METROLINX

An agency of the Government of Ontario

YONGE NORTH SUBWAY EXTENSION BENEFITS CASE

May 2013

Yonge North Subway Extension

Benefits Case Analysis Update

Final Report

May 2013

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Executive Summary

The Benefits Case Analysis (BCA) update for the proposed Yonge Subway North Extension was undertaken in 2011. Since then Metrolinx and York Region have undertaken further planning studies to inform the BCA's conclusions. The findings from these have been incorporated into this report. The results of the analysis are unchanged and remain based on the available data provided in 2011.

1. In November 2008 the Metrolinx Board approved the Regional Transportation Plan (RTP) entitled *The Big Move*, a 25-year plan for the implementation of the Province's *MoveOntario 2020* vision of 52 new rapid transit projects in the Greater Toronto and Hamilton Area (GTHA) by 2020.
2. The proposed Yonge North Subway Extension is a top 15 priority transit project in the GTHA. This report provides an update on the interim Benefits Case Analysis (BCA) that was carried out for the project in June 2009.
3. Benefits Case Analysis entails the robust and consistent Multiple Account Evaluation (MAE) of the relative environmental, economic and social impacts of proposed projects, by considering their benefits and costs, and hence the trade-offs, between a set of project options. This process is a key input to the Metrolinx Project Prioritization Framework and assists decision-making for unfunded rapid transit projects.
4. The project evaluated in this BCA is an extension of the Yonge subway line north from Finch Station in Toronto across the municipal boundary to Richmond Hill Centre in York Region.
5. The Yonge North Subway Extension is supported by a wealth of policy and planning documents beyond *The Big Move*. Population and employment forecasts suggest that York Region will be one of the fastest growing areas in the GTHA and neighbours Toronto, which already has significant existing population and employment that are also projected to grow. Both York Region and Toronto have undertaken or are underway with a planning policy framework that supports urban intensification along its major rapid transit centers and corridors. These policy and planning studies support the significant increase in ridership projected for the Yonge corridor.
6. Three proposed options for the Yonge North Subway Extension were evaluated against the Base Case:

   - The **Base Case** for this analysis is defined as the committed municipal bus network, as well as, the funded transit infrastructure projects such as the subway extension to Vaughan Metropolitan Centre and Yonge Subway capacity improvements, Eglinton-Scarborough Crosstown LRT and Viva BRT expansion
   - **Option 1: Subway extension to Richmond Hill Centre** – subway extension from existing Finch subway station to Richmond Hill Centre (RHC) serving six new stations at Cummer, Steeles, Clark, Royal Orchard, Langstaff and RHC.

- **Option 2: Phased subway extension** - initial subway extension from existing Finch subway station to Steeles Avenue serving two new stations at Cummer and Steeles.
- **Option 2A: Phased subway extension and increased GO frequencies** - initial subway extension from existing Finch subway station to Steeles Avenue serving two new stations at Cummer and Steeles. Increased GO service frequencies between Richmond Hill GO station and Union.

7. A summary of the MAE analysis is shown below. Option 1 performs most strongly for four of the accounts and is forecast to generate almost twice the level of transportation user benefits, and approximately three times the estimated land value impact of Option 2. On the fifth account, the significant capital cost of Option 1 contributes to a lower Benefit Cost ratio than Option 2 and a negative value for Net Benefits.
8. Phasing the construction could mitigate these costs by making the construction more affordable and capturing a portion of the benefits. However Places to Grow growth assumptions and associated transit demand on the corridor suggest that the extension to Richmond Hill Centre provides a more long term solution to accommodate all the forecast growth.
9. Ridership resulting from implementing the Yonge North Subway Extension may challenge downstream capacity on the Yonge subway line. To address this concern Metrolinx will be undertaking a regional network capacity analysis, in partnership with York Region and the City of Toronto, to determine how to sequence construction of the Yonge subway extension to Richmond Hill Centre (Option 1) with the phased implementation of other network improvements such as automatic train control, the Downtown Relief Line, Union Station and Yonge/Bloor improvements.
10. In considering value for money through the traditional cost-benefit accounts, Option 2 has a positive Net Benefit and a Benefit Cost Ratio exceeding 1:1. However, from an economic and land value perspective, Option 2 amounts to less than 35% of that of the full subway extension (Option 1) and half the long term impact.
11. Option 2A is forecasted to generate greater benefits than Option 2, but the high costs of increasing GO frequencies indicate that this option is the poorest return on investment of the options.

MAE SUMMARY

	Option 1	Option 2	Option 2A
Transportation User Account			
Transportation User Benefits (PV $M)	1,980.3	1,025.5	1,210.5
Qualitative User Benefits	✓✓✓	✓	✓
Financial Account			
Costs (PV $m)	2,645.0	971.5	1,907.7
Net Benefits (PV $m)	-664.8	+54.0	-697.2
Benefit Cost Ratio	0.8:1	1.1:1	0.6:1
Environmental Account			
GHG Emissions Reductions (PV $m)	9.2	4.5	5.4
CAC Emissions Reductions	✓✓✓	✓✓	✓✓
Economic Development Account			
Economic Impacts during Construction:			
Employment (person years)	28,600	10,630	16,860
GDP ($m)	2,760	1,020	1,630
Wages ($m)	1,070	400	630
Economic Impacts during Operation (2031):			
Employment (jobs)	276	143	168
GDP ($m)	26.7	13.8	16.3
Wages ($m)	10.4	5.4	6.3
Land Value Uplift ($m)	480-1,202	157-392	157-392
Development Potential	✓✓✓	✓	✓
Social and Community Account			
Land Use Shaping	✓✓✓	✓	✓
Health	✓✓	✓	✓
Accessibility	✓✓✓	✓✓	✓✓

1 Introduction

Context

1.1 In 2006, the Government of Ontario created the Greater Toronto Transportation Authority, renamed to Metrolinx in 2007. Since the creation of Metrolinx, the organization has grown steadily. In May 2009, GO Transit, which delivers commuter services, became Metrolinx' first operating division. In 2010, the Union-Pearson Airport Rail link became an operating division of Metrolinx along with PRESTO in 2011.

1.2 Metrolinx' mandate is to improve the coordination and integration of the multi-modal transportation network in the Greater Toronto and Hamilton Area (GTHA) to achieve the objectives and vision set out in the Province's Greater Golden Horseshoe Growth Plan, known as '*Places to Grow*'.

1.3 In November 2008 the Metrolinx Board approved the Regional Transportation Plan (RTP) entitled '*The Big Move*', a 25-year plan for the implementation of the Province's MoveOntario 2020 vision of 52 new rapid transit projects in the GTHA by 2020. The RTP presented the new rapid transit proposals in four bundles. These are:

- Top 15 priority projects;
- First 15 years;
- 16 to 25 years; and
- Projects for consideration beyond 25 years.

1.4 The Top 15 projects have completed, or are undergoing, Benefit Cases that assist provincial decision-makers in determining project next steps and funding decisions. For the balance of the unfunded projects, a Metrolinx Project Prioritization Framework is under development, which will also be used to assist decision-making. The Framework links to the Vision, Goals and Objectives set out in '*The Big Move*' and also incorporates the results from the Benefit Case Analyses (BCAs).

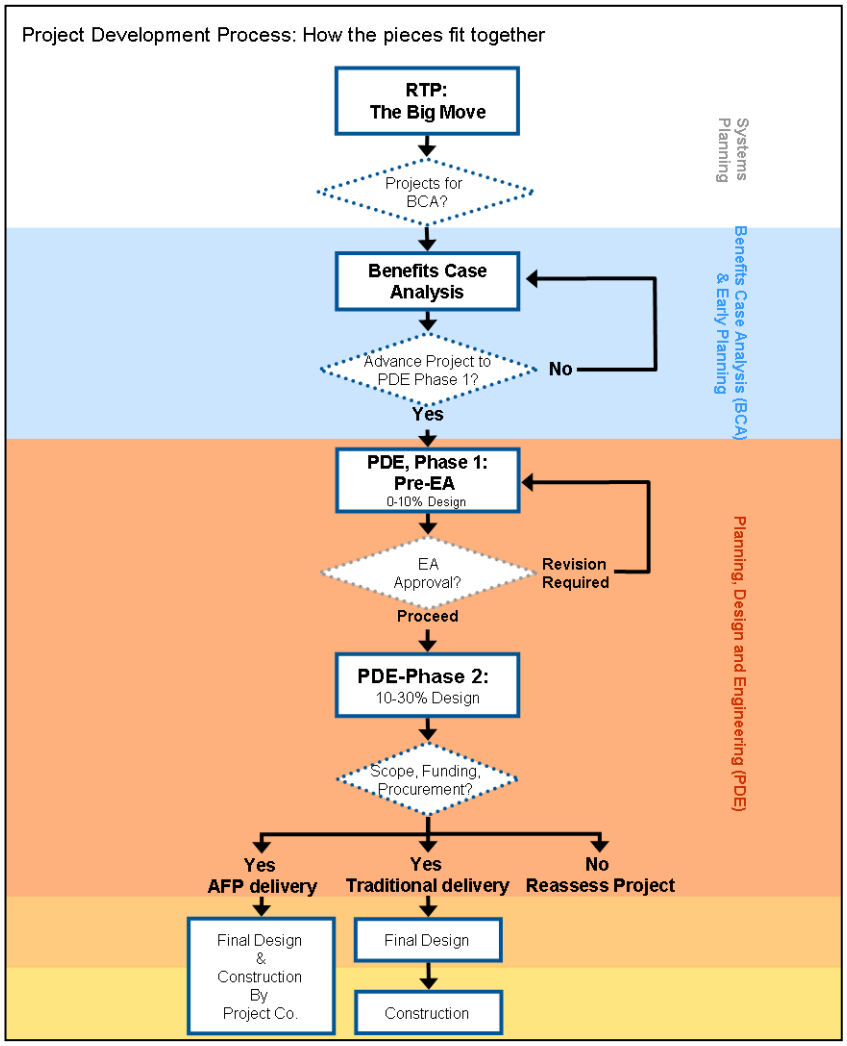
Benefits Case Analysis & Project Development

1.5 Benefits Case Analysis (BCA) entails the robust and consistent Multiple Account Evaluation (MAE) of the relative environmental, economic and social impacts of proposed rapid transit projects, by considering their benefits and costs, and hence the trade-offs, between a set of project options. These options may include variations in alignment, technology, performance, stations and/or phasing of the project.

1.6 The results are presented in a clear and consistent way to assist decision-makers in selecting a preferred option in terms of most appropriate project scope and implementation phasing. In doing so, provides direction for the further development of the project.

1.7 Following the determination of a preferred project option, a planning, design and engineering (PDE) program takes the project to the next stage of development. The process is intended to reduce delivery risk by refining the project scope. Figure 1.1 shows an overview of the Metrolinx project development process.

FIGURE 1.1 METROLINX PROJECT DEVELOPMENT PROCESS



Source: Metrolinx

Yonge North Subway Extension Interim BCA (2009)

1.8 The proposed Yonge North Subway Extension is identified as a top 15 priority project and one of the currently prioritized transit projects in the GTHA. In collaboration with the City of Toronto and York Region, Metrolinx developed an interim high level project appraisal for the scheme. This interim BCA was completed and released in June 2009.

1.9 The Yonge North Subway Extension interim BCA compared three options for the Yonge Street corridor as follows:

- Subway extension from Finch to Richmond Hill with six stations (Cummer, Steeles, Clark, Royal Orchard, Langstaff and Richmond Hill Centre);
- Subway extension from Finch to Richmond Hill with five stations (Royal Orchard removed); and
- Bus Rapid Transit (BRT) operating in mixed traffic between Finch and Richmond Hill Centre with Richmond Hill GO Line service improvements.

1.10 In summary, the results showed little difference between the two subway options with Benefit Cost Ratios of 0.7:1. Both options exhibited considerable positive economic development impacts and strong social community benefits.

1.11 The analysis of the third option suggested that the BRT would experience substantial crowding in the peak periods and therefore would not deliver the same level of transit user benefits as the subway options. In addition, its contribution to the economic development, social community and environmental accounts is less than with the subway options.

1.12 Following review of the interim BCA by the Metrolinx Board of Directors, it was requested that additional analysis to more comprehensively scope the project should be undertaken prior to a project scope recommendation. The additional analysis was to consider:

- Possible adjustments in project scope, timing or phasing;
- Consideration of the extent to which improved service levels on the parallel GO Richmond Hill rail corridor off-loads some of the demand on the Yonge Street subway; and
- The cost impacts of the various options on the subway yards strategy, Yonge-Bloor subway station improvements, and a future Downtown Relief Line to bypass the Yonge-Bloor congestion pinch point.

1.13 This report provides an update on the interim BCA, informed by the findings of this additional analysis. The analysis documented in this report was undertaken in 2011. Since then Metrolinx and York Region have undertaken further planning studies to inform the BCA's conclusions. The results of this analysis are unchanged and remain based on the available data provided in 2011.

Report Structure

1.14 This report presents the revised BCA for the proposed Yonge North Subway Extension. The remainder of the report is structured as follows:

- Chapter 2 presents the **Project Rationale**. This section sets out the project context and need, as well as the project objectives, project overview and opportunities and challenges;
- Chapter 3 describes the **Project Options** that are evaluated; and
- Chapter 4 sets out the **Project Assessment**, presenting the assessment methodology, analysis and summary results.

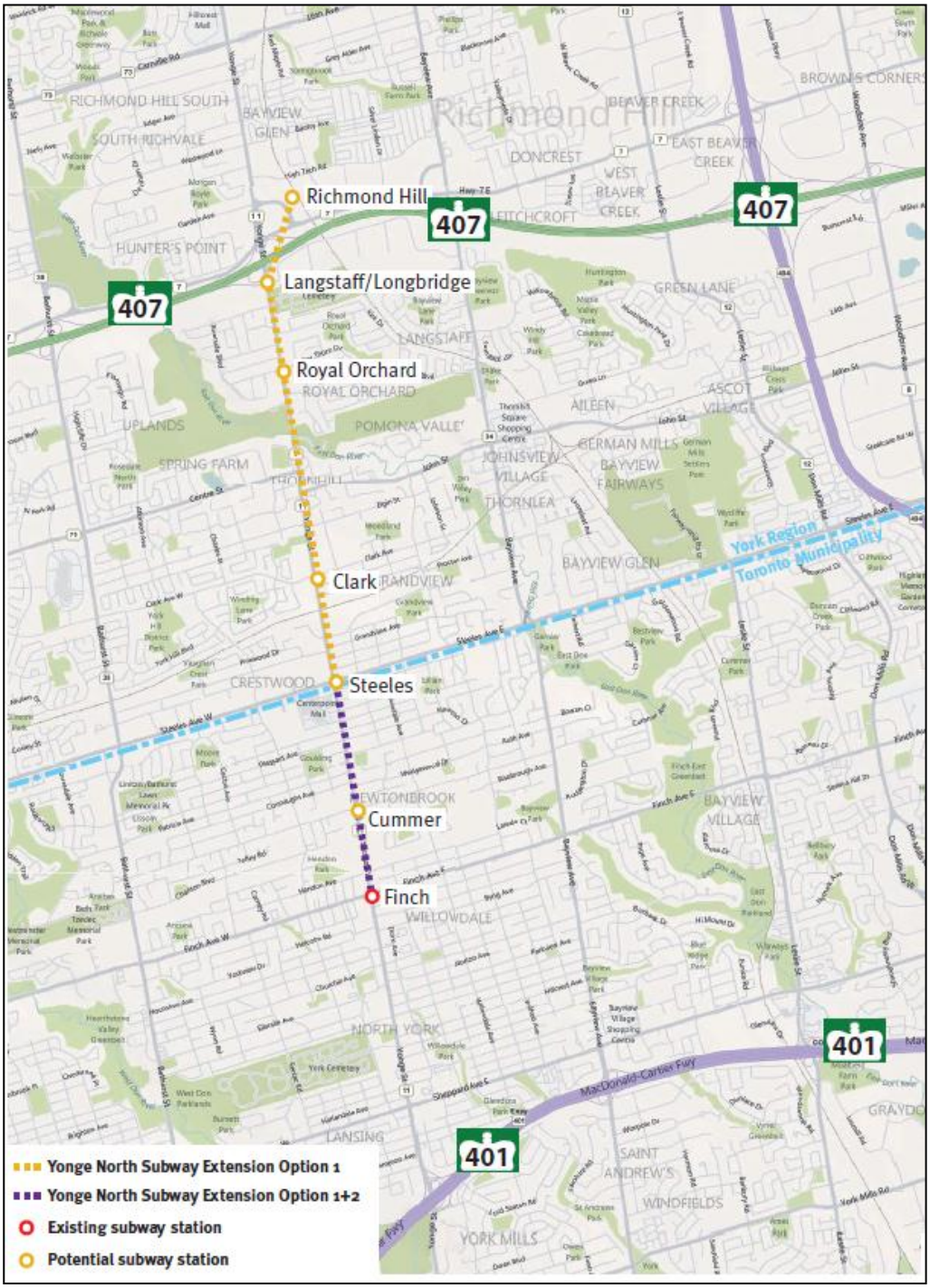
2 Project Rationale

Context and Need

2.1 The Yonge subway line acts as the spine of Toronto's transit system, with the highest volume of ridership of all transit facilities in the Greater Toronto and Hamilton Area (GTHA) and significant population growth forecast along the length of corridor. The northern terminal station at Finch Avenue is a significant regional transportation facility, providing access to the Toronto subway network for Toronto residents and residents of York Region.

2.2 This project proposes an extension of the Yonge Subway line north from Finch Station across the municipal boundary to Richmond Hill Centre in York Region. A context map of this area is shown in Figure 2.1.

FIGURE 2.1 THE YONGE NORTH SUBWAY EXTENSION



Source: Steer Davies Gleave

Regional Policy

2.3 The Yonge North Subway Extension is supported by a number of regional policies - the most relevant and more recent of which are outlined below.

Places to Grow: Growth Plan for the Greater Golden Horseshoe

2.4 The Growth Plan under the Places to Grow Act is a framework for implementing the Government of Ontario's vision for better managing growth in this region. The plan identifies the Yonge North Subway Extension as one of the major candidates for improved high-order transit. It will provide a link to the two Urban Growth Centres (UGC), North York Centre and the Richmond Hill-Langstaff UGC, located near the start and end of the proposed extension.

2.5 The level of success achieved by the Yonge North Subway Extension will be significantly enhanced by the degree of realization of the land use policies outlined in the Growth Plan. Achievement of the proposed high-density and mixed-use development in the Yonge Corridor would deliver the required transit demand to support higher-order transit. Conversely, given the mutual relationship between land use and transportation, the Growth Plan development objectives themselves will be supported by the presence of an effective transportation system, including the Yonge North Subway Extension.

The Big Move: Transforming Transportation in the Greater Toronto and Hamilton Area

2.6 Building on the Growth Plan and the Greenbelt Act (2006), Metrolinx and the RTP entitled 'The Big Move' were created to help achieve provincial planning objectives by building a comprehensive transportation network to help relieve congestion and connect communities throughout the GTHA.

2.7 As mentioned in Chapter 1, the RTP is a 25-year plan for the implementation of the Province's MoveOntario 2020 vision. 'The Big Move' recommends the construction of over 1,200 km of rapid transit.

2.8 The Yonge North Subway Extension is identified as a top 15 transit priority action for implementation. Other top 15 priority projects relevant to this corridor are the Viva BRT along Highway 7 and Yonge Street as well as the capacity improvements on the existing Yonge Subway line.

2.9 Construction of Viva BRT is already underway along the Yonge Street and Highway 7 corridors. The capacity improvements along the existing Yonge Subway line are also underway with the procurement of new subway trains and the installation of Automatic Train Operation (ATO). In addition, the station congestion issue at Yonge-Bloor is being addressed with short term measures of improvement having been identified.

2.10 Directing growth and development to intensification corridors is an essential element of the province's Growth Plan for the Greater Golden Horseshoe, as well as municipal Official Plans. The Big Move has identified several mobility hubs[1]

[1] Mobility hubs consist of major transit stations and the surrounding area. They are places of connectivity where different modes of transportation – from walking to biking to riding transit – come together seamlessly and where there is an intensive concentration of working, living, shopping and/or playing.

along the Yonge North corridor. The extension of the subway will provide a direct link between the Finch, Steeles, and the Richmond Hill Centre mobility hubs.

York Region's Transportation Master Plan

2.11 The Regional Municipality of York recognized the growing problem of traffic congestion in York Region and produced their Vision 2026 strategic plan articulating a multi-pronged regional growth management strategy that will direct and time new development. The Transportation Master Plan (TMP) is a core element of Vision 2026 and guides the proposed transit expansion in the immediate and long-term future.

2.12 The TMP is based on a transportation vision that foresees an integrated highway and public transit network that will support York's growth to 2031. It complements all other regional and provincial planning initiatives and recognizes that transportation has an impact on housing, job creation, human services and the shape of York's municipalities. The emphasis of the plan is to support the four designated Regional Centres, of which Richmond Hill is one, located along the Yonge Subway Extension corridor and connected to Highway 7.

2.13 Yonge Street between Highway 7 and Finch subway station was identified for immediate focus in the first five years of the Action Plan. Consequently, York Region initiated the Yonge Subway Extension Study in June 2007.

2.14 The policies outlined above emphasize the important relationship between transit and growth and development. There is a clear consensus that transit is seen as necessary to support growth and vice versa. The north Yonge region is an area ear-marked for substantial growth by the various planning bodies and as a result transit improvements have been identified in this area with the Yonge North Subway Extension being the most significant.

Future Growth and its Implications

2.15 The Yonge North Subway Extension crosses the municipal boundary between City of Toronto and York Region just north of Steeles Avenue, between Finch Avenue and Richmond Hill Centre.

2.16 Over the last decade, York Region has experienced significant population and employment growth. Between 2001 and 2006 York's population increased by 22.8% to 932,000 residents[2]. By mid-2011, this had grown to 1,070,000 residents, making it the third largest census division in Ontario[3]. As a result of this rapid growth, land use patterns have shifted from predominantly rural and agricultural to urban; particularly in the southern and central portions of the region along the Highway 7 and Yonge Street corridors.

[2] Source: Canada 2006 Census. Statistics Canada

[3] Source: Ontario census divisions – Annual population estimates at July 1. Statistics Canada

2.17 The regional population is forecasted to double over 30 years, from 759,000 people in 2001 to over 1.5 million in 2031. This is coupled with a doubling in employment from 386,000 to 780,000 jobs in the same 30 year period[4].This growth is anticipated regardless of the implementation of planned transit developments in York Region.

2.18 Along with the growth that has occurred in York Region, travel patterns between York Region and Toronto are becoming more balanced. The morning peak period traffic volume crossing the Steeles Avenue boundary has seen changes with growth. While 58% of traffic is in the southbound direction, 42% goes northbound[5]. The Yonge Street corridor traffic pattern at a 60/40 split reflects the overall boundary pattern.

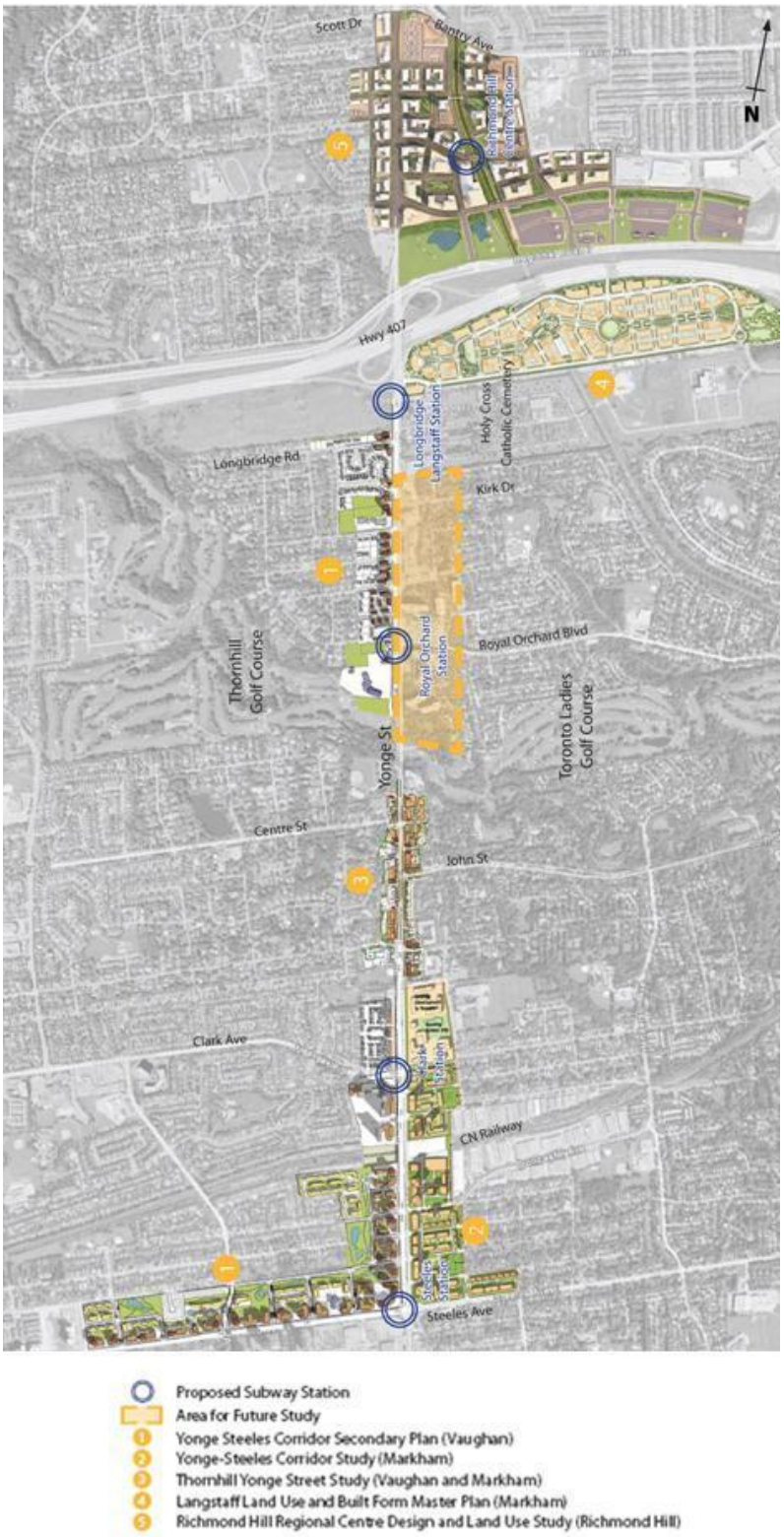
2.19 At the corridor level, on the north side of the municipal boundary, York Region, in conjunction with its local level municipalities, has put in place a planning framework for Yonge Street as a designated Regional Corridor, which supports high growth based on high capacity transit infrastructure.

2.20 As illustrated in Figure 2.2, intensification and transit supportive policies have been developed to encourage optimum utilization of the Yonge Street corridor. Studies such as the Centre-Wide Transportation Study for the Richmond Hill-Langstaff UGC have made detailed recommendations on the phasing of development relative to transportation infrastructure including the Yonge North Subway Extension.

[4] Source: Yonge Subway Extension – Demand Forecasting Report. January 2011

[5] Source: York Region

FIGURE 2.2 YORK REGION'S PLANNING FRAMEWORK FOR THE YONGE EXTENSION CORRIDOR (BETWEEN STEELES AND RICHMOND HILL)



Source: Yonge Subway Extension – Demand Forecasting Report, January 2011

2.21 On the south side of the municipal boundary, the City of Toronto's North York Centre Secondary Plan also provides for major concentrations of population and employment growth in the corridor around Finch station. The 'North York Centre North' extends along Yonge Street towards Cummer, specifying the highest densities and intensities of uses in those locations closest to the existing subway station as seen in Figure 2.3.

FIGURE 2.3 NORTH YORK CENTRE SECONDARY PLAN DENSITY LIMITS[6]

Source: North York Centre Secondary Plan, Toronto City Planning 2009

2.22 Building from the North York Centre Secondary Plan, the Toronto City Planning department has recently initiated the Yonge Street North Planning Study, which will assess development in the area and what can be supported should the subway be extended. The study will review the following[7]:

- Locations of various densities and built forms;

[6] Stars represent density that can only be assigned pursuant to the Official Plan

[7] Yonge Street North Planning Study Report, June 2, 2011

- Level of development prior to and after a Yonge subway extension;
- Transportation and infrastructure improvements;
- Pedestrian amenities and streetscape;
- Community infrastructure, parks and open space improvements; and
- Implementation strategies.

2.23 The study will be conducted in three phases, from background research to preparation and modelling land use concepts. Consultation meetings and / or workshops will be held with the local community throughout each phase.

Project Objectives

2.24 The overarching project objective recognizes the policy rationale for investment in the Yonge Street corridor supporting the growth and intensification planned along the corridor both in the City of Toronto and York Region, while ensuring the best return for taxpayer investment. It is to:

Deliver high-order transit to relieve congestion and support proposed land use intensification in the Yonge Street corridor, demonstrating value for money.

2.25 As identified in the Interim BCA, both the provincial Growth Plan and York Region's Official Plan promote more efficient, liveable, mixed-use communities integrated with higher-order transit services and improved regional connectivity. In relation to transit investment, specific strategies include:

- Provide convenient rapid transit access to urban growth centres;
- Improve inter-regional transit connectivity;
- Increase people-moving capacity along key transportation corridors;
- Increase transit choices for inter-regional travel;
- Improve transit rider safety and comfort; and
- Optimize use of existing transit facilities, services and corridors.

2.26 An extension of the subway along Yonge Street north of Finch would support these goals by improving connectivity and access between downtown Toronto and York Region. In addition, transit service feeder route improvements would accompany a subway extension. Together these would support current land use planning objectives in both Toronto and York Region to increase densities and improve the urban experience for those living and working along the corridor.

Project Overview

The Yonge Street Corridor

2.27 Yonge Street is a major arterial route connecting the shores of Lake Ontario in Toronto to Lake Simcoe, a gateway to the Upper Great Lakes. It lays claim to being the longest street in the world at 1,896 kilometres and its construction in the 1790s is designated as an Event of National Historic Significance for Canada.

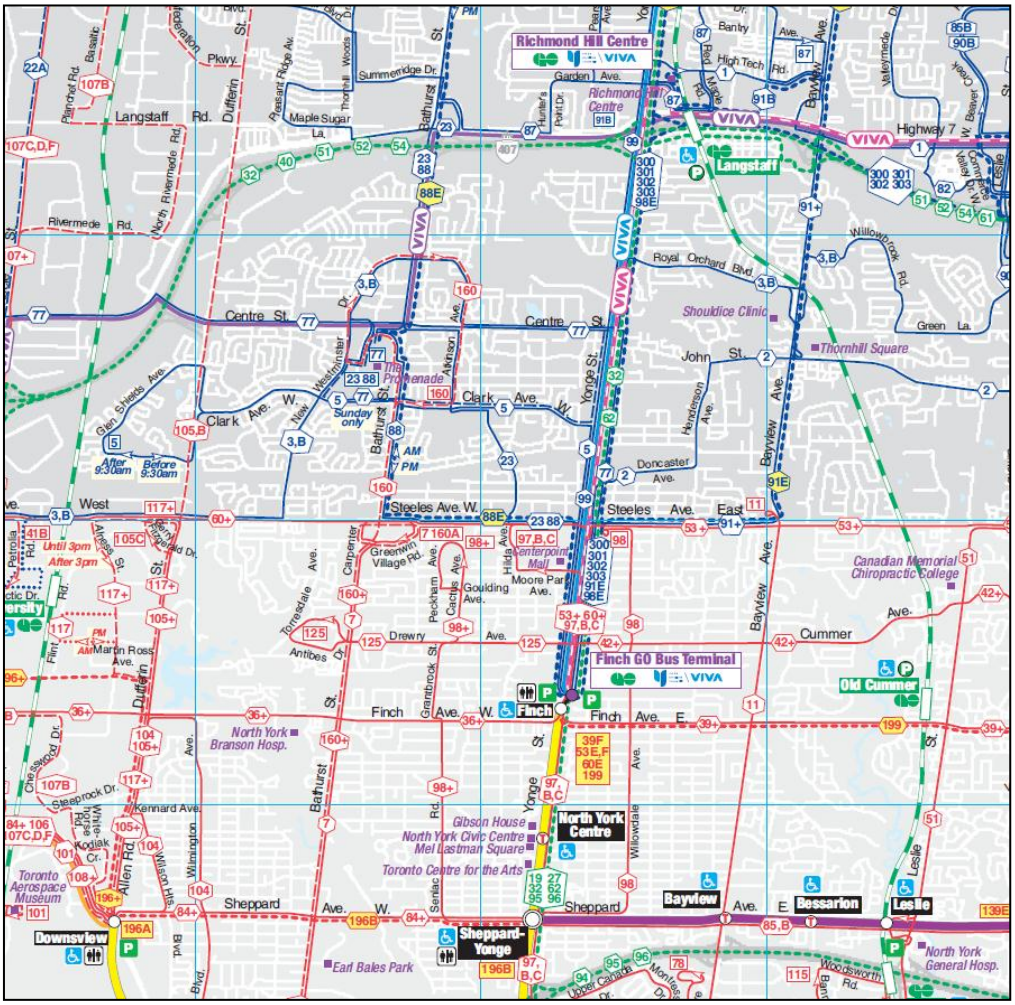
2.28 Yonge Street is home or close to many attractions in Toronto running parallel to Bay Street (centre of the business district) and University Avenue, home of the Ontario Legislature. Yonge Street is therefore a popular and commercial main thoroughfare. It has been referred to as 'Main Street Ontario' and is also the site of Canada's first subway line.

2.29 Heading northwards, beyond the current subway line, between Finch Avenue and the Richmond Hill Centre the corridor is characterized by a traditional mix of older, two story main street commercial and residential development, punctuated with car dealerships and a large shopping mall. Evidenced by planning applications, large portions of these older developments have been purchased and consolidated for redevelopment. Extensive planning policy will guide the redevelopment of the Yonge corridor, particularly around stations, should the subway line be extended. Some of this development is underway, such as World on Yonge, which has laid the foundation for the powerful visual and economic transformation of this corridor from traditional one to two story main street uses to high density office and residential buildings, reaching densities of 2.5 to 5.0 times coverage. The Richmond Hill-Langstaff Urban Growth Centre, a major anchor hub for the north central quadrant of the GTHA, is designated to have at least 200 residents and jobs per hectare and may exceed this level of density[8].

2.30 The north Yonge Street corridor transit network is shown in Figure 2.4. Viva, GO and TTC bus services operate along north Yonge Street between the Finch subway station and Richmond Hill Centre and the surrounding area. A GO rail service also operates to and from downtown, stopping at Langstaff and terminating at the Richmond Hill GO station, approximately nine kilometres north of Richmond Hill Centre. The existing and future transit services are outlined and discussed later in this chapter.

[8] Source: York Region

FIGURE 2.4 EXISTING YONGE NORTH CORRIDOR TRANSIT NETWORK DIAGRAM



Source: [TTC System Map]

Project Development Progress

2.31 York Region initiated the Yonge Subway Extension Study in June 2007. The City of Toronto participated in the early stages of the process as an observer and later in the study process became an active co-proponent of the project. Alignment alternatives and potential station locations were generated and assessed.

2.32 The study team filed the Environmental Assessment (EA) under the Transit Project Assessment Process (TPAP) and it was approved unconditionally on April 6, 2009.

2.33 While the City of Toronto supports the implementation of the Yonge North Subway Extension project in general, on January 28, 2009 City Council passed a resolution that attaches conditions that must be met before the City is prepared to fully support the project. These conditions are as follows:

- The Spadina Extension and the Automatic Train Operation (ATO) system on the YUS line must be in place prior to opening of the Yonge North Subway Extension;
- The costs of addressing potential capacity constraints at the Bloor-Yonge Station and North York Service Road arising from the proposed Yonge North Subway Extension are to be included as project costs; and
- Metrolinx be requested to prioritize the Downtown Relief Line within its 15-year plan, noting that Transit City is the first priority for the TTC and the City of Toronto.

2.34 Further to the work completed as part of the EA and the interim BCA, TTC and York Region have done additional concept design and costing work on the subway extension from Finch to Richmond Hill Centre. This work addresses the storage requirements, station design and refines the order of magnitude estimates. This concept design and costing work was used to inform this BCA update.

Transit Considerations

Current & Forecasted Demand

2.35 Currently, the Yonge Street corridor between Finch Avenue and Richmond Hill Centre has high transit ridership, which is expected to increase over time as York Region experiences growth and travel volumes to downtown increase. In 2006, demand on all transit modes from York Region to downtown Toronto was 20,100 trips during the AM peak period. 55% of these trips were carried by GO services and the remainder by TTC.

2.36 The City of Toronto and TTC in conjunction with York Region produced demand forecasts, reported in the Yonge Subway Extension Demand Forecasting Report in January 2011. These estimate that in 2031 over 20,000 people will board the subway in the morning peak hour from the extended subway section and travel southbound[9]. The forecasts are intended to inform preliminary designs for the stations on the subway extension.

2.37 In addition to the January 2011 demand forecasts, a number of ridership estimates for the corridor have been produced as part of various studies, such as the TTC's Downtown Rapid Transit Expansion Study further discussed in the Opportunities and Challenges section, assessing different network perspectives relating to the Yonge Street corridor.

[9] Includes initial and transfer boarders and excludes additional boardings at the existing Finch Station

2.38 While the specific modelling results from the various studies[10] conducted along the corridor vary, they all suggest substantial ridership growth in the corridor from 2006 to 2031, potentially by 70% to 90%.

Network Routing

2.39 The Yonge Street corridor is currently served by several bus routes, including Viva services that carry passengers from York Region across the municipal boundary into Toronto, to a bus terminal adjacent to Finch subway station. Despite the success of York Region's first phase of the Viva program, growing traffic congestion along the Yonge Street corridor, particularly between Finch Avenue and Steeles Avenue is expected to impact TTC's and Viva's ability to reliably maintain their current levels of service.

2.40 As part of the January 2011 Yonge Subway Extension Demand Forecasting Report, a number of network changes upon implementation of the Yonge subway extension were assumed. These changes are to complement and feed the subway extension.

2.41 In the case of TTC routes, several bus routes would be extended to, or terminate at, Steeles Station. The Extension would also interface with GO bus services at Richmond Hill and the York Region Transit (YRT) / Viva bus network at all stations. These network changes were used to inform the local network routing for the Option investigated by this BCA update.

2.42 The demand forecasting work undertaken by the City of Toronto and TTC also assumed the implementation of the Transit City LRT Network Plan, which consists of:

- Spadina Subway Extension to the Vaughan Metropolitan Centre;
- Transit City LRT lines (Etobicoke-Finch, Sheppard East, Eglinton Crosstown, Jane (to Steeles West Station), Don Mills (to Highway 7), Scarborough-Malvern and Waterfront West);
- Scarborough RT extension to Malvern Town Centre; and
- Feeder bus updates associated with Transit City.

2.43 On June 29, 2012, the Province of Ontario approved the Toronto City Council's transit plan for the Eglinton-Scarborough Crosstown, Scarborough RT replacement, Finch West, and Sheppard East LRT lines. Currently it is assumed that the Eglinton-Scarborough Crosstown LRT will extend from Black Creek Drive in the west to Kennedy Station in the east at grade with an 11km underground section in the middle section[11] (it had previously been assumed for the purposes of analysis that it would be fully grade separated.). The Metrolinx rapid transit network study will assess how this project will interface with the Yonge North corridor.

[10]Yonge North Subway Extension interim BCA (June 2009), Yonge Subway Extension - Demand Forecasting Report (January 2011), Downtown Rapid Transit Expansion Study – Problem Statement (March 2011)

[11] http://www.thecrosstown.ca/

Opportunities and Challenges

Land Use Intensification

2.44 As previously mentioned, York Region is expected to experience significant population and employment growth in the future. In addition to anticipated growth, there are also land use proposals that are contingent on the subway extension being built. These proposals will only be realised if the significant investment in transit, particularly the subway extension, is made. The City of Toronto is also currently undertaking a Yonge Street North Planning Study to address how best to manage growth in the area and focus growth closest to the planned subway stations.

2.45 This reflects the interdependency between transit investment and land use development and is an opportunity for urban design that is transit oriented. The challenge of managing the growth pressures also exists. If anticipated growth occurs, transit investment will be necessary to provide sufficient capacity to accommodate demand. The level of transit service will influence the location of land use development and extent of growth in localized areas.

Yonge Subway Capacity

2.46 In the context of the Yonge North Subway Extension, its network impact needs to be part of the consideration. The Yonge Subway line is already operating over capacity south of Bloor during the morning peak period[12]. Between Bloor and Wellesley stations, the morning peak demand is over 28,000 in the southbound direction – exceeding its capacity by 2,000 passengers. Other links also operate close to capacity during peak times. With the anticipated population growth in both Toronto and York Region, and associated forecasted increase in transit demand, the current capacity constraint experienced on the Yonge line in the southern section is expected to worsen and is a major challenge for the subway network and for the Yonge North Subway Extension. Additional projects underway, including the Eglinton-Scarborough Crosstown LRT, will also contribute to ridership growth on the Yonge line and more detailed network analysis is underway to understand the interactions between all of these projects.

2.47 The ability to improve capacity on the line has in the past been limited by the current train control system, which can only handle the turn-around of 25 trains per hour. As part of the Metrolinx Quick Wins package of rapid transit initiatives in 2008, the Yonge subway line capacity improvements were funded in order to quickly achieve customer and system improvements. The Quick Wins investment of $293 million provided funding to the TTC for the installation of Automatic Train Operation (ATO) and a one-third funding contribution towards the acquisition of higher-capacity subway trains – 'Rocket' trains.

2.48 ATO includes a new signalling system that will enable a reduction in the minimum headway between trains. This allows a higher service frequency than the previous system, with a maximum number of 34.3 trains per hour[13]. The ATO is expected to

[12]TTC's Downtown Rapid Transit Expansion Study Problem Statement. March 2011

[13]Maximum Line Capacity Study for the YUS Line in ATC Operation. Parsons Transportation Group & TTC. March 2009

be fully installed by early 2018. The Rocket trains, providing a 10% increase in train capacity, and the ATO together will deliver an improvement in planning capacity from 26,000 to 38,000 passengers per hour on the line.

2.49 Further to line capacity challenges, the subway system also experiences capacity pinch points at stations, notably Bloor-Yonge and St George, where passengers can interchange between the Yonge-Union-Spadina (YUS) line and the Bloor-Danforth (BD) line.

2.50 Even with the existing signal system or the new ATO, the key bottleneck for Yonge Subway capacity is the current dwell time for trains in Bloor Station[14]. In order to operate a higher frequency through Bloor-Yonge Station with ATO it will be necessary to significantly reduce the vehicle dwell time that is caused by the large volume of passengers boarding and alighting.

2.51 To address this constraint, the TTC completed a Capacity Improvements Study for Yonge-Bloor in September 2010; evaluating a number of scenarios using pedestrian flow analysis and phasing options. The analysis focuses on platform dwell times that will be achievable in future conditions. Recommendations have gone no further than interim solutions, such as passenger communications, stairwell and door management. Although the results of these methods are effective in the short-term, additional capacity improvements may be required.

2.52 However, with the implementation of the Eglinton-Scarborough Crosstown, the rapid transit network will have new interchange stations that will provide alternatives to Bloor-Yonge station. This will assist in dispersing the high volume of passengers using this station and provides the opportunity to defer the need for major capital investment in expanding the Bloor-Yonge station capacity. While the Yonge-Bloor capacity constraint is potentially resolved, a new constraint is also created at Yonge-Eglinton station, which will need to be considered as the Eglinton-Scarborough Crosstown is designed and constructed.

2.53 Related to these capacity constraints, the roll-out of ATO and Rocket Trains will also place additional strain on subway train storage and maintenance facilities. TTC anticipates that there will be insufficient capacity at the existing sites by 2030.

2.54 To assess this maintenance storage facility constraint, the TTC has undertaken a Subway Rail Yards Needs Study to examine options to accommodate future demand arising from ridership growth, ATO and Rocket Train implementation, the Yonge North Subway Extension, and at the time the Transit City initiatives.

2.55 The Subway Rail Yards Needs Study (SRYNS) concludes that there will be a storage shortfall of up to 170 vehicles at the Wilson/Davisville Yards in 2030 and recommends that Wilson Yard is expanded as a primary site for the YUS fleet, with storage/cleaning of trains at Davisville Yard. York Region and the TTC are jointly proceeding with an environmental assessment through the Transit Project Assessment Process to examine the potential for train storage to be

[14]Maximum Line Capacity Study for the YUS Line in ATC Operation. Parsons Transportation Group & TTC. March 2009

accommodated at the north end of the Yonge line, underground at Richmond Hill Centre.

2.56 The 'Quick Wins' of ATO and Rocket Trains, as well as passenger flow management at Yonge-Bloor station and SRYNS all address near term capacity issues on the Yonge subway. While there exists opportunity for resolving these capacity challenges in the near term, from a long term perspective, as demand continues to increase and the rapid transit network expands, these challenges will need to be monitored and reassessed.

2.57 Acknowledging the aforementioned challenges, the Downtown Rapid Transit Expansion Study (DRTES) looks at capacity deficiencies in the longer term. The Study examines future travel trends on transit in the GTA and assesses the alternative strategies for long term capacity relief, including:

- Construction of a new subway line (commonly referred to as the Downtown Relief Line (DRL)), which would divert riders on the Yonge line travelling south of Bloor to reduce crowding and allow for future growth;
- Improvements in streetcar services to enhance shorter-distance transit accessibility in the downtown;
- Fare, service and other policy initiatives to increase downtown transit ridership that may be appropriate; and
- Construction of additional GO Rail capacity specifically to offload the Yonge subway by:
  - Diverting Toronto and York Region residents currently using the Yonge subway to Barrie, Richmond Hill and Stouffville GO; and
  - Diverting Toronto residents currently using the Bloor-Danforth line to GO Lakeshore East and West.

2.58 The impact of the Yonge North Subway Extension on other transit services is also assessed as part of the DRTES, as well as the associated impact of the DRL on the network conditions with the Eglinton-Scarborough Crosstown LRT in place. The opportunities for offloading the demand along the Yonge line warrants further regional network planning analysis and completion of sufficient analysis of the DRL BCA metrics in collaboration with the TTC, YRRTC, and Metrolinx. This work will inform implementation considerations for both the DRL and the Yonge North Subway Extension.

Regional Transit Connectivity

2.59 As already described, the Yonge North Subway Extension will expand the existing transit network by providing a cross-municipal boundary subway link between Richmond Hill Centre and Finch station with a complementary local bus network feeding the subway. The line will also connect with the GO Richmond Hill line at Richmond Hill Centre where the GO Langstaff station is located. The GO Richmond Hill line also provides north-south transit service that mainly targets commuters to the downtown core of Toronto.

2.60 Other network improvements relevant to the Yonge north corridor include the work undertaken to study the electrification of the GO Transit rail network. In January 2010, Metrolinx initiated this electrification network study as a future alternative to diesel trains that are currently in service. Although some lines proved beneficial to electrify, the Richmond Hill line was not part of this initial bundle.

2.61 Prior to the Electrification Study, in June 2010, Metrolinx reported BCAs for GO Rail improvements to address short-term capacity issues. The Richmond Hill line was a part of this assessment that proposed an extension to the existing GO line north from Richmond Hill to Bloomington and increased service to all-day, 2-way service from the current four inbound and five outbound in the morning and afternoon peak periods, respectively.

2.62 The service improvements would provide service every 20 minutes in the peak period inbound to Union station and services every half hour in the outbound direction during the peak period and bi-directional during the off-peak periods. In 2031, peak period service would improve to 10 minute headways.

2.63 The results of the GO Richmond Hill BCA show positive net benefits when compared to the life-cycle costs of the project, with additional environmental, social and other economic benefits. When assessed alongside the Yonge North Subway Extension, the benefit is reduced by 15%, but still demonstrates a positive net benefit for the GO Richmond Hill line.

2.64 As a parallel route, the GO Richmond Hill line is a potential option for providing some off-load transit capacity for the Yonge corridor north of Steeles. At this time however, with the current fare structure, the GO service may not divert a significant number of riders from the subway.

2.65 Further to GO improvements, there are also plans to expand the rapid transit network and improve connectivity within York Region. The VivaNext program will implement rapidways on major regional routes, including Highway 7 through Richmond Hill. The plans intend that Richmond Hill becomes an anchor transit hub that acts as a terminus for the Yonge subway extension and enables connections with Viva, GO transit, YRT and other transit systems.

2.66 VivaNext is currently working on two rapidway corridors in York region. In March 2011, the first rapidway section and new rapid transit station opened in Markham and a further section from Yonge to Warden in Markham is due for completion in 2014. The remaining Highway 7 sections are set to be constructed and in service as they are completed.

2.67 Running perpendicular to Yonge Street and through the Richmond Hill intersection is Highway 407. Identified as part of the 25-year *Big Move* plan, the 407 transitway would support existing GO express services operating in the corridor and enhance connectivity with the three dedicated regional centres, namely Vaughan, Markham and Richmond Hill and to the existing, primarily radial transportation network.

2.68 Improving connectivity along Highway 407 and the expansion of Viva would work in complement to the Yonge North Subway Extension and promote the use of Richmond Hill as a mobility hub.

2.69 In addition to the infrastructure and service proposals described above, transit integration throughout the GTHA is being supported by the introduction of PRESTO. PRESTO is an electronic pay card system that is currently being rolled-out throughout the GTHA. Since summer 2011, riders are able to use PRESTO on most transit services, including GO transit, select TTC services and YRT. It is anticipated that PRESTO will encourage greater transit use in York Region and Toronto.

Fiscal Context

2.70 The Province of Ontario has dedicated $16B towards delivering top priority projects in the Big Move. The Province's contribution is currently fixed with no additional funds for capital expansion. Metrolinx is working on an Investment Strategy for bringing predictable and sustainable transit funding to the GTHA. With many competing projects that are requesting funding assistance, an infrastructure project's value for money is important for justifying the continued support of a project's development in order to bring it to a maximum state of implementation readiness.

3 Project Options

Project Options

3.1 Three proposed options for extending the Yonge subway north towards Richmond Hill Centre have been developed for the purposes of this evaluation. They have been defined in collaboration with Metrolinx, York Region and TTC. A Base Case, against which the two options are assessed, has also been developed.

3.2 In summary, the Base Case and project options are:

- **Base Case**: **Transit network investment** – subway extension to Vaughan Metropolitan Centre and network capacity investment, Eglinton-Scarborough Crosstown LRT and Viva BRT.
- **Option 1: Subway extension to Richmond Hill Centre** – subway extension from existing Finch subway station to Richmond Hill Centre (RHC) serving six new stations at Cummer, Steeles, Clark, Royal Orchard, Langstaff and RHC.
- **Option 2: Phased subway extension** - initial subway extension from existing Finch subway station to Steeles Avenue serving two new stations at Cummer and Steeles.
- **Option 2A: Phased subway extension and increased GO frequencies** - initial subway extension from existing Finch subway station to Steeles Avenue serving two new stations at Cummer and Steeles. Increased GO service frequencies between Richmond Hill GO station and Union.

3.3 Options 2 and 2A were developed and analysed as a way of considering the merits of a phased implementation approach that could see partial construction and services occur sooner.

3.4 The following sections set out the descriptions of the Base Case and Options in more detail.

Base Case

Overview

3.5 The Base Case provides the benchmark against which the options are assessed. The Base Case is intended to reflect the current transportation infrastructure and services and incorporate investment proposals that are funded and anticipated to take place in the next few years. Accompanying these transportation assumptions are land use and population forecasts.

Background assumptions

3.6 The land use, employment and population forecasts used for the assessment are consistent with those identified in '*Places to Grow*' the Growth Plan for the Greater Golden Horseshoe. This maintains consistency with the other Metrolinx BCAs done for the Top 15 priority projects identified in *The Big Move*.

Transit assumptions

3.7 The GTHA transit network assumptions are based on the existing services and the implementation programs for funded projects. These are described in more detail on the following page.

Subway

3.8 For the Base Case, the Yonge-University-Spadina (YUS) subway is expected to encompass the following characteristics and investments:

- Spadina extension to Vaughan;
- ATO implementation across entire YUS line;
- Full roll-out of Rocket Trains on YUS line;
- Service frequency of 105 second headways;
- Short turn at Wilson Station;
- Rail Yard provision as required; and
- Yonge-Bloor station investment.

3.9 Capacity issues downstream on the Yonge line including at Yonge-Bloor station are addressed qualitatively in the BCA. The scope of works and investment required, with or without the subway extension, is not included in the quantified assessment as they have not been fully determined to date. An indicative value for Yonge-Bloor station work, as provided in TTC's Capacity Improvement Study for Yonge Bloor Station, is between $80m for the 'Phasing 2 Design' and $328m for the 'Do All Concept Design'. Additional costs associated with addressing network capacity issues continue to be developed through the regional network analysis and DRL project development.

GO services

3.10 The assumed GO rail services are:

- GO Richmond Hill with AM peak inbound service only, with the following characteristics:
  - 30 minute frequency; and
  - 42 minute travel time from Richmond Hill Station to Union.

General network

3.11 Other network characteristics are as follows:

- Implementation of Eglinton-Scarborough Crosstown LRT and York Region Viva BRT program;
- Current fare structure;
- Highway as now;
- Maintain existing bus network along Yonge corridor and allow for growth over time to accommodate increased demand; and
- 3 minute headways for Viva Blue services on Yonge corridor.

Option 1: Subway extension to Richmond Hill Centre

Overview

3.12 Option 1 is incremental to the Base Case.

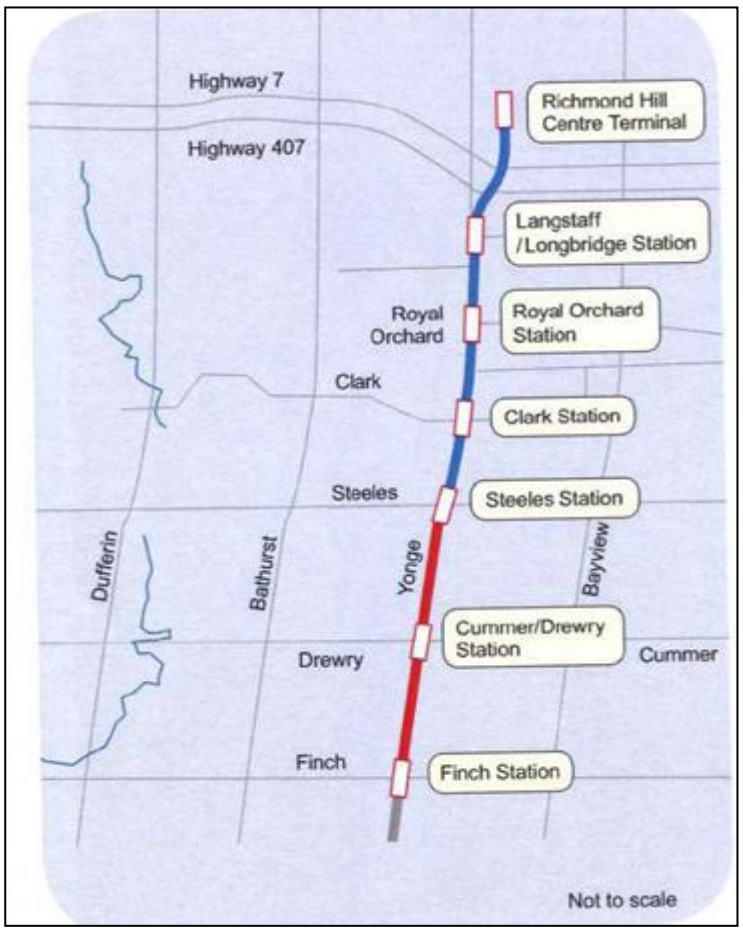
3.13 The option is to extend the Yonge subway line from the existing Finch station, serving six[15] new stations with Richmond Hill Centre as the terminus. The layout is shown by both the red and blue lines in Figure 3.1.

3.14 The rationale behind the station locations is described below:

- **Cummer/Drewry** - This station is located in the City of Toronto. The area surrounding the station is currently well developed and has sufficient population and ridership to support a subway station. Several local bus routes converge in this area and would benefit from a connection to the subway.
- **Steeles Avenue** – A significant transit hub is envisioned at this location. The location has strong redevelopment potential in the immediate vicinity on the west side of Steeles, with excellent opportunities for Transit Oriented Development.
- **Clark Avenue** – Several local bus routes converge at Clarke and would benefit from connection to the subway. There is relatively strong development/ intensification potential in the area.
- **Royal Orchard** – Similarly to Clark Avenue this station has local bus routes including Viva that converge, and would benefit from a connection to the subway. There are some opportunities for densification, but any development has to be done with consideration for heritage requirements.
- **Langstaff** - This station would be a significant commuter hub, working in tandem with RHC as it is the only location suitable for a significant Park and Ride (P&R) lot along the alignment. (Most of the users of the Finch P&R come from the north and it is thought that those drivers would use a P&R at this location and thereby shorten the trip by car.) There is also development being planned for the Langstaff Lands in Markham, located in the northeast quadrant of the station area.
- **Richmond Hill Centre** – The proposed new terminus station would be an Anchor Hub and a significant regional multi-modal transit interchange with connections to local buses, Viva buses, GO Transit, the subway and any future service, such as the Express Rail and Highway 407 transit services.

[15] At the time of this undertaking further decision on whether a 6 station extension or a 5 station extension had not been made. The results from the interim BCA indicate that there is no material difference in the results should a 5 station subway be pursued

FIGURE 3.1 YONGE NORTH SUBWAY EXTENSION



Source: Yonge Subway Extension Design – Demand Forecasting Report

Transit Assumptions

3.15 As Option 1 is incremental to the Base Case, the additional assumptions are with regard to subway changes only. These changes are listed below:

- Extension of Yonge line from Finch to Richmond Hill;
- Six new stations at Cummer, Steeles, Clark, Royal Orchard, Langstaff and Richmond Hill Centre;
- Park & Ride at Langstaff;
- Short turn at Finch Station;
- Service frequency of 105 second headways to Finch, 210 second headways between Finch and RHC;
- Additional rolling stock;
- Required fleet storage capacity provided at RHC; and
- Revised bus network (as per Transit Network Assumptions in 'Yonge Subway Extension Design – Demand Forecasting Report').

3.16 Table 3.1 summarizes the characteristics of Option 1 by route section.

TABLE 3.1 OPTION 1 TRAVEL TIMES AND SPEEDS[16]

Route section	Distance (km)	Average Speed (kph)	Travel Time (min)
Finch to Cummer/Drewry	0.85	34	1.5
Cummer/Drewry to Steeles	1.2	34	2.1
Steeles to Clark	1.0	35	1.7
Clark to Royal Orchard	1.9	35	3.3
Royal Orchard to Langstaff/Longbridge	0.9	34	1.6
Langstaff to Richmond Hill	1.1	35	1.9
TOTAL ROUTE	**7**	**35**	**12**

Option 2: Phased subway extension

Overview

3.17 Option 2 is incremental to the Base Case.

3.18 The option extends the Yonge subway line from the existing Finch station, serving two new stations with Steeles Avenue as the terminus. This option is viewed as a phased approach to implementation where the initial subway extension is constructed and the remaining portion of the line deferred. The phase to Steeles Avenue is shown by the red line in Figure 3.1.

Transit Assumptions

3.19 Option 2 requires changes to the bus transit network incremental to the Base Case, as well as subway changes. These are listed below:

Subway

- Extension of Yonge subway line from Finch to Steeles Avenue;
- Two new stations at Cummer and Steeles;
- Short turn at Finch Station;
- Service frequency of 105 second headways to Finch, 210 second headways between Finch and Steeles; and
- Additional rolling stock.

Bus Network

- Revised bus network (as per Transit Network Assumptions in 'Yonge Subway Extension Design – Demand Forecasting Report' for Finch, Cummer and Steeles).

[16] Values are indicative

3.20 Table 3.2 summarizes the characteristics of Option 2 by route section.

TABLE 3.2 OPTION 2 TRAVEL TIMES AND SPEEDS

Route section	Distance (km)	Average Speed (kph)	Travel Time (min)
Subway			
Finch to Cummer/Drewry	0.85	34	1.5
Cummer/Drewry to Steeles	1.2	34	2.1
Bus Transit (via Yonge)			
Steeles to Richmond Hill	4.9	21 southbound 27 northbound	14 southbound 11 northbound
TOTAL ROUTE	**7**	**24 southbound** **28 northbound**	**18 southbound** **15 northbound**

Option 2A: Phased subway extension and increased GO frequencies

Overview

3.21 Option 2A is incremental to the Base Case.

3.22 The option is to extend the Yonge subway line from the existing Finch station, serving two new stations with Steeles Avenue as the terminus, as with Option 2. It is shown by the red line in Figure 3.1. In addition, GO services between Richmond Hill GO station and Union station will operate at increased frequencies.

Transit Assumptions

3.23 Option 2A requires changes to the bus transit network incremental to the Base Case, as well as subway changes. These are listed below:

Subway

- Extension of Yonge subway line from Finch to Steeles Avenue;
- Two new stations at Cummer and Steeles;
- Short turn at Finch Station;
- Service frequency of 105 second headways to Finch, 210 second headways between Finch and Steeles; and
- Additional rolling stock.

Bus Network

- Revised bus network (as per Transit Network Assumptions in 'Yonge Subway Extension Design – Demand Forecasting Report' for Finch, Cummer and Steeles).

GO Network

- GO services between Richmond Hill GO station and Union station will increase in frequency from every 30 minutes to every 10 minutes during the AM peak period.

3.24 The characteristics of Option 2A by route section are the same as Option 2 in Table 3.2.

Summary

3.25 The assessment options are summarized in Table 3.3, alongside the Base Case.

TABLE 3.3 SUMMARY OF YONGE NORTH SUBWAY EXTENSION BCA OPTIONS

Option	Definition	Headway	Travel time (mins)[17]	Subway Stations	Richmond Hill GO Rail Service
Base Case	Transit network investment	105 sec	21	No additional	30 min frequency Inbound only 42 min travel time to Union Station
1	Subway extension to Richmond Hill Centre	105 sec to Finch 210 sec Finch to RHC	12	Cummer Steeles Clark Royal Orchard Langstaff Richmond Hill Centre	30 min frequency Inbound only 42 min travel time to Union Station
2	Subway extension to Steeles Avenue	105 sec to Finch 210 sec Finch to Steeles	15-18	Cummer Steeles	30 min frequency Inbound only 42 min travel time to Union Station
2A	Subway extension to Steeles Avenue and increased GO frequencies	105 sec to Finch 210 sec Finch to Steeles	15-18	Cummer Steeles	10 min frequency Inbound only 42 min travel time to Union Station

[17] Richmond Hill Centre to Finch station

4 Project Assessment

Introduction

4.1 This chapter outlines the Multiple Account Evaluation (MAE) approach used to assess the three options described in Chapter 3 and presents the methods used to assess each 'account'. This chapter also provides the results of the analysis, both in total and disaggregated by individual accounts.

Evaluation Framework

4.2 The comparative analysis uses a Multiple Account Evaluation (MAE) framework, which is a project assessment methodology that systematically identifies and analyses the broader impacts of each option being assessed. The framework appraises the relative costs and benefits of a number of different evaluation 'accounts' and hence the trade-offs between the different options.

4.3 The accounts identified for the Yonge North Subway Extension project assessment are:

- Transportation User Account;
- Financial Account;
- Environmental Account;
- Economic Account; and
- Socio-Community Account.

4.4 The options are assessed by comparing each of them to the Base Case, therefore determining the incremental costs / benefits for each account. The analysis is carried out for a 30 year operating period (2018 – 2047) and where appropriate, the project impacts are quantified and monetized in order to allow a simple and consistent comparison of the options. The assumptions used in these calculations are set out in Appendix A.

4.5 The monetized costs and benefits for each account are used to determine the net present benefit of each option, which allows a simple comparison between the two. Qualitative assessments are also included to allow fully informed decision-making.

4.6 The options defined in this report have been developed to a level of technical detail sufficient to enable a comparative analysis for the purpose of selecting a preferred option for further study. Project scope, costs and service plans would need to be developed in more detail for funding and implementation.

Transportation User Account

4.7 The Transportation User Account assesses the additional benefits to existing and new transit users, as well as highway users, resulting from implementation of each project option. The analysis quantifies savings to journey times and automobile operating costs, as well as safety benefits. Other indicators, such as service quality and crowding, are addressed qualitatively.

4.8 All quantifications and monetised values are incremental to the Base Case and are in 2011 prices, unless otherwise stated.

Travel Time Savings

4.9 Incremental travel time savings were calculated using the Greater Golden Horseshoe (GGH) Model, which is the regional forecasting tool used by Metrolinx for projects throughout the GTHA.

4.10 Existing transit users are expected to experience a benefit to their generalized travel time due to the enhanced service that the subway extension will provide. In addition, users that switch from auto to transit for their trip will do so to benefit from travel time savings as a result of their mode shift. This mode shift is expected to reduce congestion on the road network, creating auto user travel time benefits.

4.11 Table 4.1 shows the monetized travel time savings for each option in 2031.

TABLE 4.1 TRAVEL TIME BENEFITS IN YEAR 2031 ($M 2011)

	Option 1	Option 2	Option 2A
Transit Users			
Existing Users	57.5	31.6	38.4
New Users	10.0	3.7	3.6
Auto Users	45.1	22.1	27.2
All Users	**112.6**	**57.4**	**69.1**

Totals may not sum due to rounding

4.12 The total Present Value (PV) of travel time savings over the 30 year period is $1,226m for Option 1. Due to the shorter subway extension, the total transit benefits under Option 2 are more than 50% lower, at $641m. The PV of travel time savings for Option 2A is $757m. This exceeds Option 2 because the increase in GO service frequencies provides travel savings for some GO users and alleviates capacity constraints on the buses to Steeles, as a proportion of demand is diverted to GO.

Automobile Operating Cost Savings

4.13 In addition to travel time benefits, auto users are expected to benefit from a reduction in auto operating costs. This estimation is derived from the incremental reduction in auto vehicle kilometres over the GTA highway network.

4.14 Over the 30 year appraisal period, this vehicle operating cost saving equates to $689m for Option 1, $353m for Option 2 and $416m for Option 2A.

4.15 The saving in auto costs for Option 2 is approximately 50% of that of Option 1, in line with the highway travel time benefits. Both options have a positive effect on highway congestion and related costs, although the full subway extension would have a significantly greater impact. Greater demand diverted to GO results in auto operating savings that are 18% higher for Option 2A than Option 2.

4.16 Additional savings could arise from some individuals deciding to reduce the number of vehicles owned, because they feel that they could rely on the transit network. In those cases the individuals would also save on car ownership costs. These have not been captured quantitatively within this BCA.

Safety Benefits

4.17 With a reduction in auto vehicle kilometres, a saving in costs associated with traffic collisions is assumed. These costs are largely related to human costs through fatality or injury, and infrastructure repairs incurred by the City and / or Region.

4.18 The PV of safety savings for the 30 year appraisal period is $65m for Option 1, $32m for Option 2, and $38m for Option 2A.

Qualitative Transportation User Benefits

4.19 As well as travel time and other quantified savings, transit users will also benefit from other factors, such as a higher quality service, better reliability and greater convenience, as a result of the subway extension.

4.20 In comparison to the transit options in the Base Case, the subway has particular benefits from being grade-separated, resulting in improved reliability. These service benefits would be greater the further the subway is extended.

4.21 Crowding is another consideration. Crowding can cause passenger disbenefits and contribute to reliability concerns with boarding and alighting at stations. Under all options, the forecast ridership is near capacity on the subway closer to the downtown core. Under Option 2 (and to a lesser extent Option 2A) increased crowding on buses north of Steeles is expected to grow in the future and on the basis of *Places to Grow* and other planning forecastswould need to be addressed by implementing higher capacity transit, for example as provided by the full subway extension to Richmond Hill Centre (Option 1).

Summary

4.22 The Transportation User Benefits of the Yonge North Extension Options 1, 2 and 2A are summarised in Table 4.2.

TABLE 4.2 INCREMENTAL TRANSPORTATION USER BENEFITS (PV $M)

	Option 1	Option 2	Option 2A
Travel Time Savings (PV $M)	1,226	641	757
Auto Operating Cost Savings (PV $M)	696	353	416
Safety Savings (PV $M)	65	32	38
Transportation User Benefits (PV $M)	**1,980**	**1,026**	**1,210**

4.23 Total Transportation User Benefits for Option 2 are 48% lower than Option 1. This is largely due to the shorter subway extension, which creates fewer travel time benefits for both transit and highway users, as well as a lower reduction in highway congestion. Total Transportation User Benefits for Option 2A are 39% lower than Option 1. The increase in GO service frequency provides greater benefits than Option 2 through the diversion of demand onto the GO network from auto and bus services.

4.24 Option 1 begins to test the limits of the subway capacity in the southern section of the line in comparison to Option 2 and 2A. However, Option 2 and 2A also experience fewer reliability and crowding benefits by relying on the bus network north of Steeles.

Financial Account

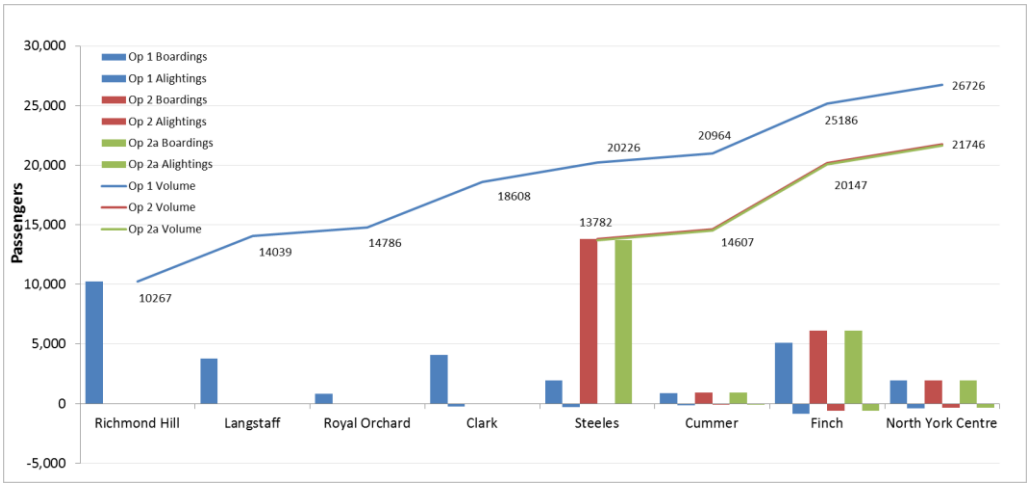
4.25 The Financial Account assesses the direct incremental 'cash' items of the Yonge North Subway Extension. This includes an overview of capital and operating costs and revenues compared to the Base Case.

Ridership and Revenues

4.26 Demand levels on the line increase in the southbound direction, with peak loads south of Finch just over 25,000 passengers for the 2031 AM peak hour for Option 1, and reaching a line maximum of just over 44,000[18] passengers at Bloor-Yonge. Options 2 and 2A show similar ridership levels, which are lower than Option 1. This is illustrated in the figure below.

[18] This maximum load of 44,000 pphpd uses a peak hour factor of 0.6 as forecasted by the GGH model. TTC ridership forecasts use a peak hour factor of 0.55. If the TTC peak hour factor is applied to the GGH forecast, just over 40,000 pphpd is the expected load.

FIGURE 4.1 2031 SOUTHBOUND RIDERSHIP PROFILES (AM PEAK HOUR)



4.27 Demand levels forecast on the line are higher than the subway planning capacity estimates (38,000 passengers per hour per direction at 180[19] passengers per subway car). However, it is acknowledged that maximum allowable capacity is likely to be higher. Assuming 220[20] passengers per subway car, the forecast level of demand is below the allowable capacity for all options after ATO and Rocket train roll out.

4.28 The majority of demand on the line will come from transit users who will transfer from other services (bus or GO), but it is estimated that 1,909 new transit trips (i.e. modal transfer from auto) will be generated in the AM peak period for Option 1. Option 2A has a reduced effect on modal transfer (1,584 additional transit trips) while Option 2 will have the lowest effect at 1,168 trips.

4.29 In 2031, the incremental forecast annual revenue is $8.4m for Option 1, $3.4m for Option 2 and $6.2m for Option 2A. Over the 30 year appraisal period this equates to revenues of $94m for Option 1, $38m for Option 2 and $67m for Option 2A.

Capital and Operating Costs

4.30 Option 1 is estimated to cost $3.1B in capital costs, net of tax[21] in 2011 dollars. This includes $221m for 12 additional subway vehicles. Options 2 and 2A are expected to cost $1.2B in capital (including $73.8m for four additional vehicles) for the subway component. In addition, Option 2A[22] will have additional GO capital costs required to fund the increased frequency, including six additional GO trains at $32m each.

4.31 The construction period is expected to take between three to four years. Total capital costs for each Option are displayed in Table 4.3.

[19] TTC uses 60% of the specified passenger loading standards to assess the maximum loading capacity for planning purposes.

[20] 220 passengers per subway car is approximately 72% of the specified passenger loading standards

[21] Capital cost of the project after the Ontario HST rebate has been applied.

[22] Capital costs for the GO Richmond Hill infrastructure are from the GO Rail BCA.

TABLE 4.3 TOTAL CAPITAL COSTS ($M 2011)

	Option 1	Option 2	Option 2A
Subway construction	2,897	1,085	1,085
Subway vehicles	221	74	74
GO construction	0	0	470
GO vehicles	0	0	210
Total Capital Cost	**3,118**	**1,159**	**1,839**

4.32 Option 2A is also assumed to be subject to vehicle renewal costs amounting to between $0.5m and $2.7m per annum for the GO Rail vehicles.

4.33 In terms of operating costs, the subway component of Option 1 is expected to cost a gross total of $14.8m per annum, whereas Options 2 and 2A would cost $5.4m per annum (in 2031). Option 2A will also have additional operating costs for increased GO frequencies, amounting to a further $14.1m per annum in 2031.

4.34 All Options will be subject to bus operating cost savings as services operating north of Steeles are adapted to feed the subway extension.

4.35 Table 4.4. shows the breakdown of the annual operating cost by mode.

TABLE 4.4 ANNUAL NET OPERATING COSTS IN 2031 ($M 2011)[23]

	Option 1	Option 2	Option 2A
Subway	14.8	5.4	5.4
GO	0.0	0.0	14.1
Bus	-5.4	-2.9	-2.9
Total Operating Costs[24]	**9.3**	**2.5**	**16.6**

4.36 The net operating cost per annum for Option 1 is $9.3m, for Option 2 is $2.4m and for Option 2 A is $16.6m in 2031.

4.37 Option 2A is the most expensive option to operate, since 85% of the gross annual operating cost accrues to increased GO operations. Subway termination at Steeles under Option 2 costs just 26% of the full extension (Option 1) each year.

4.38 For Option 1 and Option 2A, the net annual operating cost exceeds the annual revenue, resulting in a Revenue Cost ratios of 0.9:1 for Option 1 and 0.4:1 for Option 2A. Option 2 has a Revenue Cost ratio of 1.4:1 making this option the most attractive from an operating standpoint as the incremental revenue is estimated to

[23] Negative numbers demonstrate net cost savings

[24] Subject to rounding

cover incremental operating cost. However, these conclusions do not take into account transfer of revenue from bus services to the subway.

4.39 The gross operating cost in PV over the 30 year period is $106m for Option 1, $28m for Option 2 and $180m for Option 2A.

Comparison of Traditional Benefits and Costs

4.40 A summary of the traditional net benefits and costs over the 30 year appraisal period is provided in Table 4.5. Option 1 generates the highest level of transportation user benefits. However, due to its incremental cost the option results in a negative Net Benefit and a Benefit Cost Ratio of 0.8:1. Option 2 has a positive Net Benefit, to the value of $54m, with a Benefit Cost Ratio of 1.1:1. While Option 2A delivers a greater level of benefits, it achieves a negative Net Benefit due to its greater costs.

4.41 The net benefit and Benefit Cost Ratio exclude environmental, economic and socio-community considerations, which are described in the following sections. The consideration of these other accounts in addition to the traditional Benefit to Cost Ratio provides a complete look at all additional benefits generated by the various project options.

TABLE 4.5 COMPARISON OF BENEFITS AND COSTS (PV $M)

	Option 1	Option 2	Option 2A
Transportation User Benefits	1,980	1,026	1,1210
Incremental Costs	2,645	972	1,908
Net Benefit	**-665**	**+54**	**-697**
Benefit:Cost Ratio	**0.8:1**	**1.1:1**	**0.6:1**

Environmental Impacts

4.42 The Environmental Account examines the effect of the Yonge North Subway Extension on Greenhouse Gas (GHG) emissions through reduced auto usage. The Account also looks at the comparative effect on Criteria Air Contaminants (CACs) of the Options. CACs affect air quality and cause smog and acid rain.

Greenhouse Gas Emissions

4.43 The evaluation of emissions is estimated based on the change in vehicle kilometres travelled (VKT) by auto as forecast by the GGH model.

4.44 The Option 1 monetized CO_2 savings in 2031 exceed those of Option 2 due to the longer subway extension having greater effect on mode shift from auto to transit. The CO_2 savings of Option 2A are marginally greater than Option 2 due to greater modal shift with the addition of more GO services in the AM peak. The PV of this benefit is $9.2m for Option 1 ($0.0036 per $ invested), $4.5m for Option 2 ($0.0048 per $ invested), and $5.4m for Option 2A ($0.0032 per $ invested). Despite the lowest overall impact on GHGs, Option 2 has the greatest emission

savings per dollar invested in the project. The results are summarized in Table 4.6 below.

TABLE 4.6 MONETIZED CO2 SAVINGS ($M)

	Option 1	Option 2	Option 2A
CO_2 Savings (in 2031 $M)	0.85	0.41	0.51
CO_2 Savings (PV $M)	9.2	4.5	5.4
Monetized CO_2 Savings per dollar invested	**0.0036**	**0.0048**	**0.0032**

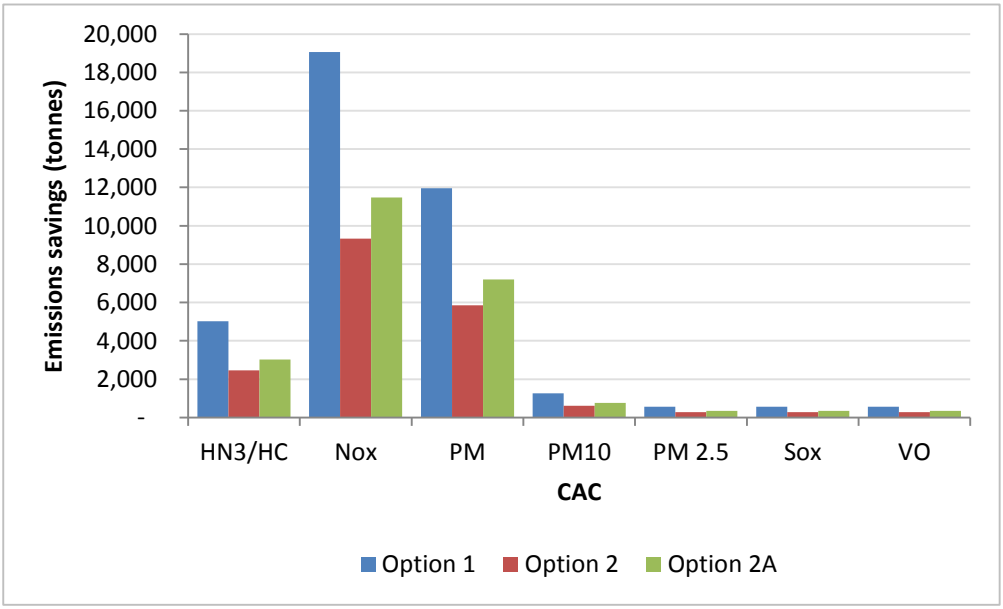
4.45 The effect of the change in transit kilometres has not been included in the analysis, but is expected to be minor since the subway is electrically powered. The GHG emissions associated with electricity-driven modes depends on the source of energy generation.

Other Environmental Issues

4.46 The effect of each Option on CAC emissions is calculated using CAC rates derived from the Urban Transportation Emissions Calculator (UTEC). Although rates vary for different modes the incremental transit kilometres have not been included as the subway emits zero CACs directly.

4.47 Through reduced auto use, Option 1 is expected to reduce Carbon Monoxide (CO) emissions by 560,000 tonnes in 2031, Option 2 by 274,000 tonnes, and Option 2A by 337,000 tonnes. The remaining CAC savings are shown in Figure 4.2.

FIGURE 4.2 CAC EMISSION SAVINGS IN 2031



Source: Steer Davies Gleave

4.48 Any bus service savings as a result of the Options are likely to create a further benefit in both CAC and GHG emissions. Option 1 will replace a greater number of services than Options 2 and 2A and so is likely to have a more significant impact on top of auto emission savings.

Economic Development Impacts

4.49 The Economic Development Account measures the economic impact resulting from the construction and operation of the project. The account summarises the potential impacts on both the supply and demand side of the economy, and quantifies the effect on GDP, job creation and the resultant labour income. In doing so, the account provides the overall economic impact of each option within Toronto and the GTHA, as well as the likely effect on local development and land values.

Demand Side Impacts

4.50 On the demand side, the construction and operation of the project will result in a significant increase in spending and economic activity in areas of Toronto and the GTHA. There are three levels of demand side economic impacts that relate to how expenditure 'ripples though' the economy to provide an overall estimate of end state economic activity that results from an economic shock, such as a major construction project. These three levels are:

- **Direct impacts** – relating to the direct spending and employment created in each industry (i.e. on-site construction jobs during the construction phase, rolling stock manufacturing jobs etc), or operational jobs over the life of the project.
- **Indirect impacts** - relating to the spending and employment created in other industries further down the supply chain in order to produce the materials (goods) and other inputs (services) necessary for the direct inputs to the project.
- **Induced impacts** – relating to the additional spending impact generated by the **direct** and **indirect** impacts from higher wages and employment.

4.51 The Economic Development Account seeks to quantify both the direct and indirect impacts of the Yonge North Subway Extension.

Construction Impact

4.52 The implementation of the Yonge North Subway Extension will generate both direct and indirect economic benefits during construction. These impacts are temporary, but substantial, and span only the period of construction.

4.53 Table 4.7 shows the direct impact resulting from project build, as well as further reaching regional impacts resulting from economic activity for suppliers and sub-contractors.

4.54 The total economic impact of a project is related to the level of investment required for its implementation, as well as the cost profile, which will alter the outcome depending where the majority of the costs accrue. Option 1 is expected

to generate around 28,600 person years of employment, as well as over $1B in wages and $2.8B in GDP during the construction stage in total.

4.55 Due to the relative investment costs, the economic impact for Option 2 and 2A are expected to be 37% and 59% that of Option 1 respectively.

TABLE 4.7 ECONOMIC IMPACT DURING CONSTRUCTION

	Direct Impacts			Regional (Direct+Indirect) Impacts		
	Employment (person yrs)	Wages ($m)	GDP ($m)	Employment (person yrs)	Wages ($m)	GDP ($m)
Option 1	18,400	690	1,770	28,600	1,070	2,760
Option 2	6,840	260	660	10,630	400	1,020
Option 2A	10,850	410	1,050	16,860	630	1,630

Long-Term Economic Impacts

4.56 In the long-term there will be on-going economic benefits as a result of the Yonge North Subway Extension. These benefits reflect both households' freed up vehicle operating expenditures and transportation cost savings to area businesses. The former effect is simply a redirected consumption demand by households away from purchases of gas, parking, automotive parts and services and into other consumer goods and services.

4.57 The latter reflects improved regional competitiveness for metro-area businesses that now have lower costs of doing business; including access to a larger labour market and encountering less highway congestion because people are choosing to use the transit system instead of driving. The impact of the Yonge North Subway Extension will be different for each business.

4.58 Implementation of the project will also generate social benefits that can be monetized, including valuing time savings and emission benefits. These have already been captured above under Transportation User benefits.

4.59 As shown in Table 4.8, the Yonge North Subway Extension is expected to create significant long term employment and income impacts under Option 1, with 276 jobs per year, $10.4m in wage income and almost $27m in GDP value increases. Option 2 and Option 2A are expected to create long-term impacts in the region of 52% and 61% of that of Option 1 respectively.

TABLE 4.8 LONG TERM EMPLOYMENT AND INCOME IMPACTS

	Direct Annual Impacts in 2031			Direct and Indirect Annual Impacts in 2031		
	Employment (jobs)	Wages ($m)	GDP ($m)	Employment (jobs)	Wages ($m)	GDP ($m)
Option 1	199	7.4	19.2	276	10.4	26.7
Option 2	103	3.9	9.9	143	5.4	13.8
Option 2A	122	4.5	11.7	168	6.3	16.3

4.60 The induced economic impacts of the options have not been quantified, but are likely to uplift the overall economic impact. It would be expected that the induced impact would be related to the level of the estimated direct and indirect impact, thus Option 1 would deliver a higher induced impact than Options 2 and 2A during construction and operation.

4.61 While this analysis assesses the likely economic impact of the options on the local and regional scale, it approximates the incremental gain in economic benefits from the project rather than those benefits arising from displacement from other areas. This is dependent on the level of unemployment in the region and the number of jobs that are gained rather than displaced. As such, the economic impact reported in this chapter does not provide a complete assessment of value for money from the national perspective, although the increased spending and employment will be of significant benefit to the region.

Supply-side impacts

4.62 On the supply-side of the economy, the project could lead to significant agglomeration impacts on business and labour productivity, increased labour supply, and imperfect competition benefits, which will directly increase employment, output and GDP throughout the region. These effects are known as 'wider economic impacts' and are typically estimated to generate productivity benefits proportional to between 5% and 50% of 'standard' economic benefits.

Agglomeration

4.63 There is a significant body of evidence to show that businesses that operate in denser economic environments tend to be more productive[25]. This effect is apparent in the formation of business clusters, for example, which 'agglomerate' in an area to take advantage of co-location benefits in business parks and incubator units. Transportation is a critical factor in the determination of the effective

[25] Department for Transport (UK). (2009). *The Wider Impacts Sub-Objective TAG Unit 3.5.14.*

Graham. (2006). *Investigating the link between productivity and agglomeration.* Retrieved from Department for Transportation: http://www2.dft.gov.uk/pgr/economics/rdg/webia/webtheory/

density of an area, and good transportation links can increase the productivity of firms by expanding their access to a range of shared inputs and outputs, including labour, suppliers and customers.

4.64 The location of the Yonge North Subway Extension, running directly to downtown, means that it has the potential to significantly increase the economic density of the city and deliver productivity benefits for the businesses that operate there.

Labour supply

4.65 By reducing the time and cost of commuting to work, transportation projects can in effect increase the real wage of employees by reducing the fixed cost of travelling to work. This can result in a significant increase in labour supply as, for example, those at the margins of participation in the workforce decide to re-enter employment as a result of the improved access to employment opportunities or reduced access costs. This impact has numerous benefits for the individual and an important tax impact for the city and provincial economies. Labour market impacts are not always positive and transportation projects are typically shown to generate labour supply impacts of between -2% to 22% of conventionally measured benefits.

4.66 Whether the labour market impact is positive or negative depends on the amount of benefit accruing to the transportation user, which is usually positive. However, if the transportation project increases the cost of travel to the users without a consummate fall in travel time, the generalized cost of travel will increase and reduce the incentive to work. For example, a highway toll could create overall congestion reduction benefits by reducing the number of users to those that are willing to pay to drive on that highway. However, these benefits accrue mainly to those users with a high value of time (business users) at the expense of low value of time users (commuters and other purposes), who now experience higher travel costs either through paying the toll or taking a less direct and/or slower route.

4.67 Labour supply impacts are highest for projects which deliver significant time saving benefits to commuters, increasing the mobility of workers and potential workers. In comparing the project options assessed for the Yonge North Subway Extension, it is expected that the supply side impact would be greatest for the Option that has the greatest travel time benefit – in this case, Option 1.

Imperfect Competition

4.68 Standard cost benefit analysis is based on assumptions of perfect competition which are a simplification of the structure of the economy. It can be shown by adopting a more realistic monopolistic competition model that there are additional 'imperfect competition' benefits related to the under-supply of goods in an economy. This impact is directly related to the business cost saving impacts of a transportation project and typically generates an uplift of around 3% on conventionally measured benefits[26].

[26] Under perfect competition assumptions, businesses that benefit from travel time savings / costs are assumed to increase their output to this level; however, under imperfect competition assumptions, it implies a monopolistic power, which allows businesses to increase their output greater than the level of savings, thus creating a greater benefit.

Urban Development

4.69 There is significant evidence that high quality public transportation can generate a positive impact on the urban development of a city or region. Transit projects can promote regeneration in several ways, by improving accessibility, productivity, access to labour and employment opportunities, boosting land values and promoting sustainable land use patterns and development. These effects occur through several processes:

- **Increased Transport Accessibility** – lowers the cost of travel and makes it easier and cheaper to get to and from work, leisure and education destinations. This increases the availability of labour for local businesses and expands the available range of employment and leisure options for individuals. It can also open up new areas of land for development and increase the attractiveness of under-used land parcels.
- **Increased Productivity** – improving transport links reduces business costs and directly boosts the productivity of firms. Transport can also reduce the 'effective distance' between businesses and individuals. Increasing productivity through 'agglomeration effects', improving access to shared inputs and outputs, generating denser labour markets and creating positive network effects.
- **Improved Urban Fabric** - new stations or stops can improve the level of facilities and quality of urban realm at a location. This can in turn have a positive impact on the environment and perceptions of an area, and can induce further private sector investment in some cases.
- **Increased Footfall** – a new station or stop may generate an increase in levels of pedestrian traffic. This enhances the value of a location as a retail or commercial site by bringing more customers and increasing its profile.
- **Improved City Image** – transport hubs are often the first point of call for visitors to city locations and major transport projects, particularly high quality transit projects, can have an important impact on the image of a city, encouraging new investment and migration.

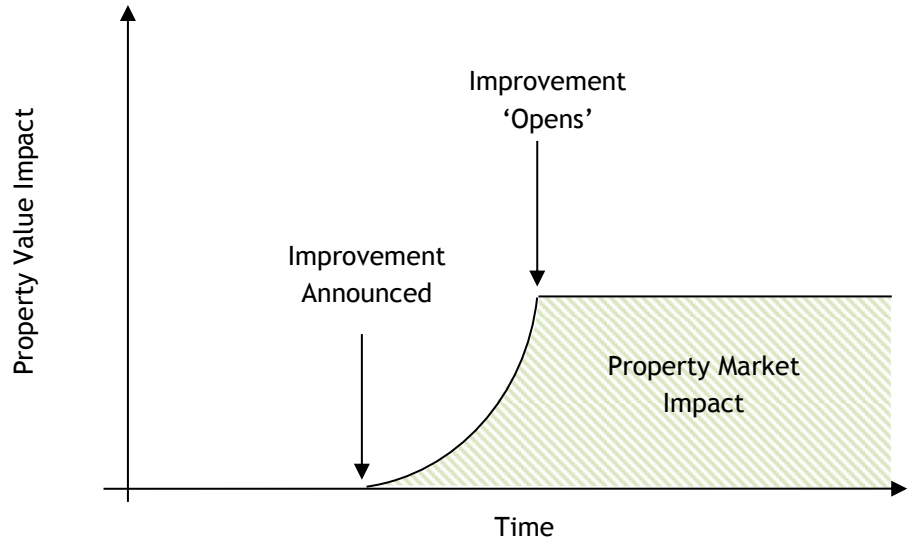
4.70 Toronto's YUS subway line already exhibits much of the above discussion. High density development around subway stations along Yonge Street has characterized the area since the introduction of the subway in the 1950s. When comparing the options assessed in this report, Option 1 has the highest potential for the described benefits.

Impact on Land Values

4.71 As described above, transport projects affect land values through several mechanisms that cause properties located near transit hubs to often enjoy a significant price premium. This effect can be principally attributed to the lower access costs of such locations, which enable large travel 'catchment' areas to make such locations valuable for many different uses. Transport projects can also increase the accessibility and availability of unused land, which can encourage new development.

4.72 In theory, assuming the effects of a transport project are correctly anticipated, any uplift in property values is likely to begin following the announcement of the improvement and be fully realised upon opening. This means that the timing of the property impact is complex, potentially taking place over several years as the project nears completion. The fact that building leases are normally made across multiple years adds an additional complication. The effect is illustrated in Figure 4.3.

FIGURE 4.3 PROPERTY MARKET IMPACT TIMING



Source: Steer Davies Gleave

4.73 A matrix of potential land value uplift percentages based on value impact research from other North American urban centres (Table 4.9) has been developed. The ranges provided in the table are based on a compilation of research findings relating to land value uplift assessment around transit stations and corridors in various countries, including Canada, the United States and the United Kingdom.

4.74 In developing these factors, the research demonstrated the degree of difficulty involved in isolating the impact of transit investment amid a multitude of factors that determine land value. The ranges presented in Table 4.9 represent the mid-range land value impacts found in the reference material and shows the level of premium in land value that can be expected for properties around the transit stations and along the transit corridor.

TABLE 4.9 LAND VALUE UPLIFT FACTORS

Technology		Bus	BRT	LRT: at-grade	LRT: grade separated	Subway	GO Rail
Station impact Area (m)		100	400	500	600	800	800
Premium %							
Residential	Low	1%	2%	10%	15%	20%	20%
	High	2%	4%	25%	30%	50%	50%
Office	Low	1%	2%	10%	15%	20%	20%
	High	2%	4%	50%	50%	50%	50%
Retail	Low	1%	1%	10%	10%	7%	7%
	High	2%	2%	50%	50%	15%	15%
Industrial	Low	0	0	1%	1%	5%	5%
	High	1%	2%	2%	2%	5%	5%

Technology		Bus	BRT	LRT: at-grade	LRT: grade separated	Subway	GO Rail
Right of way impact Area (m)		0	0	200	200	0	300
Premium %							
Residential	Low			0	-5		-5
	High			-10	-15		-15
Office	Low			0	0		0
	High			-10	-15		-10
Retail	Low			5	5		0
	High			10	10		-10
Industrial	Low			0	0		0
	High			1	1		0
		(1)	(1)			(2)	(3)

Notes:

(1) no impact for bus right of way impact areas, given that the short distance between bus stops creates situation where station impact areas are almost adjoining each other.

(2) no impact for underground subway since right of way impact area is underground.

(3) Ref Landis et al (1994) found negative externalities from being too near commuter rail (within 300 m)

Source: Metropolitan Knowledge International

4.75 York Region has extensively researched the potential development in the corridor for the Yonge North Subway Extension. This information on existing land use patterns, alongside the land value uplift parameters set out by Metropolitan Knowledge International, creates the basis on which this report forms the land value analysis. The land value analysis is based on assumed land values (informed by a small sample of current land values in the areas) and the distribution of land uses by Official Plan (OP) designation in the area. OP designations approximate the current land use patterns and are a generally good long-term indicator of the mix and density of uses anticipated in the area.

4.76 As shown in Table 4.9, the Station Impact Area (SIA) for a subway station from a land value perspective can extend outward to 800 metres or more. For the land value uplift calculation, we have based the analysis on a 500 metre SIA in order to be consistent with previous analysis. Even so, extending the analysis to an 800 metre radius would result in relatively little additional value uplift due to the close proximity of the stations and overlapping SIAs. The exception to this is the Thornhill area, where the distance between Clark and Royal Orchard stations is approximately 1.9 kilometres. However, it is worth noting that while values might increase in this area with an 800 metre SIA, heritage constraints on development may limit redevelopment opportunities in the area.

4.77 This analysis seeks to quantify the land value uplift that could be attributed singularly to the introduction of transit in an area, rather than use transit as a rationale to enable further development in a region. Further, the analysis estimates the impact of the subway extension only.

4.78 Table 4.6 shows the potential land value uplift associated with each Option compared to the Base Case and represents an estimate of the total overall increase in property values assuming no change in land use designation.

TABLE 4.6 POTENTIAL LAND VALUE UPLIFT ($M)

	Low	High
Option 1	480	1,202
Option 2	157	392
Option 2A	157	392

4.79 Option 1 is expected to have a significantly greater uplift on properties due to the larger number of additional subway stations. Option 2 and 2A are assumed to have the same impact with relation to the subway extension.

Increase in development

4.80 Prior experience with the Sheppard Subway extension and the construction of the Yonge-University lines shows that there is considerable potential in land development resulting from transit investment. The assessment presented in this report for the Yonge North Subway Extension is a high level appraisal and based on experience from other jurisdictions. This appraisal does not separate the value generated by the transit investment in the Yonge corridor from the value of development that would have occurred elsewhere in the GTHA.

4.81 To further explore the land uplift capture (LUC) concept, York Region, in collaboration with Metrolinx, is undertaking a more detailed assessment of the corridor from this perspective. The scope of work is to assess the LUC potential of the corridor as a result of the subway investment as well as approximate an amount of LUC that could potentially be captured. The assessment will take into account the property development proposals that will be unlocked as a result of building the subway extension. The findings of the LUC assessment were not available in time for incorporation into this report. However, the information, when available, will be used to supplement decision-making on this account.

Summary

4.82 The total potential economic benefits of the Yonge North Subway are shown in Table 4.11.

TABLE 4.7 ECONOMIC DEVELOPMENT IMPACTS (DIRECT AND INDIRECT)

	Option 1	Option 2	Option 2A
Economic impacts during construction			
Employment (person years)	28,600	10,630	16,860
GDP ($m)	2,760	1,020	1,630
Wages ($m)	1,070	400	630
Long Term economic impacts (2031)			
Employment (jobs)	276	143	168
GDP ($m)	26.7	13.8	16.3
Wages ($m)	10.4	5.4	6.3
Land value uplift ($m)	480-1,202	157-392	157-392

Social Community Account

4.83 The Social Community Account assesses the relative impact of each option on the quality of life within the local community. The investment could create a local and/or regional impact through greater accessibility, as well as land use changes and development. The account also qualitatively assesses at the potential impact of the subway extension on the health and wellbeing of the community.

Land Use Impacts

4.84 The Supply-side impacts

4.85 On the supply-side of the economy, the project could lead to significant agglomeration impacts on business and labour productivity, increased labour supply, and imperfect competition benefits, which will directly increase employment, output and GDP throughout the region. These effects are known as ‘wider economic impacts’ and are typically estimated to generate productivity benefits proportional to between 5% and 50% of ‘standard’ economic benefits.

Agglomeration

4.86 There is a significant body of evidence to show that businesses that operate in denser economic environments tend to be more productive. This effect is apparent in the formation of business clusters, for example, which 'agglomerate' in an area to take advantage of co-location benefits in business parks and incubator units. Transportation is a critical factor in the determination of the effective density of an area, and good transportation links can increase the productivity of firms by

expanding their access to a range of shared inputs and outputs, including labour, suppliers and customers.

4.87 The location of the Yonge North Subway Extension, running directly to downtown, means that it has the potential to significantly increase the economic density of the city and deliver productivity benefits for the businesses that operate there.

Labour supply

4.88 By reducing the time and cost of commuting to work, transportation projects can in effect increase the real wage of employees by reducing the fixed cost of travelling to work. This can result in a significant increase in labour supply as, for example, those at the margins of participation in the workforce decide to re-enter employment as a result of the improved access to employment opportunities or reduced access costs. This impact has numerous benefits for the individual and an important tax impact for the city and provincial economies. Labour market impacts are not always positive and transportation projects are typically shown to generate labour supply impacts of between -2% to 22% of conventionally measured benefits.

4.89 Whether the labour market impact is positive or negative depends on the amount of benefit accruing to the transportation user, which is usually positive. However, if the transportation project increases the cost of travel to the users without a consummate fall in travel time, the generalized cost of travel will increase and reduce the incentive to work. For example, a highway toll could create overall congestion reduction benefits by reducing the number of users to those that are willing to pay to drive on that highway. However, these benefits accrue mainly to those users with a high value of time (business users) at the expense of low value of time users (commuters and other purposes), who now experience higher travel costs either through paying the toll or taking a less direct and/or slower route.

4.90 Labour supply impacts are highest for projects which deliver significant time saving benefits to commuters, increasing the mobility of workers and potential workers. In comparing the project options assessed for the Yonge North Subway Extension, it is expected that the supply side impact would be greatest for the Option that has the greatest travel time benefit – in this case, Option 1.

Imperfect Competition

4.91 Standard cost benefit analysis is based on assumptions of perfect competition which are a simplification of the structure of the economy. It can be shown by adopting a more realistic monopolistic competition model that there are additional 'imperfect competition' benefits related to the under-supply of goods in an economy. This impact is directly related to the business cost saving impacts of a transportation project and typically generates an uplift of around 3% on conventionally measured benefits.

4.92 Urban Development Account demonstrates how all three options can impact land development and intensification around the stations. The implementation of a subway can also encourage more compact and walk-able neighbourhoods through trying to optimise the number of developments that can easily access the station. It is expected that the full subway extension (Option 1) would have an impact on a

larger area, from being extended a further distance (i.e. Finch to Richmond Hill), whereas the effect of Options 2 and 2A would be limited to south of Steeles primarily.

4.93 The development potential along the corridor is also constrained by Built Heritage Resources (BHR) and Cultural Heritage Landscapes (CHL) along Yonge Street. These have been documented in a report published in January 2009, entitled *Existing Conditions: Built Heritage and Cultural Heritage Landscapes* for the Yonge Subway Extension Environmental Project. The report identifies 20 heritage sites that could restrict densification along the full corridor. However, intensification on the land parcels around these build heritage areas is planned. Overall, the potential impact of all three options will only be realised if supported by municipal planning and zoning guidelines.

Health

4.94 Transit is a mechanism for encouraging active transportation, particularly when integrated with pedestrian/cycling facilities. A recent study calculated that taking public transit in the US is associated with walking an additional average 8.3 minutes per day and could save individuals US$5,500 in obesity-related medical costs[27].

4.95 Transit demand is highest for Option 1, followed by Option 2A and then Option 2; and the likely effect on physical health is potentially greater where demand for transit is greatest.

4.96 As demonstrated in the Environmental Impacts section, there is likely to be a benefit in emissions reduction under all Options. The health effects of poor air quality are far reaching, affecting the body's respiratory systems and cardiovascular system. By reducing congestion and facilitating a modal shift to transit, in particular subway, local air quality and associated health issues should be improved.

Accessibility

4.97 The full subway extension would provide greater accessibility to downtown and locations along the subway as it requires no interchange between modes from Richmond Hill. In addition, Option 1 serves as a more accessible option for road users, with the provision of a Park & Ride site at Langstaff.

Sensitivity Analysis

4.98 Future demand for transit will be highly dependent on changes in land use along the corridor and vice versa. This is particularly likely for the Yonge North Subway Extension due to numerous frameworks and studies depicting growth for York Region. As such, sensitivity tests were carried out on Options 1 and 2, which use a more aggressive land use scenario. The land use scenario tested as part of this sensitivity analysis is consistent with the land use in DRTES in which there is a greater proportion of future employment to downtown Toronto with more population out in the rest of the GTHA region when compared to the current *Places to Grow* assumptions.

[27] Edwards, R.D. 2008. Public transit, obesity and medical costs: assessing the magnitudes

4.99 The sensitivity results suggest a 7% increase in Option 1 transportation benefits under this alternative land use assumption, and 15% increase for Option 2. With higher employment forecasts focused on downtown Toronto, the degree of transit use on the subway extension will be slightly greater, marginally improving the value for money of each Option. However, based on the land use sensitivity, the relative performance of the Options from a value for money perspective does not change.

Summary Results

4.100 The results of the Multiple Account Evaluation are summarized in Table 4.12.

4.101 Option 1 performs most strongly for four of the accounts and is forecast to generate almost twice the level of transportation user benefits, and approximately three times the estimated land value impact of Option 2. On the fifth account, the significant capital cost of Option 1 contributes to a lower Benefit Cost ratio than Option 2 (0.8 versus 1.1) and a negative value for Net Benefits. Phasing the construction could mitigate these costs by making the construction more affordable and capturing a portion of the benefits. However Places to Grow growth assumptions and associated transit demand on the corridor suggest that the extension to Richmond Hill Centre provides a more long term solution to accommodate all the forecast growth.

4.102 Option 2A is forecast to generate greater benefits than Option 2, but the high costs of increasing GO frequencies indicate that this option is the poorest value for money of the Options analysed.

4.103 For all options ridership resulting from implementing the Yonge North Subway Extension may challenge downstream capacity on the Yonge subway line. To address this concern Metrolinx is undertaking a regional network capacity analysis, in partnership with York Region and the City of Toronto, to determine how to sequence construction of the Yonge subway extension to Richmond Hill Centre (Option 1) with the phased implementation of other network improvements such as automatic train control, the Downtown Relief Line, Union Station and Yonge-Bloor improvements.

TABLE 4.8 MAE SUMMARY

	Option 1	Option 2	Option 2A
Transportation User Account			
Transportation User Benefits (PV $M)	1,980.3	1,025.5	1,210.5
Qualitative User Benefits	✓✓✓	✓	✓
Financial Account			
Costs (PV $m)	2,645.0	971.5	1,907.7
Net Benefits (PV $m)	-664.8	+54.0	-697.2
Benefit Cost Ratio	0.8:1	1.1:1	0.6:1
Environmental Account			
GHG Emissions Reductions (PV $m)	9.2	4.5	5.4
CAC Emissions Reductions	✓✓✓	✓✓	✓✓
Economic Development Account			
Economic Impacts during Construction:			
Employment (person years)	28,600	10,630	16,860
GDP ($m)	2,760	1,020	1,630
Wages ($m)	1,070	400	630
Economic Impacts during Operation (2031):			
Employment (jobs)	276	143	168
GDP ($m)	26.7	13.8	16.3
Wages ($m)	10.4	5.4	6.3
Land Value Uplift ($m)	480-1,202	157-392	157-392
Development Potential	✓✓✓	✓	✓
Social and Community Account			
Land Use Shaping	✓✓✓	✓	✓
Health	✓✓	✓	✓
Accessibility	✓✓✓	✓✓	✓✓

APPENDIX

A

ASSUMPTIONS TABLE

A1 ASSUMPTIONS TABLE

A1.1 The following table shows the assumptions that were applied to the Yonge North Subway Extension economic appraisal.

Assumption	Value	Source
Opening Date	2018	Metrolinx
Price Base/Currency	2011 CAD	
Benefits/Revenue Build-Up	2018: 60% 2019: 90% 2020: 100%	Metrolinx
Revenue Cap	After year 2035	Metrolinx
Value of Time (per hour)	Business: $38.45 Other: $11.83 Weighted Average: $14.24	GGH Model
Value of Time Growth	1.64% p.a.	Metrolinx
Auto Cost Unit Rate	$0.56/km (2011 prices)	CAA
Safety Saving Unit Rate	$0.07/km (2011 prices)	Canadian Motor Vehicle Collision Statistics
Greenhouse Gas Emission Cost	$0.01/km (2011 prices)	GGH and Transport and Environment Canada
Real Growth	Construction: 1.0% p.a. Vehicles: 1.0% p.a. Operations: 0.0% p.a. Revenues: 0.0% p.a. Auto Costs: 2.0% p.a.	Metrolinx
Annualisation Factors (AM Peak period to Annual)	Transit: 1170 Highways: 3000	Metrolinx
Discount Rate	5% p.a.	Metrolinx