enhanced service levels have been checked against the proposals in different feasibility study reports for the different corridors.

The costs of these works have not only been checked against the feasibility studies' cost estimates, but, also against a set of 2008 unit costs derived from Hatch Mott MacDonald's "rough order of magnitude" estimates produced for the Lakeshore line electrification study. High levels of contingency allowance, ranging between 55% and 85%, have been applied to these cost estimates. An allowance of 26% is applied to estimated costs to allow for Engineering and Project Management.

The estimated cost of new rolling stock is $32 million for a diesel locomotive and 10 bi-level coaches.

Property costs are outside the scope of this study and have not been included in the cost estimates of this study. The extent of the alignment planning and engineering design work undertaken at this stage does not reliably allow for the identification of property requirements or the estimation of its costs. It is almost inevitable that some additional property will be required to accommodate enhanced service levels in these corridors. As a result, the omission of property costs suggests that the capital costs provided in this study may be underestimated to some extent.

4.3 Operating and Maintenance Costs

The proposed service plans, with all-day train services, represent a significant change in operations from the current, peak-only service. This in turn means that the set of unit operating and maintenance costs applicable to current services will not be applicable to the proposed services. The Rail Services division of GO Transit has produced "rough order of magnitude" operating and maintenance (O&M) cost estimates for the proposed services based on previous costs developed for the RTP. Allowances are also made for the O&M costs associated with the new maintenance facility and layover facilities, for the capital renewal of track and signal structures and for station operating costs.

The Rail Services division has also produced estimates of the O&M costs by corridor for the current service provision to be used in estimating Do Minimum costs.

In addition, GO Transit staff provided estimates of the variable operating costs of Train-Bus services in these corridors which would be saved when all-day rail services replaced the Train-Bus services.

4.4 Transport Modelling

This study's approach to transport modelling and appraisal makes use of:

- GO Rail's long-standing Direct Demand Model, particularly as described in GO Rail's Forecasts, Peter Dalton Consulting, March 19 2009;
- The Greater Golden Horseshoe Transportation Model (GGHM) which provides estimates of travel time differences to feed into the assessment template developed for these Metrolinx Benefits Case assessments; and
- An off-peak ridership forecasting approach that makes use of information from the Lakeshore line, as well as other modelling and observed experience from elsewhere, given this study's emphasis on introducing two-way, all-day

and weekend GO Rail services and the peak period-only nature of the two models referred to above.

Over the years GO Rail has maintained a direct demand model to prepare ridership forecasts. It is referred to as a 'direct demand model' since it forecasts demand for GO Rail directly from relevant factors including population growth in the catchment areas of GO Rail lines and stations, employment growth in downtown Toronto (in the constrained forecasts), and service level changes, including service frequencies, train travel times (including the provision of express services) and new rail stations.

A weakness of this modelling approach lies in the modelling of trips which could take advantage of the opportunities for interchange presented, for example, at Bloor station on the Milton line or Downsview station on the Barrie line. The modelling approach cannot recognise the range of trip attractions opened up by the interchange facility so is likely to under-forecast the trips which might be expected to make use of GO Rail services and these interchange opportunities.

The peak period forecasts used in this study have been derived from a Direct Demand Model produced by Halcrow which is based on GO Rail's Direct Demand Model.

The Greater Golden Horseshoe Model provides estimates of travel time differences by transit and auto and auto cost savings as well as other impacts (benefits) to feed into the assessment template developed for these Metrolinx Benefits Case assessments. The benefits quoted in this document have been derived from the GGHM but with adjustments made so they correspond to the additional riders forecast in each corridor by the Direct Demand Model.

Given the importance of the introduction of two-way, all day and weekend GO Rail services in this study, a new approach to forecasting off-peak ridership, which is not addressed in either the Direct Demand Model or the Greater Golden Horseshoe Model, was needed.

This was developed making use of available information from the Lakeshore line, as well as other modelling and observed experience from elsewhere in North America and Europe.

The resulting ridership forecasts, for peak periods and off-peak periods in 2021 and 2031, are given for each corridor in the following five chapters and a fuller description of the approach to transport modelling is given in Appendix A to this document.

4.5 Transportation User Benefits

The transportation user benefits estimated include: travel time savings to transit users and road users; auto operating cost savings; and safety benefits on the road network. Auto operating cost savings and safety benefits arise from the reduction in auto kilometres travelled.

The BCA template was set up to take estimated differences – in travel times or vehicle kilometres, for example – between Do Minimum and Do Something model runs in 2021 and 2031. These estimates are then converted to the present values of the different benefit items.

In this study, we have applied the template following the same procedure, but with the following two adjustments:

- The addition of another step to account for the different ridership forecasts being used, as referred to in Section 4.3 above; and
- Different factors being used to convert from the modelled peak period to all-day, weekly and annual totals as explained in the Appendix to this Report.

The time savings to transit users have been estimated from a consumer surplus calculation of in-vehicle time differences. Auto time savings and differences in auto vehicle kilometres have been estimated from the difference in network totals between the Do Minimum and Do Something.

4.5.1 Factoring for Different Ridership Forecasts

The GGHM provides estimates of the differences in transit and auto travel times or vehicle kilometres between Do Minimum and Do Something and also provides estimates of the difference in GO Rail and car trips between Do Minimum and Do Something. Initially the benefits to transport users – time savings, the benefits resulting from changes in auto kilometres – are estimated on the basis of GGHM model outputs and then factored to reflect the Direct Demand Model's demand forecasts.

The factor applied in each corridor is the difference in the Direct Demand Model's forecasts of Do Something and Do Minimum ridership divided by the GGHM Model's forecasts for the two scenarios.

4.6 Financial Account

The Financial Account measures the changes in public sector finances resulting from the enhanced services. It takes account of the additional operating and maintenance costs involved, the savings in variable bus operating costs from the withdrawal of bus services in these rail corridors, and the passenger revenues the enhanced services will generate.

4.7 Environmental Impacts

The principal environmental impact of enhanced transit is expected to be the reduction in greenhouse gas emissions as a result of reduced automobile usage. Greenhouse gas reductions are estimated in terms of tonnes of CO_2 which are converted to a dollar value.

Other environmental impacts, principally noise and air pollution impacts, are assessed on a qualitative basis.

4.8 Economic Impacts

The broader economic impacts of the options are measured in terms of their impacts on employment, income and GDP, and on land values.

During the construction period, the estimates reflect the *direct* impacts the options will have on households and businesses in the region as well as the further *indirect* impacts on employment, wages and GDP. These estimates are based on Province of Ontario multipliers, 2004, which convert capital costs into employment, wages and GDP as shown in Table 4-1 below.

During the period of operation of enhanced rail services, savings in auto operating costs are the driver of wider economic benefits, with GDP benefits being 9.5% of auto cost savings.

Other economic impacts – transport user benefits – have been discussed above while land value impacts are discussed below.

Table 4-1: Estimation of Other Economic Benefits per $ million of Capital Costs

Economic Benefit	Units	Direct Benefits	Direct and Indirect Benefits
Employment	Person years	5.85	9.05
Wages	$ million	0.22	0.34
GDP	$ million	0.56	0.87

4.9 ***Land Value Changes***

Much of the empirical work investigating the relationship between transit accessibility and property prices has focused on residential property and has aimed to identify the premium to be paid for houses with good access to transit or the discount rate which sets a time stream of future travel time savings equal to the higher property cost of a house located close to transit. The findings from this empirical work are:

- Generally, a premium is found for houses within a mile of a station;
- Among the numerous survey papers, Vessali 1996[3] surveyed thirty-seven studies, finding an average property premium of 6% to 7% associated with transit accessibility; and
- Implied discount rates relating the value of accessibility (reduced travel time as well as vehicle costs) have tended to be in the 6% to 10% range.

This suggests that where a genuinely new rail service is being introduced, an increase in property prices of up to 6% might be generated within a mile of stations, but this depends on the nature of the rail service and whether it is genuinely new.

[3] Berkeley Planning Journal 11 (**1996**): 71-105. LAND USE IMPACTS OF RAPID TRANSIT. A Review of the Empirical Literature. Kaveh V. **Vessali**

This study appraises the enhancement of existing diesel-powered commuter rail services – all-day services and higher frequencies – at existing stations as well as some new stations. Long commuter trains operating at-grade, and their stations and car parking facilities, tend to require relatively large areas of land, thereby limiting the accessibility gain and potential land value uplift to other land uses.

Countering this, the provision of high-frequency peak period and reasonable frequency all-day services will make the general area served by these commuter rail lines more attractive to particular groups of potential residents. These are likely to be households with at least one employee working in downtown Toronto that is receptive to commuting by rail and is comfortable living some distance from downtown Toronto to enjoy the lower property values and different lifestyles associated with more suburban or rural living.

There are likely to be positive impacts of the GO Rail services assessed here on land values and development but these contrasting impacts make it very difficult to place a specific value on the impacts of the proposed changes on land values and development.

The principal impact of the enhancements to GO Rail services may be in generating residential development and enhancing residential land values as well as the values of businesses and services that serve local communities. The proximity of these land value impact areas may not be immediately close to rail stations but within reasonable access of substantially enhanced rail services.

Close to stations, land value changes will be at their greatest where the following two criteria are met: where there is a step change in the level of transit service and there is the opportunity to change land uses or intensify development in response to the enhanced transit service. Table 4-2 below identifies the nine areas where the latter condition will apply, since these are the nine designated UGCs served by the GO Rail service enhancements being assessed here. The table also indicates the largest scale of change being assessed in GO Rail services to each of these centres.

Table 4-2: Urban Growth Centres and Rail Service Changes

Urban Growth Centre	Change in Peak Period Services	Change in Off-peak Services
Downtown Toronto	Peak direction increase from the current 14 trains in the peak hour to 30 trains per hour in 2031.	Increase from 1 arrival/departure per hour, on the Lakeshore East line, to 10 arrivals/departures per hour (2 arrivals/departures per hour per line).
Downtown Pickering	Peak direction increases from 5 trains per hour to 6 trains per hour in 2031. Counter-peak direction increases from 2 to 3 trains per hour in 2031.	Off-peak services will increase from 1 train per hour to 2 trains per hour in 2031.
Downtown Oshawa	Peak direction increases from 5 trains per hour to 6 trains per hour in 2031. Counter-peak direction increases from 2 to 3 trains per hour in 2031.	Off-peak services will increase from 1 train per hour to 2 trains per hour in 2031.
Markham Centre	Pending	Pending
Richmond Hill/Langstaff Gateway	Peak direction increases from 2 trains per hour to 6 trains per hour in 2031. Counter-peak direction hourly bus service will be replaced by 2 trains per hour in 2031.	The current bus service will be replaced by 2 trains per hour in 2031.
Newmarket Centre and Downtown Barrie	Peak direction increases from 2 trains per hour to 6 trains per hour in 2031 originating at the new Allandale Station. Counter-peak direction hourly bus service will be replaced by 2 trains per hour in 2031.	The current bus service will be replaced by 2 trains per hour in 2031.

Urban Growth Centre	Change in Peak Period Services	Change in Off-peak Services
Etobicoke Centre	Peak direction increases from 3 trains per hour to 6 trains per hour in 2031. Counter-peak direction hourly bus service will be replaced by 2 trains per hour.	The current bus service will be replaced by 2 trains per hour in 2031.
Downtown Milton	Peak direction increases from 3 trains per hour to 6 trains per hour in 2031. Counter-peak direction hourly bus service will be replaced by 2 trains per hour.	The current bus service will be replaced by 2 trains per hour.

The principal changes are as follows:

- At Union Station serving downtown Toronto, the AM peak arrivals on these lines will more than double and a reasonable off-peak service of a train every thirty minutes will be provided on each line, whereas now there is effectively no off-peak service. GO Rail services, including the Lakeshore West and Georgetown lines which are not being considered here, are important to downtown Toronto. The 2006 TTS survey indicated that GO-related services accounted for 17% of trips into PD1 by all modes including car and that GO services had effectively accounted for all of the growth in trips into PD1 since 1986.

- On the Lakeshore East line there is relatively little improvement in the peak hour and off-peak hour rail services so we cannot expect any land value uplift at either Pickering or Oshawa.

- At the remaining Urban Growth Centres – Richmond Hill / Langstaff, Newmarket, Etobicoke and Milton – peak hour services increase from two or three trains per hour to six and in the off-peak a half-hourly train service replaces bus services. These train services will serve Markham, Richmond Hill / Langstaff, Etobicoke and Newmarket from both directions.

4.10 Social Community Impacts

These impacts assess the options from a community perspective, and particularly with an option's potential to enhance the quality of life within a community. This may result from land use changes or developments that might occur in relation to enhanced GO Rail services, as well as from improvements

brought about by the enhanced accessibility, both locally and regionally, offered by the enhancements.

Consideration is also given to the ability of options to affect the overall health of the local community and its residents through reduced auto congestion and the ability of transit to support a more balanced lifestyle for local residents.

5 Barrie (Allandale) Corridor

5.1 Introduction

In the Barrie corridor, Downtown Barrie and Newmarket Centre are designated UGCs. This corridor – as does the Richmond Hill corridor and part of the Stouffville corridor - serves York Region, expected to be the fastest growing region in the Greater Golden Horseshoe area between 2001 and 2031. The population of the region is forecast to effectively double, from 760,000 in 2001 to 1.5 million in 2031.

In the Barrie corridor, services currently extend to Barrie South Station. On April 3, 2009 the Ontario government announced a plan to build a new station at Allandale (or Barrie North) serving downtown Barrie by 2011, which will become the new terminal point. Allandale station has therefore been incorporated in the Do Minimum as well as the Do Something scenarios.

A new station is assumed to serve new developments at Innisfil, some five miles south of the existing Barrie South station. As well, the current York University station is assumed to be relocated to Downsview to provide a connection with the Spadina subway line, which is being extended to York University and Vaughan Metropolitan Centre.

5.2 Services Assessed

Current (as of March 2009) weekday service frequencies as well as those assumed for 2021 and 2031 are set out in Table 5-1. The AM peak period is assumed to be arrivals at Union Station from 0630 to 0930 hours and the PM peak period departures from Union Station from 1530 to 1930 hours. Assumptions for the two years of 2021 and 2031 are needed for transportation modelling purposes. In practice the '2021 frequencies' could be implemented sooner, as could those for 2031.

Currently there are only 8 trains per day, four in each peak period in the peak direction. The assumed 2021 service has this growing to 39 trains per direction per day and the 2031 service to 43 trains per direction per day.

On weekends, it has been assumed that there would be two trains per direction in each hour between 0600 hours and midnight.

Table 5-1: Barrie (Allandale) Line Weekday Trains per Period*

Time Period	Current		2021		2031	
	IN	OUT	IN	OUT	IN	OUT
Before AM peak	0	0	1	1	1	1
AM peak	4	0	8	6	6/6	6
Inter-peak	0	0	12	12	12	12
PM peak	0	4	8	10	8	8/6
Evening	0	0	10	10	10	10
Total	**4**	**4**	**39**	**39**	**43**	**43**

*Where two numbers are shown in an x/y format, the 'x' number indicates the number of LOCAL services and the 'y' indicates the number of express services

The speeds assumed for local, stopping services are based on current passenger timetable speeds. Express services are assumed to operate in the peak direction in peak periods, running non-stop between King City and Union Stations, omitting the stops at Maple, Rutherford, and Downsview.

A summary of the Barrie (Allandale) line service times and speeds can be found in Table 5-2.

Table 5-2: Barrie (Allandale) Line Service Time and Speeds

Barrie (Allandale)		Southbound (Peak Direction)				Northbound (Counter-Peak Direction)	
		Local (All-Stops) Train		Express (Limited-Stops) Train		Local (All-Stops) Train	
From	To	Time min	Speed kph	Time min	Speed kph	Time min	Speed kph
Allandale	Barrie South	5	71	5	71	5	71
Barrie South	Innisfil	6	80	6	80	6	80
Innisfil	Bradford	18	89	18	89	18	89
Bradford	East Gwillimbury	8	72	8	72	8	72
East Gwillimbury	Newmarket	3	42	3	42	3	42
Newmarket	Aurora	7	59	7	59	7	59
Aurora	King	12	58	12	58	12	58
King	Maple	8	53	↓	↓	8	53
Maple	Rutherford	4	53	↓	↓	4	53
Rutherford	Downsview	5	68	↓	↓	5	68
Downsview	Union Station	22	55	30	73	22	55
Total		98	64	89	68	98	64

The Barrie (Allandale) line serves the same general corridor to the north as the Richmond Hill (Bloomington) line and the Yonge Street subway. There could also be some overlap between the catchment area for the Barrie (Allandale) line and part of the Stouffville line. The demand forecasts from the direct demand model include passengers who might be attracted to enhanced services on other lines, so the Barrie (Allandale) line has effectively been assessed on a basis which does not include enhancement of any services that might compete with it.

5.3 Engineering Requirements

5.3.1 Infrastructure

Much of the information below is based on the GO Transit Bradford Corridor Planning Study March 2002, the GO Transit Rail Expansion Bradford to Barrie Environmental Study Report, February 2005, and the GO Transit Conceptual Planning Study of Expanded Rail Service between Toronto and Barrie, January 1992. The main infrastructure requirements to accommodate 6 trains per hour in the peak direction on the Barrie (Allandale) line are:

- the installation of a second line and a full double track bi-directional signalling system over the entire line between Union and Allandale;

- two new stations – Innisfil, Downsview – are also included, as well as improvements to existing stations. Allandale station is not included since it has now been approved and is included in the Do Minimum scenario;

- Downsview station replaces the existing York University station since Downsview is expected to perform better in terms of its own catchment and particularly its connection with Sheppard West station, a proposed station on TTC's extended Spadina line which is currently in implementation.

Infrastructure requirements also include the costs for either expanded layover facilities in Barrie or an additional layover facility in the vicinity of Barrie South station, rail/rail grade separation near Davenport Road and modifications to several existing stations.

Figures 5-1 and 5-2 show the alignment to be followed by the extension of services from Barrie South to Allandale and the new stations of Innisfil and Allandale.

Figure 5-1: Barrie (Allandale) Proposed Alignment from Bradford to Innisfil

Figure 5-2: Barrie (Allandale) Proposed Alignment from Innisfil to Allandale

Table 5-3 summarises the estimated costs of the works. The main cost item is trackwork, totalling $199 million with $122 million between Union and Bradford stations and $77 million between Bradford and Allandale stations.

With a 26% allowance for engineering and project management and appropriate contingency allowances, the total infrastructure cost is $638 million.

Table 5-3: Barrie (Allandale) Line Capital Costs

Description	Cost ($000)	contingency %
Trackwork	199,109	60%
Signals	34,012	80%
Structures	34,723	60%
Roads and Highways	_	55%
Road Crossings (level crossings)	_	55%
Stations	32,728	55%
Maintenance and Layover facilities	37,433	70%
Property	_	85%
Sub-total	**338,005**	
Contingency	211,712	
Engineering and Project Management	87,881	26%
Total	**637,599**	

5.3.2 *Rolling Stock*

The additional services proposed would require additional rolling stock. Five additional trains would be required to provide the 2021 service and a further five

trains to provide the 2031 service. Each train, consisting of a locomotive, and 10 coaches, is estimated to cost $32 million.

5.4 Findings

5.4.1 Ridership

Forecast ridership on the Barrie (Allandale) line is summarised below. Table 5-4 presents observed morning peak period inbound ridership for 2008 as well as modelled forecasts for 2021 and 2031. The total inbound boardings increase from 6,400 in 2008 to 10,800 in the 2031 Do Something, an increase of 69%. In the 2031 Do Minimum there are 7,900 boardings so the additional features of the Do Something – new stations, higher frequency services and some express services running non-stop between King City and Union Station – increase boardings by 2,900 or 37%.

Table 5-4: Barrie Line Peak Period Ridership Forecasts, Inbound

Line	2008		2021		2031	
	Observed	Modelled	Do Minimum	Do Something	Do Minimum	Do Something
Barrie	6,400	5,200	7,000	8,700	7,900	10,800

At the new stations, boardings by 2031 are forecast to be 1,000 per AM peak period at Allandale, 600 at Innisfil. Ridership at Downsview has not been forecast. This will principally be interchange with the TTC Spadina line which the Direct Demand Model is not well equipped to forecast (see Section 4.4).

Counter-peak ridership is forecast to be approximately 10% of peak direction ridership, resulting in just over 1,000 boardings in the AM peak period in the 2031 Do Something scenario.

5.5 Summary of Assessment

The assessment of the enhanced and extended service on the Barrie (Allandale) line is summarised in Table 5-5 below.

Table 5-5: Summary of Barrie (Allandale) Line Assessment

	Barrie (Allandale) Line
Transportation User Benefits NPV $m	Time Savings to auto and transit users – $1,398 million Auto cost savings – $1,088 million Safety Benefits – $112 million **Total Transportation User Benefits – $2,598 million**
Incremental costs NPV $m	Estimated Capital Costs – $742 million Estimated Incremental Operating Costs – $763 million **Total Incremental Costs – $1,505 million**
Net benefits NPV $m	**$1,093 million**
Benefit Cost Ratio	**1.7:1**
Environmental Impacts - GHG reductions - Qualitative impacts	Approximately 33,000 tonnes of CO_2 or equivalent GHGs will be saved per year by 2031. CO_2 savings over the first 25 years have a present value of $16 million. There will be additional noise and air pollution impacts from additional peak rail services and from all-day and weekend services

	Barrie (Allandale) Line
Economic Impacts - Employment impacts - GDP impacts - Land value impacts	The construction impacts will generate 5,700 and 8,800 person years of direct and indirect employment, respectively, and $545 million of direct GDP and $847 million of direct and indirect GDP In the long term there will be continuing economic impacts with GDP impacts in 2031 of $113 million. The enhanced services, including all-day and weekend services, will make the corridor more attractive particularly for residential development, adding to land values, and will serve the Newmarket Centre and Downtown Barrie UGCs.
Social Community Impacts - Health and Quality of Life - Traffic and Community Impacts	The additional services will contribute to reduced auto-dependency and increased walking and cycling activity. They will stimulate development in residential areas accessible to services and reinforce the sense of community.

5.5.1 *Off-Peak*

Weekday off-peak ridership, outside the two peak periods is expected to be approximately 76% of AM peak period ridership by 2021 or 2031 and weekend ridership approximately 56% of total weekday ridership. Ridership, trains operated, and the numbers of riders per train in off-peak periods in the 2021 and 2031 Do Something estimates are set out in Table 5-6 below.

In 2021 the average number of riders per weekday off-peak train on the Barrie (Allandale) line could be approximately 158 increasing to approximately 196 by 2031. On weekends the average number of riders per train is estimated at approximately 102 in 2021 increasing to approximately 127 in 2031.

Table 5-6: Off-peak Ridership on the Barrie Line

Year	Time Period	Boardings	Trains operated	Boardings per train
2021	Weekday off-peak	7,270	46	158
	Weekend	14,740	144	102
2031	Weekday off-peak	9,030	46	196
	Weekend	18,300	144	127

Weekday off-peak periods and weekends account for 35% of all benefits while weekday peak periods account for the other 65%. In the Barrie (Allandale) corridor the off-peak and weekends contribute benefits of approximately $909 million.

5.5.2 *Transportation User Benefits*

The additional peak period services attract more riders to GO Rail services, thereby conferring benefits to users of transportation networks, as do the new off-peak and weekend services. Some of these new riders are attracted from the car. A range of transportation user benefits have been estimated, with the major items being:

- Time savings to transit and auto trips in the corridor totalling $1,398 million over the first 25 years;
- Reduced auto operating costs of $1,088 million over the first 25 years; and
- Safety benefits as a result of fewer road accidents of $112 million over the first 25 years.

5.5.3 *Financial Account*

The present value of the capital costs and incremental operating costs of Barrie Line services amount to $1,505 million and the present value of benefits to $2,598 million, giving a Benefit:Cost ratio of 1.7:1.

Incremental passenger revenues from the proposed Barrie line service enhancements are estimated at $40.3 million in 2021 and $52.2 million in 2031 – at today's fare levels

The annual costs of operating the expanded services are estimated at $70.0 million in 2021 and $96.9 million in 2031, again at today's prices. The all-day services proposed here would replace bus services and lead to savings in bus costs. The annual variable costs of operating bus services in the Barrie (Allandale) corridor (Route 65) are estimated at $2.6 million.

These estimates suggest a farebox recovery ratio of approximately 0.5, with 2031 revenues of $52.2 million and 2031 operating costs of $96.9 million.

5.5.4 *Environmental Impacts*

The major environmental impact of the additional services arises from the reduction in car use and the reduction in greenhouse gas emissions. Some 744,000 tonnes of CO_2, with a current value of $16 million, will be saved over the first 25 years.

Beyond the positive GHG reduction impacts, the additional rail services may also generate localized adverse environmental impacts, most notably noise/vibration and emissions, for occupants of track-side properties. The additional diesel-powered services will create additional track-side air pollution, which will be offset by the reduction in auto pollution. By 2031 there will be 3.2 million train kilometres per year and a reduction of 165 million auto kilometres per year.

5.5.5 *Economic Impacts*

The capital costs involved in construction work and the manufacture of the new rolling stock required will generate economic impacts other than those to users of the transport networks already discussed. There will be direct and indirect impacts on employment and wages and additional GDP will be created.

The initial construction and manufacturing activity will generate 5,700 person years of direct employment and a further 3,100 person years of indirect employment. It will generate additional direct wages of $215 million and indirect wages of a further $115 million. It will add $850 million to GDP through direct and indirect impacts.

The GO Rail service enhancements will make the corridor a more attractive residential location which could stimulate uplift in land values, particularly for residential land along the corridor, and will serve Newmarket Centre and Downtown Barrie UGCs.

5.5.6 *Social Community Impacts*

The additional services will stimulate development in the areas around the stations served and support more sustainable, liveable communities. The service improvements will contribute to reducing auto-dependency and stimulating walking and cycling activity, which will have positive health impacts.

The introduction of all-day and weekend services at reasonable frequencies will mean that the GO Rail service will serve more than the commuter trips served at present. They will serve a variety of optional purpose and leisure trips, strengthening the links between Toronto and the communities they serve, giving local residents a good, alternative to the car for many trips into Toronto, thereby strengthening these communities. By 2031, there will be approximately 9,000 off-peak riders per weekday and approximately 9,000 per weekend day, as well as an extra 2,900 weekday peak period riders compared with the Do Minimum.

6 Lakeshore East (Bowmanville) Corridor

6.1 *Introduction*

In the Lakeshore East corridor, Downtown Pickering and Downtown Oshawa are designated UGCs. The line serves Durham Region where the population is forecast to increase by 81%, from 530,000 in 2001 to 960,000 in 2031.

The Lakeshore East and West lines are the only GO corridors that currently have off-peak and weekend rail services. The Lakeshore East (Bowmanville) line has 11 inbound trains in the morning peak period and 13 outbound in the afternoon peak period. There is an hourly, two-way service in the off-peak and on weekends.

The major changes being assessed here are the extension of services from Oshawa to Bowmanville with new intermediate stations. Off-peak and weekend services are assumed to double in frequency, from hourly to half-hourly, There is relatively little change in peak hour, peak direction service frequencies.

It has been assumed in this analysis that the extension to Bowmanville would use the CP Rail corridor north of Highway 401, which would more directly serve the Oshawa UGC and other established communities (including Bowmanville) compared with the CN corridor south of Highway 401. A new connection from the GO Subdivision to the CP corridor over Highway 401 has been included in the cost estimates for this project. This assumption is

consistent with the findings of the Oshawa East Track Extension and New Maintenance Facility study completed for GO Transit in April 2009.

6.2 Services Assessed

Current (as of March 2009) weekday service frequencies as well as those assumed for 2021 and 2031 are set out in Table 6-1. The AM peak period is assumed to be arrivals at Union Station from 0630 to 0930 hours and the PM peak period departures from Union Station from 1530 to 1930 hours. Assumptions for the two years of 2021 and 2031 are needed for transportation modelling purposes. In practice the '2021 frequencies' could be implemented sooner, as could those for 2031.

Currently there are 32 arriving trains and 30 leaving trains per day. The assumed 2021 service has this growing to 45 trains per day per direction and the 2031 service to 51 trains per day per direction.

At weekends, we are assuming there would be two trains per direction in each hour between 0600 hours and midnight.

Table 6-1: Lakeshore East (Bowmanville) Line weekday trains per period*

TIME PERIOD	Current		2021		2031	
	IN	OUT	IN	OUT	IN	OUT
Before AM peak	1	1	1	1	1	1
AM peak	6/5	4/1	6/6	4/2	6/6	4/2
Inter-peak	7	6	12	12	12	12
PM peak	5/2	5/8	9	8/8	12	10/9
Evening	6	5	11	10	14	13
Total	**32**	**30**	**45**	**45**	**51**	**51**

*Where two numbers are shown in an x/y format, the 'x' number indicates the number of local services and the 'y' indicates the number of express services

The speeds assumed for local, stopping services and for express services are based on current passenger timetable speeds. Express services are assumed to operate similar to the current conditions, running non-stop between Pickering and Union Stations, omitting the stops at Rouge Hill, Guildwood, Eglinton, Scarborough and Danforth. A summary of the Lakeshore East (Bowmanville) line service times and speeds can be found in Table 6-2.

Table 6-2: Lakeshore East (Bowmanville) Line Service Time and Speeds

Lakeshore East (Bowmanville)		Westbound (Peak Direction)				Eastbound (Counter-Peak Direction)			
		Local (All-Stops) Train		Express (Limited-Stops) Train		Local (All-Stops) Train		Express (Limited-Stops) Train	
From	To	Time min	Speed kph	Time min	Speed kph	Time min	Speed kph	Time min	Speed kph
Bowmanville	Courtice Rd	8	48	8	48	8	48	8	48
Courtice Rd	Oshawa 2	5	57	5	57	5	57	5	57
Oshawa 2	Oshawa 1	3	57	3	57	3	57	3	57
Oshawa 1	Whitby	8	60	8	60	8	60	8	60
Whitby	Ajax	8	65	8	65	8	65	8	65
Ajax	Pickering	5	49	5	49	5	49	5	49
Pickering	Rouge Hill	7	61	↓	↓	8	53	↑	↑
Rouge Hill	Guildwood	5	75	↓	↓	7	54	↑	↑
Guildwood	Eglinton	4	50	↓	↓	5	40	↑	↑
Eglinton	Scarborough	4	50	↓	↓	5	40	↑	↑
Scarborough	Danforth	6	52	↓	↓	5	63	↑	↑
Danforth	Union station	10	39	25	76	15	26	30	63
Total		73	55	62	59	82	51	67	57

6.3 Engineering Requirements

6.3.1 Infrastructure

The principal engineering requirement in this corridor is the new track between the current terminus at Oshawa and the proposed terminus at Bowmanville. Much of the information set out below is based on the GO Transit Oshawa East Track Extension and New Rail Maintenance Facility Feasibility Study[4]. Figure 6-1 illustrates the current view of this extension. It will leave the GO Subdivision just east of Thickson Rd. and divert north over the 401 and join into the CP Belleville Subdivision at mile 175.91 and terminate at a layover and maintenance facility at mile 162.39. The Belleville Subdivision will have capacity enhancements through the addition of mainline tracks. The proposed GO service along the CP corridor will provide public access by way of four new stations, with the existing Oshawa station being replaced by two stations:

- Bowmanville Mi 164.80
- Courtice Rd. Mi 168.79
- Oshawa 2 Mi. 171.74
- Oshawa 1 Mi. 173.52

[4] GO Transit Oshawa East Track Extension and New Rail Maintenance Facility Feasibility Study, AECOM, GO Transit, January 9, 2009

Figure 6-1: Lakeshore East (Bowmanville) Proposed Alignment from Oshawa to Bowmanville

The costs of the infrastructure changes needed to deliver the proposed services are set out in Table 6-3. The principal items of expenditure are on trackwork, stations and structures. Including suitable contingencies and allowance for project management and engineering, the total cost is $399 million.

Table 6-3: Lakeshore East (Bowmanville) Line Capital Costs

Description	Cost ($000)	contingency %
Trackwork	57,722	60%
Signals	18,000	80%
Structures	40,140	60%
Roads and Highways	250	55%
Road Crossings (level crossings)	5,420	55%
Stations	56,080	55%
Maintenance and Layover facilities	35,000	70%
Property	_	85%
Sub-total	**212,612**	
Contingency	131,580	
Engineering and Project Management	55,279	26%
Total	**399,471**	

6.3.2 *Rolling Stock*

The additional and longer services proposed would require additional rolling stock. Three additional trains would be required to provide the 2021 service and a further four to provide the 2031 service. Each train, consisting of a locomotive and 10 coaches, is estimated to cost $32 million.

6.4 Findings

6.4.1 Ridership

Forecasted ridership on the Bowmanville line is summarised below. Table 6-4 presents observed morning peak period ridership for 2008 as well as modelled forecasts for 2021 and 2031. The total inbound boardings increase from 18,900 in 2008 to 23,100 in the 2031 Do Something, an increase of 22%. In the 2031 Do Minimum there are 20,300 boardings so the additional features of the Do Something – mainly the new stations on the extension from Oshawa to Bowmanville – increase boardings by 2,800 or 14%.

Table 6-4: Lakeshore East Line Peak Period Ridership Forecasts, Inbound

Line	2008		2021		2031	
	Observed	Modelled	Do Minimum	Do Something	Do Minimum	Do Something
Lakeshore East line	18,900	16,400	17,300	19,600	20,300	23,200
Bowmanville – Oshawa	n/a	n/a	n/a	4,400	n/a	5,400
Oshawa – Whitby	3,300	3,000	4,600	6,400	5,600	7,900

The extension to Bowmanville will generate some 2,300 additional riders in the AM peak period. At the new stations, boardings by 2031 are forecast to be 700 per AM peak period at Bowmanville, 1,000 at Courtice Road, 3,700 at Oshawa 2 and 2,500 at Oshawa 1. Boardings at Oshawa and the new stations on the extension to Bowmanville in the AM peak period in 2031 amount to 7,900, compared with 5,600 at Oshawa in the Do Minimum. Of the 7,900 passengers, 5,400 are forecasted to board trains at the new stations east of Oshawa.

Counter-peak ridership is forecast to be approximately 10% of peak direction ridership, so just over 2,300 boardings in the AM peak period in the 2031 Do Something scenario.

6.4.2 *Summary of Assessment*

The assessment of the extended service on the Lakeshore East (Bowmanville) line is summarised in Table 6-5 below.

Table 6-5: Summary of Lakeshore East (Bowmanville) Line Assessment

	Bowmanville Line
Transportation User Benefits NPV $m	Time Savings to auto and transit users – $386 million Auto cost savings – $251 million Safety Benefits – $26 million **Total Transportation User Benefits – $662 million**
Incremental costs NPV $m	Estimated Capital Costs – $472 million Estimated Incremental Operating Costs – $632 million **Total Incremental Costs – $1,104 million**
Net benefits NPV $m	**Negative net benefits of $442 million**
BCR	**0.6:1**
Environmental Impacts - GHG reductions - Qualitative impacts	Approximately 7,000 tonnes of CO_2 or equivalent GHGs will be saved per year by 2031. CO_2 savings over the first 25 years have a present value of $4 million. There will be additional noise and air pollution impacts from additional peak services and from all-day and weekend rail services

	Bowmanville Line
Other Economic Impacts - Employment impacts - GDP impacts - Land value impacts	The construction impacts will generate 3,700 and 5,700 person years of direct and indirect employment, respectively, and $351 million of direct GDP and $545 million of direct and indirect GDP In the long term there will be continuing economic impacts with GDP impacts in 2031 of $37 million. The enhanced services, including all-day and weekend services, will make the corridor more attractive particularly for residential development, adding to land values, and will serve the Downtown Pickering and Downtown Oshawa UGCs.
Social Community Impacts - Health and Quality of Life - Traffic and Community Impacts	The additional services will contribute to reduced auto-dependency and increased walking and cycling activity. They will stimulate development in residential areas accessible to services and reinforce the sense of community.

The transportation user benefits of $662 million listed above are those that accrue to trips beginning in areas to the east of Oshawa, which can therefore be attributed to the extension of services to Bowmanville. Total corridor transportation user benefits of $933 million were measured along the entire corridor.

6.4.3 *Off-Peak*

Weekday off-peak ridership, outside the two peak periods is expected to be approximately 76% of AM peak period ridership by 2021 or 2031 and weekend ridership approximately 56% of total weekday ridership. Ridership, trains operated and the numbers of riders per train in off-peak periods in the 2021 and 2031 Do Something options are set out in Table 6-6 below.

In 2021 the average number of riders per weekday off-peak train on the Bowmanville line could be approximately 349 increasing to approximately 431

by 2031. At weekends the average number of riders per train could be approximately 231 in 2021 increasing to approximately 273 in 2031.

Table 6-6: Off-peak Ridership on the Bowmanville Line

Year	Time Period	Boardings	Trains operated	Boardings per train
2021	Weekday off-peak	16,390	47	349
	Weekend	33,200	144	231
2031	Weekday off-peak	19,400	45	431
	Weekend	39,290	144	273

Weekday off-peak periods and weekends account for 35% of all benefits while weekday peak periods account for the other 65%. In the Bowmanville corridor the off-peak and weekends contribute benefits of approximately $232 million

6.4.4 *Transportation User Benefits*

The additional peak period services attract more riders to GO Rail services, thereby conferring benefits to users of transportation networks, as do the new off-peak and weekend services. Some of these new riders are attracted from the car. A range of transportation user benefits have been estimated, with the major items being:

- Time savings to transit and auto trips arising from the extension of services to Bowmanville totalling $386 million over the first 25 years;
- Reduced auto operating costs as a result of the extension to Bowmanville of $251 million over the first 25 years; and
- Safety benefits as a result of fewer road accidents of $26 million over the first 25 years.

6.4.5 *Financial Account*

The present value of the capital costs and incremental operating costs on the Lakeshore East line amount to $1,104 million and the present value of benefits to $662 million, giving a Benefit:Cost ratio of the extension to Bowmanville of 0.6:1.

Annual revenues of passengers on the proposed Bowmanville line services are estimated at $90.3 million in 2021 and $107.7 million in 2031 – at today's fare levels

The annual costs of operating the services are estimated at $69.1 million in 2021 and $96.6 million in 2031, again at today's prices.

The all-day services proposed here would replace bus services and lead to savings in bus costs. The annual variable costs of operating bus services in the Bowmanville corridor (Route 90) are estimated at $1.5 million.

These estimates suggest a farebox ratio of approximately 1.1, with annual farebox revenues in 2031 of $107.7 million and annual operating costs of $96.6 million.

6.4.6 *Environmental Impacts*

The major environmental impact of the additional services arises from the reduction in car use and the reduction in greenhouse gas emissions. Some 171,000 tonnes of CO_2, with a current value of $4 million, will be saved over the first 25 years.

The other principal environmental impacts are likely to be adverse. The additional rail services will generate additional noise, at intervals throughout the weekday and at weekends, which occupants of track-side properties could find disruptive. The additional diesel-powered services will create additional track-side air pollution, which will be offset by the reduction in auto pollution. By 2031 there will be 2.5 million train kilometres per year and a reduction of 37 million auto kilometres per year.

6.4.7 *Other Economic Impacts*

The capital costs involved in construction work and the manufacture of the new rolling stock required will generate economic impacts other than those to users of the transport networks already discussed. There will be direct and indirect impacts on employment and wages and additional GDP will be created.

The initial construction and manufacturing activity will generate 3,700 person years of direct employment and a further 2,000 person years of indirect employment. It will generate additional direct wages of $138 million and indirect wages of a further $87 million. It will add $545 million to GDP through direct and indirect impacts.

The GO Rail service enhancements will make the corridor a more attractive residential location which could stimulate uplift in land values, particularly for residential land along the corridor, and will serve Downtown Oshawa and Downtown Pickering UGCs.

6.4.8 *Social Community Impacts*

The additional services will stimulate development in the areas around the stations served and support more sustainable, liveable communities. The service improvements will contribute to reducing auto-dependency and stimulating walking and cycling activity, which will have positive health impacts.

The introduction of all-day and weekend services at reasonable frequencies will mean that the GO Rail service will serve more than the commuter trips served at present. They will serve a variety of optional purpose and leisure trips, strengthening the links between Toronto and the communities they serve, giving local residents a good, alternative to the car for many trips into Toronto, thereby strengthening these communities. By 2031, there will be approximately 19,000 off-peak riders per weekday and approximately 19,500 per weekend day, as well as an extra 2,900 weekday peak period riders compared with the Do Minimum.

7 Milton Corridor

7.1 *Introduction*

In the Milton corridor, Downtown Milton and Etobicoke Centre are designated UGCs. The line serves parts of Peel and Halton Regions, where populations are forecast to increase between 2001 and 2031 from 1,030,000 to 1,640,000 (by 59%) and from 390,000 to 780,000 (by 100%) respectively.

Milton services are assumed to be operated in the long-term by 10-car trains, rather than the current 12-car configuration, recognizing the enhanced capacity provided by more frequent services. The service options for appraisal are summarised below. In addition to changes in peak period frequencies and the introduction of all-day services, there is also a new station at Bloor which provides a connection with the Bloor-Danforth subway line at Dundas West.

7.2 *Services Assessed*

Current (as of March 2009) weekday service frequencies as well as those assumed for 2021 and 2031 are set out in Table 7-1. The AM peak period is

assumed to be arrivals at Union Station from 0630 to 0930 hours and the PM peak period departures from Union Station from 1530 to 1930 hours. Assumptions for the two years of 2021 and 2031 are needed for transportation modelling purposes. In practice the '2021 frequencies' could be implemented sooner, as could those for 2031.

Currently there are only six trains per day per peak direction in each peak period. The assumed 2021 service has this growing to 39 trains per direction per day and the 2031 service to 43 trains per direction per day.

At weekends, we are assuming there would be two trains per direction in each hour between 0600 hours and midnight.

Table 7-1: Milton Line Weekday Trains per Period*

Time Period	Current		2021		2031	
	IN	OUT	IN	OUT	IN	OUT
Before AM peak	0	0	1	1	1	1
AM peak	6	0	4/4	4	6/6	4
Inter-peak	0	0	12	12	12	12
PM peak	0	6	8	6/6	8	8/8
Evening	0	0	10	10	10	10
Total	**6**	**6**	**39**	**39**	**43**	**43**

*Where two numbers are shown in an x/y format, the 'x' number indicates the number of local services and the 'y' indicates the number of express services

The speeds assumed for local, stopping services are based on current passenger timetable speeds. Express services are assumed to operate in the peak direction in peak periods, running non-stop between Erindale and Union Stations, omitting the stops at Cooksville, Dixie, Kipling, and Bloor.

A summary of the Milton line service times and speeds can be found in Table 7-2.

Table 7-2: Milton Line Service Time and Speeds

Milton		Eastbound (Peak Direction)				Westbound (Counter-Peak Direction)	
		Local (All-Stops) Train		Express (Limited-Stops) Train		Local (All-Stops) Train	
From	To	Time	Speed	Time	Speed	Time	Speed
		min	kph	min	kph	min	kph
Milton	Lisgar	8	70	8	70	8	70
Lisgar	Meadowvale	4	80	4	80	4	80
Meadowvale	Streetsville	5	34	5	34	5	34
Streetsville	Erindale	5	42	5	42	5	42
Erindale	Cooksville	5	59	↓	↓	5	59
Cooksville	Dixie	5	45	↓	↓	5	45
Dixie	Kipling	5	62	↓	↓	5	62
Kipling	Bloor	13	40	↓	↓	13	40
Bloor	Union Station	10	39	26	67	10	39
Total		60	52	48	58	60	52

7.3 Engineering Requirements

7.3.1 Infrastructure

The principal infrastructure requirement in the Milton corridor is the provision of four tracks, two of which would be dedicated to commuter rail services, between Union Station and Milton.

Much of this information is taken from the GO Transit Milton Corridor Service Expansion Feasibility Study[5]. This report envisages the need for four tracks, with a full four track, bi-directional signalling system, all the way from West Toronto to Milton and two tracks from Union Station to West Toronto. The addition of one or two tracks to provide four tracks, with associated bridge works and works at stations, together with the signalling system, seem to be the major requirements. Additionally, at Humber River a new bridge over the river and a two-track fly-under are assumed. Figures 7-1 and 7-2 identify the principal infrastructure requirements.

The current view of the engineering requirements for the Milton corridor is costed in Table 7-3 below. The principal cost items are trackwork and

[5] GO Transit Milton Corridor Service Expansion Feasibility Study, Revised Report, January 2009

structures. Including suitable contingencies and allowance for project management and engineering, the total cost amounts to $750 million.

Table 7-3: Milton Line Capital Costs

Description	Cost ($000)	contingency %
Trackwork	132,573	60%
Signals	70,000	80%
Structures	127,600	60%
Roads and Highways	1,000	55%
Road Crossings (level crossings)	3,550	55%
Stations	41,000	55%
Maintenance and Layover facilities	20,000	70%
Property	_	85%
Sub-total	**395,723**	
Contingency	251,156	
Engineering and Project Management	102,888	26%
Total	**749,767**	

7.3.2 *Rolling Stock*

The additional services proposed would require additional rolling stock. One additional train would be required to provide the 2021 service and a further four to provide the 2031 service. Each train, consisting of a locomotive and 10 coaches, is assumed to cost $32 million.

Figure 7-1: Milton Proposed Alignment from Milton to Dixie Station

Figure 7-2: Milton Proposed Alignment from Dixie Station to Union Station

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7.4 Findings

7.4.1 Ridership

Forecast ridership on the Milton line is summarised below. Table 7-4 presents observed morning peak period ridership for 2008 as well as modelled forecasts for 2021 and 2031. The total inbound boardings increase by 83%, from 10,800 in 2008 to 19,800 in the 2031 Do Something. In the 2031 Do Minimum there are 14,900 boardings so the additional features of the Do Something – mainly the higher frequency service and express services running non-stop between Erindale and Union Station – increase boardings by 4,900 or 33%.

Table 7-4: Milton Line Peak Period Ridership Forecasts, Inbound

Line	2008		2021		2031	
	Observed	Modelled	Do Minimum	Do Something	Do Minimum	Do Something
Milton line	10,800	12,100	13,400	15,500	14,900	19,800

At the new station at Bloor, boardings by 2031 are forecast to be 300 per AM peak period. The nature of the direct demand model means it is not well suited to forecasting interchange trips between GO Rail and other modes.

Counter-peak ridership is forecast to be approximately 10% of peak direction ridership, which amounts to approximately 2,000 boardings in the AM peak period in the 2031 Do Something.

7.4.2 *Summary of Assessment*

The assessment of the enhanced service on the Milton line is summarised in Table 7-5 below.

Table 7-5: Summary of Milton Line Assessment

	Milton Line
Transportation User Benefits NPV $m	Time Savings to auto and transit users – $1,129 million Auto cost savings – $908 million Safety Benefits – $93 million **Total Transportation User Benefits – $2,130 million**
Incremental costs NPV $m	Estimated Capital Costs – $716 million Estimated Incremental Operating Costs – $514 million **Total Incremental Costs – $1,230 million**.
Net benefits NPV $m	**$900 million**
BCR	**1.7:1**
Environmental Impacts - GHG reductions - Qualitative impacts	Approximately 30,000 tonnes of CO_2 or equivalent GHGs will be saved per year by 2031. CO_2 savings over the first 25 years have a present value of $14 million. There will be additional noise and air pollution impacts from additional peak services and from all-day and weekend rail services.

	Milton Line
Other Economic Impacts - Employment impacts - GDP impacts - Land value	The construction impacts will generate 5,500 and 8.500 person years of direct and indirect employment, respectively, and $528 million of direct GDP and $820 million of direct and indirect GDP In the long term there will be continuing economic impacts with GDP impacts in 2031 of $94 million. The enhanced services, including all-day and weekend services, will make the corridor more attractive particularly for residential purposes, adding to land values, and will serve the Etobicoke and Milton Urban Growth Centres.
Social Community Impacts - Health and Quality of Life - Traffic and Community Impacts	The additional services will reduce auto-dependency and stimulate walking and cycling activity. They will stimulate development in the areas around the stations served and reinforce the sense of community

7.4.3 *Off-Peak*

Weekday off-peak ridership, outside the two peak periods is expected to be approximately 76% of AM peak period ridership by 2021 or 2031 and weekend ridership approximately 56% of total weekday ridership. Ridership, trains operated and the numbers of riders per train in off-peak periods in the 2021 and 2031 Do Something options are set out in Table 7-6 below.

In 2021 the average number of riders per weekday off-peak train on the Milton line could be approximately 282 increasing to approximately 360 by 2031. At weekends the average number of riders per train could be approximately 182 in 2021 increasing to approximately 233 in 2031.

Table 7-6: Off-peak Ridership on the Milton Line

Year	Time Period	Boardings	Trains operated	Boardings per train
2021	Weekday off-peak	12,960	46	282
	Weekend	26,250	144	182
2031	Weekday off-peak	16,550	46	360
	Weekend	33,540	144	233

Weekday off-peak periods and weekends account for 35% of all benefits, while weekday peak periods account for the other 65%. In the Milton corridor the off-peak and weekends contribute benefits of approximately $746 million.

7.4.4 *Transportation User Benefits*

The additional peak period services attract more riders to GO Rail services; thereby conferring benefits to users of transportation networks, as do the new off-peak and weekend services. Some of these new riders are attracted from the car. A range of transportation user benefits have been estimated, with the major items being:

- Time savings to transit and auto trips in the corridor totalling $1,129 million over the first 25 years;
- Reduced auto operating costs of $908 million over the first 25 years; and
- Safety benefits as a result of fewer road accidents of $93 million over the first 25 years.

7.4.5 *Financial Account*

The present value of the capital costs and incremental operating costs on the Milton line amount to $1,230 million and the present value of benefits to $2,130 million, giving a Benefit:Cost ratio of 1.7:1.

Annual revenues of passengers on the proposed Milton line services are estimated at $64.5 million in 2021 and $83.8 million in 2031 – at today's fare levels

The annual costs of operating the services are estimated at $56.9 million in 2021 and $61.5 million in 2031, again at today's prices.

The all-day services proposed here would replace bus services and lead to savings in bus costs. The annual variable costs of operating bus services in the Milton corridor (Route 21) are estimated at $5.1 million.

These estimates suggest a farebox ratio of approximately 1.4 with 2031 farebox revenues of $83.8 million and operating costs of $61.5 million.

7.4.6 *Environmental Impacts*

The major environmental impact of the additional services arises from the reduction in car use and the reduction in greenhouse gas emissions. Some 660,000 tonnes of CO_2, with a current value of $14 million, will be saved over the first 25 years.

The other principal environmental impacts are likely to be adverse. The additional rail services will generate additional noise, at intervals throughout the weekday and at weekends, which occupants of track-side properties could find disruptive. The additional diesel-powered services will create additional track-side air pollution, which will be offset by the reduction in auto pollution. By 2031 there will be 1.5 million train kilometres per year and a reduction of 148 million auto kilometres per year.

7.4.7 *Other Economic Impacts*

The capital costs involved in construction work and the manufacture of the new rolling stock required will generate economic impacts other than those to users of the transport networks already discussed. There will be direct and indirect impacts on employment and wages and additional GDP will be created.

The initial construction and manufacturing activity will generate 5,500 person years of direct employment and a further 3,000 person years of indirect employment. It will generate additional direct wages of $207 million and indirect wages of $113 million. It will add $820 million to GDP through direct and indirect impacts.

The GO Rail service enhancements will make the corridor a more attractive residential location which could stimulate uplift in land values, particularly for residential land along the corridor, and will serve the Etobicoke Centre and Downtown Milton UGCs, enhancing their development potential.

7.4.8 *Social Community Impacts*

The additional services will stimulate development in the areas around the stations served and support more sustainable, liveable communities. The service improvements will contribute to reducing auto-dependency and stimulating walking and cycling activity, which will have positive health impacts.

The introduction of all-day and weekend services at reasonable frequencies will mean that the GO Rail service will serve more than the commuter trips served at present. They will serve a variety of optional purpose and leisure trips, strengthening the links between Toronto and the communities they serve, giving local residents a good, alternative to the car for many trips into Toronto, thereby strengthening these communities. By 2031, there will be approximately 16,500 off-peak riders per weekday and approximately 17,000 per weekend day, as well as an extra 4,900 weekday peak period riders compared with the Do Minimum scenario.

8 Richmond Hill (Bloomington) Corridor

8.1 Introduction

The Richmond Hill line serves the Richmond Hill/Langstaff Gateway UGC and part of York Region where the population is forecast to effectively double between 2001 and 2031. Services are assumed to be extended to Bloomington with an additional station at Stouffville (Gormley).

There will be an overlap in the catchment areas of the Richmond Hill (Bloomington) line with the Barrie line and any extension of the Yonge Street subway line, and perhaps also with part of the Stouffville line. The demand forecasts from the direct demand model include passengers who might be attracted to enhanced services on these other lines, so the Richmond Hill line has effectively been assessed on a basis which does not include enhancement of any services that might compete with it, though comments are made on the possible impact of an extended Yonge Street subway on an extended Richmond Hill line.

8.2 Services Assessed

Current (as of March 2009) weekday service frequencies as well as those assumed for 2021 and 2031 are set out in Table 8-1. The AM peak period is assumed to be arrivals at Union Station from 0630 to 0930 hours and the PM peak period departures from Union Station from 1530 to 1930 hours.

Assumptions for the two years of 2021 and 2031 are needed for transportation modelling purposes. In practice the '2021 frequencies' could be implemented sooner, as could those for 2031.

Currently there are only four trains per day inbound in the morning peak period and five trains outbound in the afternoon and evening. The assumed 2021 service has this growing to 37 trains inbound and 36 trains outbound per day and the 2031 service to 43 trains inbound and 41 trains outbound per day.

At weekends, we are assuming there would be two trains per direction in each hour between 0600 hours and midnight.

Services are assumed to be extended to Bloomington Road.

Table 8-1: Richmond Hill (Bloomington) Line weekday trains per period*

Time Period	Current		2021		2031	
	IN	OUT	IN	OUT	IN	OUT
Before AM peak	0	0	1	1	1	1
AM peak	4	0	6	4	6/6	4
Inter-peak	0	0	12	12	12	12
PM peak	0	4	8	9	8	14
Evening	0	1	10	10	10	10
Total	**4**	**5**	**37**	**36**	**43**	**41**

*Where two numbers are shown in an x/y format, the 'x' number indicates the number of local services and the 'y' indicates the number of express services

The speeds assumed for local, stopping services are based on current passenger timetable speeds. Express services are assumed to operate in the peak direction in peak periods, running non-stop between Langstaff and Union Stations, omitting the stops at Old Cummer and Oriole.

A summary of the Richmond Hill (Bloomington) line service times and speeds can be found in Table 8-2.

Table 8-2: Richmond Hill (Bloomington) Line weekday Service Time and Speeds

Richmond Hill (Bloomington)		Southbound (Peak Direction)				Northbound (Counter-Peak Direction)	
		Local (All-Stops) Train		Express (Limited-Stops) Train		Local (All-Stops) Train	
From	To	Time min	Speed kph	Time min	Speed kph	Time min	Speed kph
Bloomington	Stouffville	3	56	3	56	3	56
Stouffville	Richmond Hill	10	59	10	59	10	59
Richmond Hill	Langstaff	5	52	5	52	5	52
Langstaff	Old Cummer	7	58	↓	↓	7	58
Old Cummer	Oriole	4	68	↓	↓	4	68
Oriole	Union Station	26	42	29	61	26	42
Total		55	56	47	57	55	56

8.3 Engineering Requirements

8.3.1 Infrastructure

The infrastructure requirements for the Richmond Hill corridor are costed in Table 8-3 below and the alignment of the extension to Bloomington Road is summarised in Figure 8-1. The information presented has been adapted from that in the GO Transit March 2002 Richmond Hill Corridor Planning Study, the GO Transit Richmond Hill Corridor Environmental Assessment Study, February 1993 and the Richmond Hill Full Service Study, February 1991.

The principal requirements in the Richmond Hill (Bloomington) corridor are the provision of an additional track and associated signalling between Union Station and Bloomington Road to support two directional service including the construction of one additional mainline over virtually the entire length of the service route.

The new stations assumed in this current work are at Stouffville Road in Gormley and Bloomington Road near Vandorf where the line will terminate.

Infrastructure requirements also include a new layover facility at Bethesda Road, modifications to several existing stations and several grade separations.

The principal cost items are structures and trackwork. Making allowances for contingencies and project management and engineering, total infrastructure costs are estimated at $600 million.

Table 8-3: Richmond Hill (Bloomington) Line Capital Costs

Description	Cost ($000)	contingency %
Trackwork	84,288	60%
Signals	26,203	80%
Structures	152,483	60%
Roads and Highways	_	55%
Road Crossings (level crossings)	_	55%
Stations	17,930	55%
Maintenance and Layover facilities	37,433	70%
Property	_	85%
Sub-total	**318,337**	
Contingency	199,090	
Engineering and Project Management	82,768	26%
Total	**600,194**	

8.3.2 *Rolling Stock*

The additional services proposed would require additional rolling stock. Three additional trains would be required to provide the 2021 service and a further five to provide the 2031 service. Each train, consisting of a locomotive and 10 coaches, is estimated to cost $32 million.

Figure 8-1: Richmond Hill (Bloomington) Proposed Alignment from Richmond Hill Station to Bloomington Station

8.4 Findings

8.4.1 Ridership

Forecast ridership on the Richmond Hill (Bloomington) line is summarised below. Table 8-4 presents observed morning peak period ridership for 2008 as well as modelled forecasts for 2021 and 2031. The total boardings increase from 4,800 in 2008 to 8,700 in the 2031 Do Something, an increase of 81%. In the 2031 Do Minimum there are 6,400 boardings so the additional features of the Do Something – mainly the higher frequency service, express services running non-stop between Langstaff and Union Station and new stations at Bloomington and Stouffville (Gormley) – increase boardings by 2,300 or 36%.

Table 8-4: Richmond Hill Line Peak Period Ridership Forecasts, Inbound

Line	2008		2021		2031	
	Observed	Modelled	Do Minimum	Do Something	Do Minimum	Do Something
Richmond Hill line	4,800	5,200	6,200	7,000	6,400	8,700

At the new station at Bloomington, boardings by 2031 are forecast to be 200 per AM peak period and at Stouffville (Gormley) 1,900. Boardings at Richmond Hill and the new stations to the north amount to 5,700 in the AM peak period in the 2031 Do Something compared with 4,200 at Richmond Hill in the Do Minimum.

Counter-peak ridership is forecast to be approximately 10% of peak direction ridership, so approaching 1,000 boardings in the AM peak period in the 2031 Do Something.

8.4.2 Yonge Street Subway Extension

Two runs of the Greater Golden Horseshoe model were undertaken: one just included the extended and enhanced Richmond Hill services described here while the second also included the Yonge Street subway extended to Langstaff. These model runs indicated that the Richmond Hill line might lose approximately 15% of its riders to an extended Yonge Street subway. In these circumstances, presumably the benefits of the changes to the Richmond Hill line would also be reduced by approximately 15%. Summary of Assessment

The assessment of the enhanced service on the Richmond Hill (Bloomington) line is summarised in Table 8-5 below.

Table 8-5: Summary of Richmond Hill (Bloomington) Line Assessment

	Richmond Hill (Bloomington) Line
Transportation User Benefits NPV $m	Time Savings to auto and transit users – $707 million Auto cost savings – $665 million Safety Benefits – $68 million **Total Transportation User Benefits – $1,441 million**
Incremental costs NPV $m	Estimated Capital Costs – $660 million Estimated Incremental Operating Costs – $458 million **Total Incremental Costs – $1,118 million**.
Net benefits NPV $m	**$322 million**
BCR	**1.3:1.** If benefits are reduced by 15% because of the Yonge street subway extension, the BCR would reduce to 1.1:1
Environmental Impacts - GHG reductions - Qualitative impacts	Approximately 20,000 tonnes of CO_2 or equivalent GHGs will be saved per year by 2031. CO_2 savings over the first 25 years have a present value of $10 million. There will be additional noise and air pollution impacts from additional peak services and from all-day and weekend rail services

	Richmond Hill (Bloomington) Line
Other Economic Impacts - Employment impacts - GDP impacts - Land value	The construction impacts will generate 5,000 and 7,800 person years of direct and indirect employment, respectively, and $482 million of direct GDP and $748 million of direct and indirect GDP In the long term there will be continuing economic impacts with GDP impacts in 2031 of $69 million. The enhanced services, including all-day and weekend services, will make the corridor more attractive particularly for residential development, which could add to land values and will serve the Richmond Hill/ Langstaff Gateway Urban Growth Centre.
Social Community Impacts - Health and Quality of Life - Traffic and Community Impacts	The additional services will reduce auto-dependency and stimulate walking and cycling activity. They will stimulate development in the areas around the stations served and reinforce the sense of community.

8.4.3 *Off-Peak*

Weekday off-peak ridership, outside the two peak periods is expected to be approximately 76% of AM peak period ridership by 2021 or 2031 and weekend ridership approximately 56% of total weekday ridership. Ridership, trains operated and the numbers of riders per train in off-peak periods in the 2021 and 2031 Do Something options are set out in Table 8-6 below.

In 2021 the average number of riders per weekday off-peak train on the Richmond Hill (Bloomington) line could be approximately 127 increasing to approximately 158 by 2031. On weekends the average number of riders per train could be approximately 82 in 2021 increasing to approximately 102 in 2031.

Table 8-6: Off-peak Ridership on the Richmond Hill (Bloomington) Line

Year	Time Period	Boardings	Trains operated	Boardings per train
2021	Weekday off-peak	5,850	46	127
	Weekend	11,860	144	82
2031	Weekday off-peak	7,270	46	158
	Weekend	14,740	144	102

Weekday off-peak periods and weekends account for 35% of all benefits: weekday peak periods for the other 65%. In the Richmond Hill (Bloomington) corridor the off-peak and weekends contribute benefits of approximately $504 million.

8.4.4 *Transportation User Benefits*

The additional peak period services attract more riders to GO Rail services, thereby conferring benefits to users of transportation networks, as do the new off-peak and weekend services. Some of these new riders are attracted from the car. A range of transportation user benefits have been estimated, with the major items being:

- Time savings to transit and auto trips in the corridor totalling $707 million over the first 25 years;
- Reduced auto operating costs of $665 million over the first 25 years; and
- Safety benefits as a result of fewer road accidents of $68 million over the first 25 years.

8.4.5 *Financial Account*

The present value of the capital costs and incremental operating costs on the Richmond Hill line amount to $1,118 million and the present value of benefits to $1,441 million, giving a Benefit:Cost ratio of 1.3:1.

Annual revenues of passengers on the proposed Richmond Hill line services are estimated at $29.3 million in 2021 and $36.7 million in 2031 – at today's fare levels.

The annual costs of operating the services are estimated at $42.5 million in 2021 and $60.1 million in 2031, again at today's prices.

The all-day services proposed here would replace bus services and lead to savings in bus costs. The annual variable costs of operating bus services in the Richmond Hill (Bloomington) corridor (Route 61) are estimated at $0.8 million.

These estimates indicate a farebox ratio of approximately 0.6, with 2031 farebox revenues of $36.7 million and operating costs of $60.1 million.

8.4.6 *Environmental Impacts*

The major environmental impact of the additional services arises from the reduction in car use and the reduction in greenhouse gas emissions. Some 455,000 tonnes of CO_2, with a current value of $10 million, will be saved over the first 25 years.

The other principal environmental impacts are likely to be adverse. The additional rail services will generate additional noise, at intervals throughout the weekday and at weekends, which occupants of track-side properties could find disruptive. The additional diesel-powered services will create additional track-side air pollution, which will be offset by the reduction in auto pollution. By 2031 there will be 1.4 million train kilometres per year and a reduction of 100 million auto kilometres per year.

8.4.7 *Other Economic Impacts*

The capital costs involved in construction work and the manufacture of the new rolling stock required will generate economic impacts other than those to users of the transport networks already discussed. There will be direct and indirect impacts on employment and wages and additional GDP will be created.

The initial construction and manufacturing activity will generate 5,000 person years of direct employment and a further 2,800 person years of indirect employment. It will generate additional direct wages of $190 million and indirect wages of a further $100 million. It will add $750 million to GDP through direct and indirect impacts.

The GO Rail service enhancements will make the corridor a more attractive residential location which could stimulate uplift in land values, particularly for residential land along the corridor, and will serve the Richmond Hill/ Langstaff Gateway Urban Growth Centre, enhancing its development potential.

8.4.8 *Social Community Impacts*

The additional services will stimulate development in the areas around the stations served and support more sustainable, liveable communities. The service

improvements will contribute to reducing auto-dependency and stimulating walking and cycling activity, which will have positive health impacts.

The introduction of all-day and weekend services at reasonable frequencies will mean that the GO Rail service will serve more than the commuter trips served at present. They will serve a variety of optional purpose and leisure trips, strengthening the links between Toronto and the communities they serve, giving local residents a good, alternative to the car for many trips into Toronto, thereby strengthening these communities. By 2031, there will be approximately 7,000 off-peak riders per weekday and approximately 7,000 per weekend day, as well as an extra 2,300 weekday peak period riders compared with the Do Minimum

9 Stouffville (Unionville/Lincolnville) Corridor

Results Pending

Appendix 1: Transport Modelling

General Approach

This study's approach to transport modelling and appraisal makes use of:

- GO Rail's long-standing Direct Demand Model, particularly as described in GO Rail's Forecasts, Peter Dalton Consulting, March 19 2009;
- The Greater Golden Horseshoe Transportation Model (GGHM) which provides estimates of travel time differences to feed into the assessment template developed for these Metrolinx Benefits Case assessments; and
- A new approach to forecasting off-peak ridership, making use of information from the Lakeshore line, as well as other modelling and observed experience from elsewhere, given this study's emphasis on introducing two-way, all-day and weekend GO Rail services and the peak period-only nature of the two models referred to above.

Peak period modelling

Direct Demand Model

Over the years GO Rail has maintained a direct demand model to prepare ridership forecasts. It is referred to as a 'direct demand model' since it forecasts demand for GO Rail directly from relevant factors including population growth in the catchment areas of GO Rail lines and stations, employment growth in downtown Toronto (in the constrained forecasts), and service level changes, including service frequencies, train travel times (including the provision of express services) and new rail stations.

Following discussion with GO Transit staff, a replica of the GO Rail model was built to provide forecasts for Do Minimum and Do Something options in 2021 and 2031, and these forecasts are used as the study's principal peak period forecasts. These are set out in Table A-1 below.

Table A-1: Direct Demand Model Boardings, AM peak period, inbound

Line	2008		2021		2031	
	Observed	Modelled	Do Minimum	Do Something	Do Minimum	Do Something
Barrie	6,400	5,200	6,600	8,700	7,900	10,800
Milton	10,800	12,100	13,400	15,500	14,600	19,800
Richmond Hill	4,800	5,200	6,200	7,000	6,400	8,700
Lakeshore East	18,900	16,400	17,300	19,600	20,300	23,200

Modelled flows in 2008 generally align with observed flows. The biggest difference in the modelled and observed results is on the Milton line (12,100 modelled rides and 10,800 observed riders) and on the Lakeshore East line (16,400 modelled riders and 18,900 observed).

On all lines there is a growth in forecast ridership from the 2008 modelled flow to the 2021 Do Minimum and again to the 2031 Do Minimum. Similarly there is always growth in ridership forecast from the Do Minimum to the Do Something.

On the Lakeshore East line the focus of the changes is the extension of services beyond the current terminus at Oshawa to Bowmanville. Table A-2 shows how ridership at the eastern end of the line, between Oshawa and Whitby, is increased by the extension. In 2031, ridership of 5,600 in the Do Minimum becomes 7,900 in the Do Something, an increase of 2,300. 5,400 of the 7,900 have boarded trains at new stations east of Oshawa

Table A-2: AM Peak Period Ridership on Bowmanville Extension, inbound

Line	2008		2021		2031	
	Observed	Modelled	Do Minimum	Do Something	Do Minimum	Do Something
Lakeshore East line	18,900	16,400	17,300	19,600	20,300	23,200
Bowmanville – Oshawa	n/a	n/a	n/a	4,400	n/a	5,400
Oshawa – Whitby	3,300	3,000	4,600	6,400	5,600	7,900

These forecasts have been taken as the best available ridership forecasts for this study's options and have been used, as described in Chapter 4, in the estimation of the benefits accruing from the service enhancements assessed in this study.

The direct demand model is less complex than the Greater Golden Horseshoe Model in the following ways:

- It is concerned only with GO Rail services. It is not concerned with any other transit services or with auto trips and the highway network, and cannot model their impact on GO Rail ridership.

- It is concerned primarily with how many trips will be attracted to GO Rail services, but is not concerned with where these trips go to, except that employment levels in downtown Toronto affect ridership in the constrained forecasts which are used in this study. It is assumed that inbound trips in the AM peak period are headed for Union Station.

- It forecasts continuing increases in GO Rail ridership so long as populations and employment in relevant areas are expected to increase and service levels do not deteriorate.

- A weakness of this modelling approach lies in the modelling of trips which could take advantage of the opportunities for interchange presented, for

example, at Bloor station on the Milton line or Downsview station on the Barrie line. The modelling approach cannot recognise the range of trip attractions opened up by the interchange facility so is likely to under-forecast the trips which might be expected to make use of GO rail services and these interchange opportunities.

Greater Golden Horseshoe Model (GGHM)

The GGHM is a four-stage model (trip generation, trip distribution, mode split and assignment) for the Greater Golden Horseshoe area. The model covers the morning and evening peak periods, typically producing highway network outputs for the peak hour and transit outputs for peak periods.

Its principal use in this study has been to provide a number of measures necessary for benefit estimation:

- Transit user time savings;
- Auto user time savings; and
- Changes in auto vehicle kilometres, which feed into the estimation of auto operating costs, safety benefits and changes in greenhouse gas emissions.

These measures are adjusted to reflect the ridership forecasts produced by the Direct Demand Model (see Section 4.5).

Off-peak modelling

A specific requirement of this assessment is to establish the benefits of running two-way, all-day rail services on lines which currently have very little rail service in the counter-peak direction in peak periods and no rail service (except for the Lakeshore East line) in the off-peak. It should be noted that GO Transit does currently operate off-peak and counter-peak Train-Bus services in each of the corridors. This section describes the basis for this assessment of off-peak services.

The section first sets out how the current template assesses off-peak benefits, and then considers actual off-peak ridership on the Lakeshore East line, before looking at other North American and European evidence on off-peak

commuter rail ridership. Finally it sets out an approach for estimating the benefits of off-peak rail services.

Metrolinx BCA Template

In the absence of any modelling outside weekday peak periods, the Metrolinx BCA template takes account of benefits outside these periods through the use of factors applied to morning peak period output. The GGHM model produces outputs for a morning peak hour on the highway network and for a morning peak period on the transit network. These outputs need to be factored first to annual totals before they can be estimated for a 25-year period from implementation of enhanced services.

Annual highway benefits are estimated by applying a factor of 3,000 to morning **peak hour** benefits: annual transit benefits are estimated by applying a factor of 900 to morning **peak period** benefits.

On transit, the weekday peaks occur in the morning and evening on approximately 250 days per year. Therefore the peaks account for approximately 500 out of the 900 with the remaining 400 representing weekends, public holidays and weekday hours outside the peaks. If the 400 were divided equally across these days (400 / 365 = 1.1), the implication is that weekday benefits from transit improvement can be represented as 1 in the morning peak, 1 in the evening peak and 1.1 for all the other weekday hours and 1.1 for each weekend day. The non-peak hours on a weekday are nearly equivalent to a peak period. A consideration for this analysis is what the existing template factor implies for weekday inter-peak and evening ridership and for weekend ridership and how it can sensibly be used for GO Rail services.

Observed Data – Toronto and North America

In Toronto only the Lakeshore East and West lines can provide current observed information on off-peak rail ridership. On these lines the autumn 2008 surveys give the total inter-peak ridership as a proportion of morning peak period ridership as 27% on Lakeshore East and evening period ridership as a further 21% of morning peak period ridership, making the non-modelled periods equal to 48% of the AM peak. The equivalent percentages on Lakeshore West are 22% for the inter-peak and 18% for the evening, making 40% in total.

The Lakeshore line weekday off-peak ridership at 40-48% of the AM peak ridership falls short of that assumed in the annualisation factors in the current template. However this could be expected since the off-peak level of service on these lines is only one train per direction per hour.

Weekend Lakeshore East and West rail ridership is approximately 7 to 12 % of the Lakeshore total monthly ridership. Working on the basis that weekend ridership averages approximately 10% of the total monthly ridership, the two weekend days combined accounting for 10% of ridership and the five weekdays accounting for 90%. So each weekday on average accounts for approximately 18% of total weekly ridership and the two weekend days accounting for 10%, so the two weekend days account for 56% of an average weekday's ridership.

There is very little North American information available on off-peak commuter rail ridership generally or on the effects on ridership of increasing off-peak frequencies. In the San Francisco area, Caltrain (San Francisco's commuter rail service) increased the frequency of daytime off-peak services to San Mateo and Santa Clara counties from one train per hour to two per hour in 2000, generating an increase of 26% in off-peak ridership, so that off-peak trips were approximately half of daily trips. But there were few daily trips, in the peak period as well as the off-peak, therefore using this as reference may not be too reliable.

There is some evidence of appropriate elasticities of demand with respect to service frequencies for commuter rail services in North America. These tend to be lower in the short-term and higher in the longer-term, and also tend to be higher when the change in frequency is from a very low frequency. For the Lakeshore line, appropriate elasticities might be 0.5 in the short-term and 0.9 in the long-term. Taking the Lakeshore West off-peak ridership, 40% of morning peak ridership, as being generally more relevant, since this is a broader corridor with better alternative transit services than Lakeshore East, an increase of 100% in service levels, from one train per hour to two, could increase the off-peak ridership proportion from 40% to 60% in the short-term and 76% in the longer-term.

Observed Data - London

There is good evidence from London that off-peak commuter rail ridership is a higher proportion of peak ridership than the numbers reported above. Some of the most interesting points include:

- A 2006/07 household survey among London residents, who are likely to be relatively short-distance rail commuters, showed that their use of National Rail services - i.e., overground rail services into London, not Underground services – in the off-peak (inter-peak and evenings) was 98% of their morning peak period use;

- On the London – Brighton line, as an example of longer-distance rail commuting, inter-peak and evening ridership together were 131% of morning peak period ridership; and

- For stations in London and the South East of England as a whole, inter-peak and evening train boardings were 109% of morning peak boardings.

Overall Conclusions

On the Lakeshore lines the observed inter-peak and evening rail ridership is approximately 48% of morning peak ridership on Lakeshore East and 40% on Lakeshore West, with the inter-peak service consisting of one train per direction per hour. Also, the two weekend days combined carry approximately 56% of a typical weekday ridership.

Evidence on elasticities with respect to service frequency suggests that the current 40% proportion of peak ridership reported for Lakeshore West line could increase with a doubling of off-peak service frequencies to approximately 60% in the short-term and approximately 76% in the long-term. The current weekend proportion of approximately 56% of weekday ridership is assumed to continue to apply to the increased weekday ridership in the longer-term.

These proportions are lower than what would be applicable for the Toronto subway or, for example, commuter rail services in London, where proportions in excess of 100% are found.

In this study, a factor of 789 is applied to convert transit benefits from the AM peak period to an annual total, rather than the factor of 900 in the original template. This factor assumed that there are 255 weekdays and 110 weekend/ public holidays in the year, and is built up as follows:

- Two peak periods per weekday giving a factor of 510;
- Weekday off-peak ridership increasing from 40% to 76% of AM peak ridership on 255 days, giving a factor of 194; and
- The 110 weekend/ public holidays effectively form 55 weekends, each with ridership at 56% of weekday ridership, with weekday ridership equating to 2.76 times AM peak period ridership. This gives a factor of 85 (i.e., 55 * 0.56 * 2.76).

The annualisation factor for auto benefits has been similarly reduced from the factor of 3,000 in the original template to 2,630.

Appendix 2: Summary Table

Factor	Value	Source
Discount Rate	5% (real terms)	Province of Ontario
Value of Time Business Other Weighted Average	 $35.16 (2008$) per hr $10.82 per hr $13.02 per hr	Transport Canada, Greater Golden Horseshoe Model
Value of Time Growth	1.6% per annum	Based on GDP per capita increases, GDP/ Population estimates from www.greatertoronto.org
Average Accident Cost	$0.07 per km	Collision Statistics: 2004 Canadian Motor Vehicle Traffic Collision Statistics, TP3322. Vehicle Kilometres: Statistics Canada, Catalogue No. 53-223-XIE, "Canadian Vehicle Survey"
Greenhouse Gas Emissions 2006 2021 2031	 2.39 kg /l or 0.23 kg per km 2.35 kg /l or 0.21 kg per km 2.35 kg /l or 0.20 kg per km	Urban Transportation Emissions Calculator, Transport Canada, Greater Golden Horseshoe Model
Average Cost of CO_2	$0.01 per km $40/tonne (median cost)	Several literature sources, Transport and Environment Canada, Greater Golden Horseshoe Model and http://envirovaluation.org/index.php/2007/09/06/university_of_hamburg_forschungsstelle_n_1
Auto Operating Costs	In 2008$ + 2.0% p.a. increase 2008 - $0.50/km 2021 - $0.65/km 2031 - $0.79/km	Data in 2007 based on CAA calculation of average driving costs and includes operating and ownership costs (long-term costs). Increase based on Greater Golden Horseshoe Model
Annualisation Factors: Metro / LRT Road	Peak-daily/Daily-Annual 3 / 263 10 / 263	Halcrow Consulting Inc.