

Scarborough Subway Extension Preliminary Design Business Case

February 2020

Infrastructure
ONTARIO

 **METROLINX**

Scarborough Subway Extension Preliminary Design Business Case

February 2020

Contents

Executive Summary	7
-------------------	---

Scope	7
-------	---

Method of Analysis	7
--------------------	---

Findings	8
----------	---

Recommendation	9
----------------	---

1 Introduction	10
----------------	----

Preliminary Design Business Case Scope and Objectives	11
---	----

Background	11
------------	----

Business Case Overview	13
------------------------	----

2 Problem Statement	15
---------------------	----

Introduction	16
--------------	----

Case for Change	16
-----------------	----

Business as Usual	16
-------------------	----

Strategic Value	18
-----------------	----

Strategic Outcomes	19
--------------------	----

Strong Connections:	19
---------------------	----

Complete Travel Experiences:	19
------------------------------	----

Sustainable and Healthy Communities:	19
--------------------------------------	----

Strategic Objectives	19
----------------------	----

3 Investment Options	21
----------------------	----

Introduction	22
--------------	----

Options Development	22
Summary of Assumptions Used in this Business Case for Analysis and Travel Demand Modelling	25
4 Strategic Case	26
.....	
Introduction	27
BENEFIT 1: Bring rapid transit closer to Scarborough residents	28
BENEFIT 2: Increase access to existing economic opportunities and support the important employment centre at Scarborough Centre	29
BENEFIT 3: Support planned development in Scarborough	33
Outcome 2: COMPLETE TRAVEL EXPERIENCES	35
BENEFIT 4: Improve Travel Time and Reliability	36
BENEFIT 5: Build an Integrated Transportation Network	40
Outcome 3: SUSTAINABLE AND HEALTHY COMMUNITIES	43
BENEFIT 6: Move People with Less Energy and Pollution	44
BENEFIT 7: Improve Quality of Life and Public Health	45
Strategic Case Summary	46
5 Economic Case	48
.....	
Introduction and Assumptions	49
Costs	51
6 Financial Case	57
.....	
Introduction	58
Assumptions	58
Capital Costs	58
7 Deliverability and Operations Case	63
.....	
Introduction	64

Project Delivery	64
How advanced are the designs for Scarborough Subway Extension?	64
What project and program dependencies exist?	64
How could the project be procured and delivered?	65
Are there any major constructability issues?	66

Executive Summary

Scope

Metrolinx and Infrastructure Ontario have taken responsibility for delivering a 3-stop extension to the Toronto Transit Commission's (TTC) Line 2 Bloor-Danforth Subway connecting the existing eastern terminus at Kennedy Station with a station at Sheppard Avenue and McCowan Avenue.

This Preliminary Design Business Case evaluates the performance of the Scarborough Subway Extension (SSE) as currently contemplated against a Business as Usual (BAU) scenario as the basis for an investment decision. The BAU assumes that "In Delivery" projects from the *2041 Regional Transportation Plan* are in service, as modified by Ontario's Transit Plan¹. It is noted that the BAU option does not include the existing TTC Line 3 Scarborough (also known as Scarborough Rapid Transit (SRT)). In the BAU, improvements to the existing surface transit network to accommodate the decommissioning of the SRT have been included in the scenario, provided by the TTC.

Metrolinx is concurrently seeking Stage 2 approval for P3 contract for both advance tunnel work and the balance of the project.

Method of Analysis

A Business Case is a comprehensive collection of evidence and analysis that sets out the rationale for why an investment should be implemented to solve a problem or address an opportunity. Business cases are required by Metrolinx's Capital Projects Approval Policy for all capital infrastructure investments. The Scarborough Subway Extension Preliminary Design Business Case (PDBC) follows the methodology from the Metrolinx Business Case Guidance².

The Scarborough Subway Extension Preliminary Design Business Case falls under the design refinement stage of Metrolinx's Project Lifecycle (see Figure 1 on page 14) and compares the Scarborough Subway Extension against a Business As Usual scenario. As with all Metrolinx Business Cases, the SSE PDBC is structured around four cases:

¹ Ontario Government, 2019

² http://www.metrolinx.com/en/regionalplanning/projectevaluation/benefitscases/benefits_case_analyses.aspx

- The Strategic Case, which determines the value of addressing a problem or opportunity based on regional development goals, plans and policies.
- The Economic Case, which uses standard economic analysis to detail benefits and costs of the options to individuals and society as a whole, in economic terms.
- The Financial Case, which assesses the overall financial impact of the options, its funding arrangements and technical accounting issues and financial value for money.
- The Deliverability and Operations Case, which considers procurement strategies, deliverability risks, and operating plans and risks.

Findings

The Scarborough Subway Extension offers improvements compared to a Business As Usual scenario, generating \$2.7 billion worth of economic benefits. There will more than 105,000 daily boardings at SSE stations.

Table 1: High-Level Summary of Scarborough Subway Extension PDBC

Scarborough Subway Extension	
Strategic Case	
Strong Connections	<ul style="list-style-type: none"> • Extension attracts approximately 105,000 daily boardings • 34,000 jobs accessible within a 10 minute walk of new stations • Introduces seamless rapid transit to the Scarborough Centre area, the Lawrence arterial, and brings rapid transit to the Sheppard Avenue Corridor.
Complete Travel Experiences	<ul style="list-style-type: none"> • 575,000 person-minutes transit travel time savings daily compared to BAU
Sustainable and Healthy Communities	<ul style="list-style-type: none"> • 12,000 net new transit users in the morning peak hour compared to BAU • 30,000 km decrease in vehicle kilometres travelled (VKT) in the peak hour compared to BAU • Reduction in auto-related greenhouse gas (GHG) emissions of 10,000 tonnes annually compared to BAU
Economic Case	
Total Economic Benefits** (\$2020, Net Present Value (NPV))	\$2.8 billion
Total Costs (\$2020 NPV)*	\$5.5 to \$6.0 billion
Benefit-Cost Ratio	0.60 to 0.66
Net Present Value (\$2020 NPV)*	-\$2.4 billion to -1.9 billion
Financial Case	

Scarborough Subway Extension	
Capital Costs (\$2020 NPV)*	\$5.5 billion
Operating Costs (\$2020 NPV)	\$926.5 million
Incremental Network Cost	0.82
Recovery Ratio	
Return on Investment Ratio	0.14
Deliverability and Operations Case	
Procurement and Delivery	<ul style="list-style-type: none"> In order to accelerate procurement timelines, ensure on-time delivery and transfer risk, a P3 model was selected for the advance tunnel works including launch and extraction shafts, headwalls, design and procurement of Tunnel Boring Machines, tunnel liners, and utility treatment works required for the tunnelling. A P3 contract for the remainder of the Project, including the stations, rail, tunnel fit out and systems. The final scope of maintenance will be finalized through discussions with the City of Toronto, TTC and Province of Ontario
Delivery Timeline	<ul style="list-style-type: none"> Target in-service date of 2029/2030
Operations	<ul style="list-style-type: none"> Operate seamlessly with current TTC Line 2 Operations

* Cost estimates reflect a range representing low to high forecasts to account for optimism bias at the early stages of project design

**Please note, the benefits of extending operation of the SRT are not included

Recommendation

This Preliminary Design Business Case recommends advancing design and procurement of the Scarborough Subway Extension option over the Business as Usual.

1 Introduction



Preliminary Design Business Case Scope and Objectives

This Preliminary Design Business Case has two objectives:

- Document the Scarborough Subway Extension (SSE), as currently contemplated at the time the project was brought under the management of Metrolinx
- Compare SSE with a Business As Usual (BAU) scenario as a basis for an investment decision

Background

The Greater Toronto and Hamilton Area (GTHA) is one of North America's fastest growing regions, projected to grow by over 40% between 2016 and 2041³. Most growth in the region is forecasted to take place outside Toronto, resulting in a significant increase in total trips.

While population and employment growth continue across the region, key activities, in particular office growth, continue to be concentrated in Toronto's downtown core and its periphery. There is an understanding that the rapid transit network must be expanded to allow not only better access to the downtown, but ensure there are efficient effective connections across the City of Toronto. To address the demands associated with regional growth, a number of transportation infrastructure investments will be required..

To serve longer-distance trips Metrolinx is now investing more than \$20 billion in the GO Expansion program to expand the regional rail system⁴, with faster and more frequent trains and the capacity to carry three times as many passengers by 2041. This transit expansion is being developed in existing corridors with all trains running to or from Union Station.

It has been noted that the GO Rail system does not serve all parts of Toronto, nor does it serve many shorter distance trips. As a result Metrolinx is also working to implement other rapid transit investments to address the needs of the Greater Toronto Region. The recently announced Ontario Line is an important step in increasing transit capacity into the downtown core.

Similarly, the Yonge North Subway Extension and the Eglinton Crosstown Western Extension will leverage existing and in-delivery infrastructure to bring rapid transit closer to transit users as they access their homes and places of work.

³ Statistics Canada 2016 Census; *Growth Plan for the Greater Golden Horseshoe*, 2017

⁴ <http://www.metrolinx.com/en/greaterregion/projects/go-expansion.aspx>

In Scarborough, there is a particular need to replace the current TTC Line 3 Scarborough that runs from McCowan Station to Kennedy Station. This infrastructure is at or near the end of its useful life. Without a rapid transit connection, transit users coming from points north of the Kennedy Station would only be able to access Line 2 via surface bus routes. These bus trips can be lengthy and subject to delay as they compete for space on crowded roads. This means that transit users in this area would experience long journey times and poor transit service reliability. It also has the potential to impact the attractiveness of transit in this part of the region.

Toronto's Subway Network

Toronto's original subway investment was a Yonge subway from Union Station to Eglinton which was completed in 1954. This subway was designed to satisfy the demand of commuters that were taxing the ability of surface routes. The Yonge line was extended to York Mills in 1973 and further extended to Finch Station in 1974, in part, in response to levels of demand from points north.

The Bloor Danforth Subway opened in 1966, running from Keele Station in the west to Woodbine Station in the east. The line was extended just two years later to run from Islington in the west to Warden in the east. In 1980, there was a final extension of one station at each end to reach the current condition of with Kipling in the west to Kennedy in the east.

Scarborough Rapid Transit

Rather than implement a further extension to the subway, a decision was made to provide rapid transit beyond Kennedy through a connection with a new technology. The Scarborough Rapid Transit (SRT) line opened for service in 1985 and operates between Kennedy Station, connecting with the Bloor- Danforth Subway, and McCowan Station.

The SRT service successfully attracts ridership and has been operating over-capacity for a decade. Peak-period passenger volumes have been capped at 4,000 passengers per hour per direction due to limited SRT capacity, with constrained ability to improve the capacity because of the limited number of vehicles in the fleet and limited station size. The existing bus facilities at Scarborough Centre station are also overcapacity.

After almost 30 years of continuous operation, the SRT's vehicles are reaching the end of their serviceable life. The SRT system was designed to specifically accommodate the original Bombardier 'Mark I' vehicles. The next generation of vehicles (used in Vancouver and elsewhere) are longer and unable to accommodate the turning radius requirements of the SRT infrastructure. In 2015, TTC commissioned Bombardier, the original equipment manufacturer to perform a review and assessment of the fleet condition in order to determine a repair program to extend the life of the vehicles. The review uncovered corrosion in structural

areas of the vehicle which required significant intervention to prevent vehicle failure that would permanently shut the system. The vehicles and system infrastructure are now being maintained in a life extension program with the view to continue SRT operations until completion of the Scarborough Subway Extension. Since 2006, there has been considerable study and discussion on how to best address the aging SRT system. A monthly cost of \$1 million per month has been identified as the cost keeping the SRT in operation.

In 2013, TTC and City Council supported replacing the SRT with an extension of Line 2, Scarborough Subway Extension (SSE), with stations at Lawrence Ave, Scarborough Centre and Sheppard Ave, based on the following benefits:

- Higher speeds than the SRT;
- Most-reliable, highest-quality rapid transit service;
- Elimination of the transfer at Kennedy Station;
- Higher ridership than the SRT; and
- Consideration of alignments other than the existing SRT routing, which would then not require shutting down the SRT during construction of a subway extension.

Between 2013 and 2019, the City of Toronto and TTC continued to develop the SSE project, which evolved to a one stop 'McCowan Express' subway terminating at Scarborough Centre. The 'McCowan Express', in conjunction with the SmartTrack and the Eglinton East LRT projects, formed part of the Scarborough Transit Network. The 'McCowan Express' concept has been developed to approximately 100% of tunnel design and 60% of station design, with an estimated cost of \$3.87B and target in service date for of 2027 (bus terminal completed in 2030)

The 2019 Ontario Budget committed \$2B of provincial funding to a three-stop SSE as originally conceived (with an estimated cost of \$5.5B and a target delivery date of 2029 - 2030). The budget also outlined the Province's intent to that SSE would be delivered by Metrolinx.

Business Case Overview

Business Case analyses are mandated by Metrolinx for all capital projects. As projects evolve over their lifecycle, business cases are completed to define the rationale and requirements for delivering said investment. As shown in Figure 1, the Preliminary Design Business Case is the second of four business cases completed in an investment's lifecycle. The PDBC compares a recommended option against Business As Usual and looks at approaches to refine the recommended option.

With Metrolinx taking over the implementation of the SSE, it was important to advance the Preliminary Design Business Case to understand the project's cases at this important point of transition and to advance the project through the stage gate process.

Figure 1: Metrolinx Business Case Development Process



2

Problem Statement



Introduction

This chapter defines the case for change, which is used to guide the evaluation of investment options considered within this business case.

Case for Change

Problem and Opportunity Statement

The existing Line 2 Subway terminates at Kennedy Station. In the peak hour, over 7,000 transit users access the subway at this station, with many customers reaching the station from the Scarborough Rapid Transit (SRT) or after traveling significant distances by bus. Extending the subway further into Scarborough provides access to more of Scarborough by bringing stations closer to users, providing them with shorter journey times and an improved customer experience.

The SRT currently serves more than 38,000 riders daily and is operating over capacity during peak periods. It primarily serves riders accessing Kennedy Station to connect with Line 2. Much of the existing SRT ridership boards at Scarborough Centre station, with a majority of riders transferring from TTC bus routes traveling from north and west of the station. The SRT vehicles are at the end of their serviceable life. Without the SRT, existing transit users would spend additional time on buses accessing Line 2 at Kennedy Station or in some cases choosing to connect by bus to a Line 1 Station. There is also a concern among some that operating a replacement bus network to provide these connections would strain the local road network and overwhelm the bus and passenger facilities at Kennedy Station.

Replacing the SRT provides an opportunity to address capacity constraints at TTC bus facilities at Scarborough Centre Station. The existing transfer between the SRT and Line 2 at Kennedy is perceived as cumbersome by transit riders and a transit solution without a transfer would provide a benefit.

Scarborough Centre is an emerging mixed-use hub in the City of Toronto. There is an opportunity for a rapid transit investment to contribute to the success of this important transit supportive community.

Business as Usual

A Business As Usual scenario is used as a base case in this Preliminary Design Business Case to give us a comparator for the options under consideration.

The *2041 Regional Transportation Plan*, adopted by the Metrolinx Board of Directors in 2018, identifies as Priority Action 1.1 the delivery of 14 transit projects by 2025. These projects are known as "In Delivery," meaning they are currently in advanced stages of design or under construction, and include the GO

Expansion Program, Eglinton Crosstown, Finch West LRT, Sheppard East LRT, Scarborough Subway Extension, Highway 7 BRT and Yonge BRT.

The 2041 “In Delivery Network” is included in the Business As Usual (BAU) scenario, with a few modifications reflecting recent decisions:

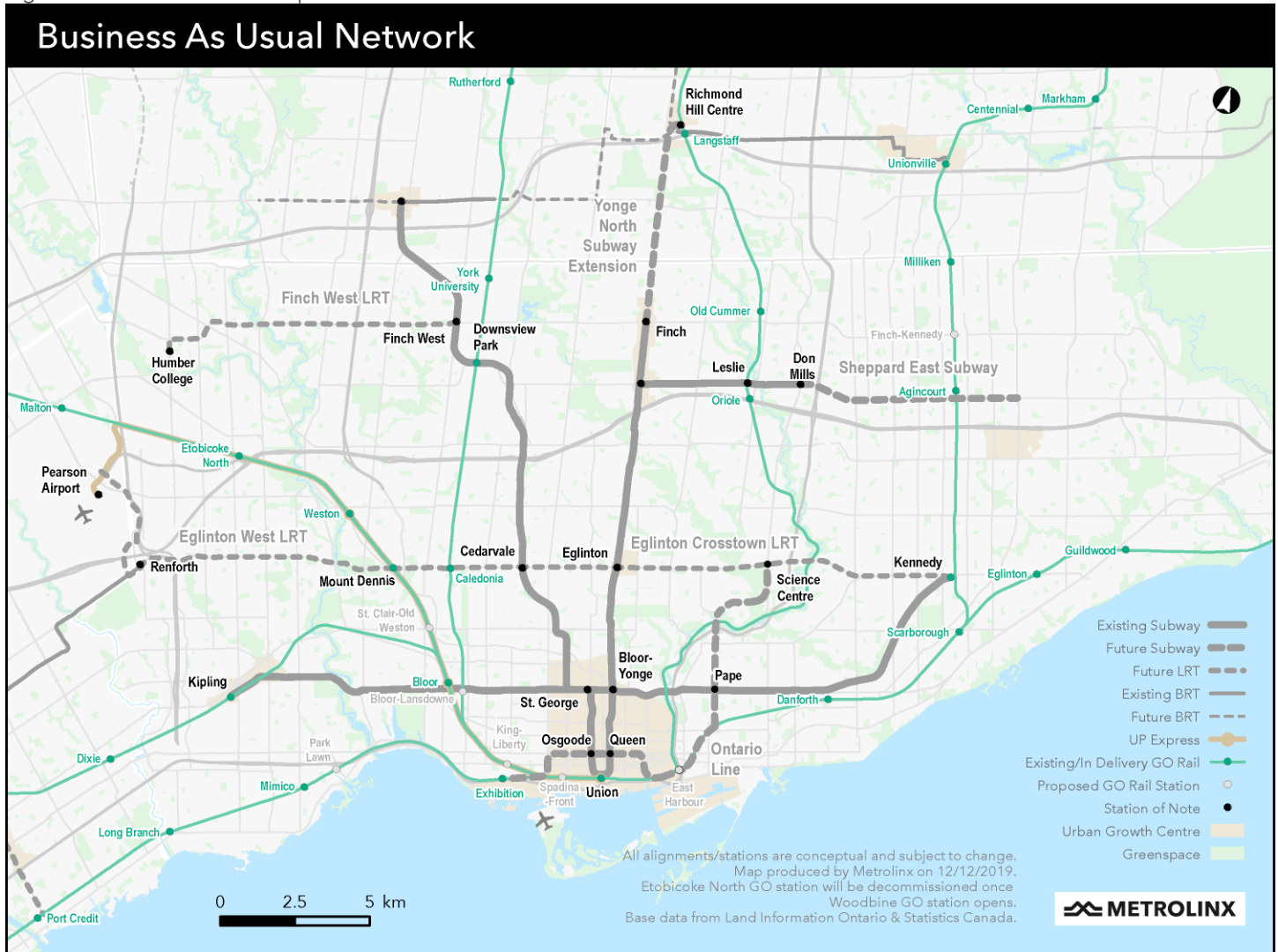
- Ontario Line is included as a new line running from Don Mills and Eglinton to Exhibition GO station.
- Yonge North Subway is included as extension of Line 1, with five stations
- Eglinton Crosstown Western Extension is included as an underground extension of the Eglinton Crosstown;
- Sheppard East is included as a six station subway of Line 4 Sheppard, rather than as an LRT

Notably, the Business as Usual scenario evaluated in this Business Case does not include the existing Scarborough Rapid Transit (SRT), which currently operates between Kennedy Station and McCowan Station. Based on available information, it is understood that the SRT would require substantial investment to remain operational during the business case’s time frame (beyond 2029/2030) and so it would be inappropriate to include it for comparison purposes.

It has been assumed that a replacement bus network has been established to provide the type and volume of transit connections required to serve former SRT passengers. In reviewing this document it will be of value to keep this assumption in mind as the Scarborough Subway Extension is not being compared against the SRT, but rather against transit network scenario where Scarborough is largely served by surface route buses.

As is typical, the Business As Usual scenario also assumes reasonable improvements to existing surface transit across the region.

Figure 2 Business As Usual Rapid Transit Network



Strategic Value

The 2041 Regional Transportation Plan (RTP) presents a common vision for the region:

“The GTHA will have a sustainable transportation system that is aligned with land use, and supports healthy and complete communities. The system will provide safe, convenient and reliable connections, and support a high quality of life, a prosperous and competitive economy, and a protected environment.”

The goals of the 2041 RTP are to achieve:

- *Strong Connections* - this PDBC will examine an option that will connect more people to more places and opportunities
- *Complete Travel Experiences* - this PDBC will examine the investment as a solution to improve reliability, comfort and safety

- *Sustainable and Healthy Communities* - this PDBC will evaluate this transit investment's potential to provide more environmental-friendly travel options

Strategic Outcomes

The proposed investment to be recommended through this Initial Business Case should support the realization of the three 2041 RTP goals as follows:

Strong Connections:

The recommended investment will improve transit coverage by providing rapid transit access closer to where people live and serving key destinations, increase access to economic opportunities for people in the region by better connecting them to jobs and support transit-oriented development, thus creating a synergy between transit and places.

Complete Travel Experiences:

The recommended investment will improve travel time and reliability for riders whose journeys would include time on surface bus routes on congested streets leading to crowding and delays. It will also improve their comfort by integrating the SSE into the future transit network to allow for convenient and seamless trips across the Region.

Sustainable and Healthy Communities:

The recommended investment will move more people more quickly using less energy by shifting trips to more sustainable modes and reducing auto congestion. Specifically, the investment will reduce the number of buses required to serve transit users in Scarborough. The recommended investment will also strive to reduce the overall negative impact of travel on the natural environment and quality of life. This will be realized through the reduction of greenhouse-gas emissions, the preservation of green spaces and limited noise and vibration impacts.

Strategic Objectives

To support the strategic outcomes, the recommended investment should achieve the objectives listed in Table 2. These objectives were developed to support the realization of the three Strategic Outcomes and tailored to the Problem and Opportunity Statement.

Table 2: Strategic Objectives

Goals	Objectives
Strong Connections	Improve access to transit
	Increase access to existing economic opportunities in Scarborough and Downtown Toronto and adjacent areas in York and Durham, and support established and emerging employment areas throughout Scarborough, notably the Scarborough Centre area.
	Support a synergistic relationship between transit and city-building
Complete Travel Experiences	Improve travel time and reliability
	Improve comfort and safety
	Build an integrated transportation network
Sustainable and Healthy Communities	Move people with less energy and pollution
	Improve quality of life and public health

3

Investment Options



Introduction

This business case compares a Business as Usual Scenario (which includes projects “in delivery” and assumes reasonable improvements to existing surface transit) with the current Scarborough Subway Extension project. As part of the preliminary design work currently underway there are a number of design refinements that remain under consideration and these will be addressed in other reports.

Options Development

Business As Usual for the horizon year 2041 assumes the delivery of fourteen transit projects identified as “In Delivery” in the *2041 Regional Transportation Plan* with modifications from Ontario’s Transit Plan, announced in April 2019. The Business As Usual scenario also assumes reasonable improvements to existing surface transit, across the region.

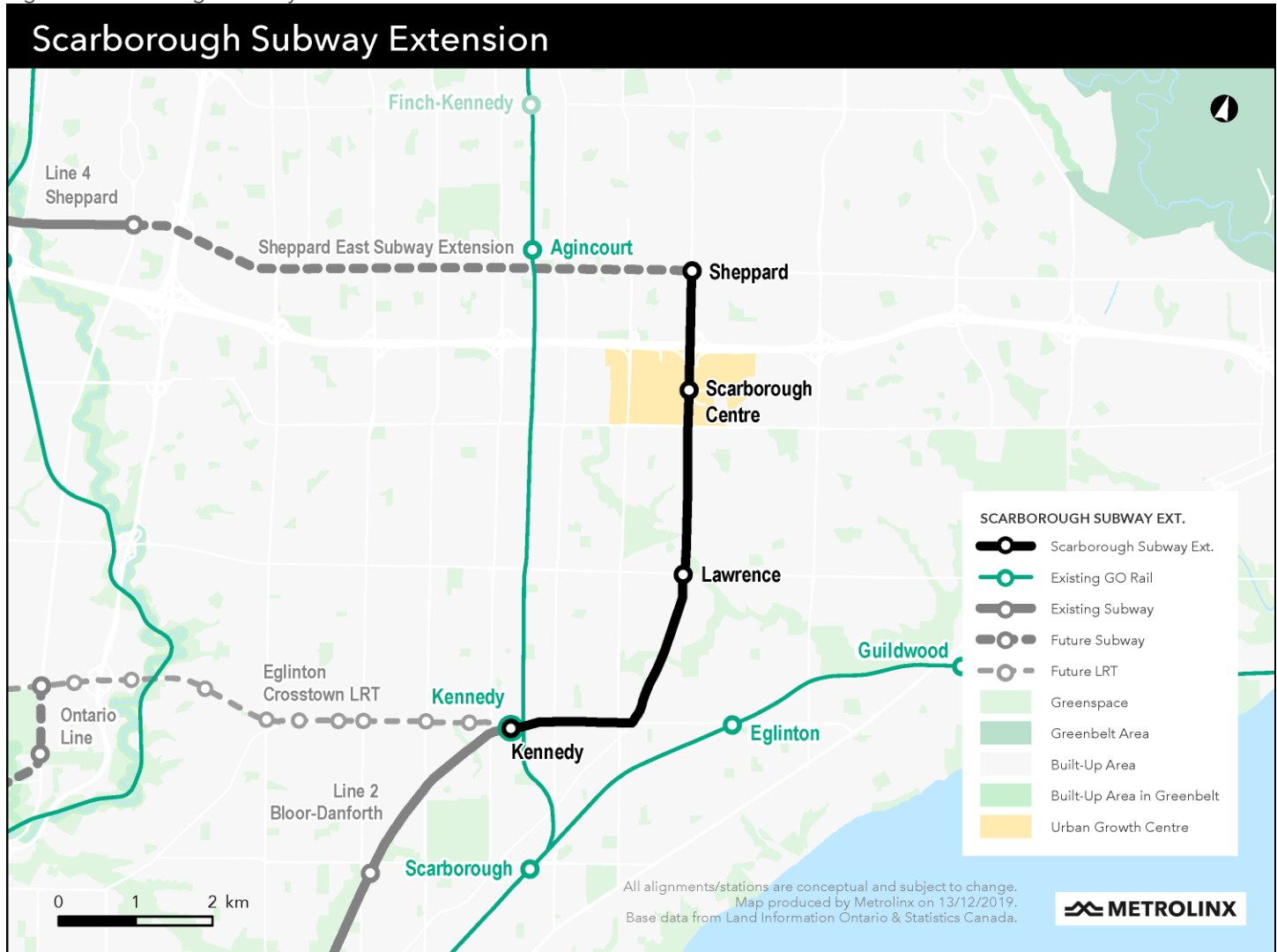
The Business As Usual scenario assumes the Scarborough Rapid Transit (SRT) has been replaced with a modified surface bus network designed to accommodate the passenger loads resulting from the closure of the SRT.

Scarborough Subway Extension

The Scarborough Subway Extension is a continuation of the existing TTC Bloor Danforth Line 2 from the existing terminus Kennedy Station to a planned station at Sheppard Avenue and McCowan Road. As shown in Figure 3, the planned alignment runs eastward from Kennedy Station under Eglinton Avenue, briefly under Danforth Avenue, before traveling north along McCowan Road to Sheppard Avenue.

In the option, the costs of extending the life of the SRT until 2029 is considered, and subsequently its demolition. The line would continue to operate during construction of the extension, and would be closed and decommissioned upon opening of the extension. Costs for continuing operating of the SSE, including life extension works needed, as well as demolition costs are included in this option.

Figure 3 Scarborough Subway Extension



The project includes three stations at Lawrence and McCowan, Scarborough Centre (McCowan north of Ellesmere Road), and Sheppard and McCowan. It also includes larger bus terminals at Sheppard and McCowan and at Scarborough Centre, with the latter terminal serving multiple carriers (TTC, GO, and Duham Region Transit).

Sheppard and McCowan Station (East of McCowan Road)

- Off-street centre platform terminal station, north of Sheppard Avenue East, east of McCowan Road
- Accommodations for terminus station operating requirements
- 19-bay TTC bus terminal on northeast quadrant of Sheppard Avenue East and McCowan Road intersection, above tunnel/station
- Taxi and accessible passenger pick-up and drop-off spaces
- Passenger Pick-up and Drop-off facility

- Spaceproofing for future Line 4 Extension (Sheppard Subway) non-revenue connecting track in special trackwork area south of Sheppard Ave East and provisioning for future passenger transfer between Line 4 and Line 2 at this location
- Main entrance building on northeast quadrant of the McCowan Rd. and Sheppard Ave. E. intersection; and a possible second entrance location

Scarborough Centre Station (on McCowan Road, north of Bushby/Triton)

- Side platforms, below McCowan Road under northbound lanes
- Accommodations for inline station requirements
- 16 bay TTC bus terminal
- 7 bay GO Transit bus terminal, including 1 bay for Durham Region Transit (DRT)
- Taxi and accessible passenger pick-up and drop-off spaces
- Primary entrance on McCowan Road; secondary entrances to be determined through Transit Oriented Development Program

Lawrence and McCowan Station (On/west of McCowan Road)

- Side platforms, straddling Lawrence Avenue East
- Accommodations for inline station requirements
- 4-bay bus terminal on southwest quadrant of Lawrence Ave East and McCowan Road intersection
- No passenger pick-up and drop-off (PPUDO) or commuter parking
- Short-turn loop on Hydro One corridor for the 54 Lawrence East bus route
- Entrances on northwest (westbound bus transfers/walk-ins) and southwest (eastbound bus transfers/walk-ins) quadrants

Kennedy Station Pocket Track/Transition Section

The Kennedy transition section extends roughly 550 metres from the east side of the GO Transit Stouffville rail corridor to Commonwealth Avenue and will include special track work and a pocket track to enable every second subway train to short turn to suit ridership demand and minimize fleet requirements, as well as lower operating costs.

Emergency Exit Buildings

A total of eight emergency exit buildings (EEBs) will be constructed along the alignment.

Summary of Assumptions Used in this Business Case for Analysis and Travel Demand Modelling

In order to develop the business case evaluation and undertake the modelling and analysis that support it, a number of assumptions were made with respect to future conditions (see Table 3). These are consistent with the standard assumptions generally applied to Metrolinx studies and are inferred from both policy and observed trends.

Table 3: Summary of Assumptions

	2041 Assumption (Source)
City of Toronto Urban Structure	City of Toronto Official Plan, Maps 2,13-20
Population and Employment	Expanded Market Land Use based on 2011 Census (Statistics Canada) and existing development applications
Base Rapid Transit Network	2041 Regional Transportation Plan "In-Delivery Network" with updates from Ontario's Transit Plan (Ontario Government, 2019)
Fare Structure	2018 TTC-level fare at all GO stations within City of Toronto Boundaries 2018 Double-Discounted Fare GO/TTC 2018 TTC fare on all TTC routes (including the projects herein evaluated) 2018 Distance-Based GO fare structure, except within City of Toronto 2018 Ride To GO fare discount YRT/GO
GO Network	GO Expansion Full Business Case, 2019
Surface Transit Network	Surface transit network assumptions were taken from bus scenarios developed by TTC for replacement of the Scarborough Rapid Transit, and for the introduction of the Scarborough Subway Extension. Additional information provided by Durham Region Transit and GO Transit
Travel Behaviour Model	Greater Golden Horseshoe Model v4

4

Strategic Case



Infrastructure
ONTARIO

 **METROLINX**

Introduction

The Strategic Case summarizes the performance of the options against the identified strategic objectives to indicate if the investment addresses the Problem Statement and the goals of the *2041 Regional Transportation Plan*. Criteria were developed and selected to evaluate each option's ability to meet the objectives and support the realization of the strategic outcomes.

This chapter will be structured around three outcomes consistent with the Problem Statement chapter, as follows:

1

STRONG CONNECTIONS

Assessment of how the options would improve people's mobility and access to opportunities and destinations.

2

COMPLETE TRAVEL EXPERIENCES

Review of how the options would allow people to travel faster, more comfortably, more conveniently and more reliably.

3

SUSTAINABLE AND HEALTHY COMMUNITIES

Examination of how the options would support sustainable travel patterns and public health.

OUTCOME 1: STRONG CONNECTIONS

BENEFIT 1: Bring rapid transit closer to Scarborough residents

The SSE extends Line 2 about 8 km east and then north of the existing terminus at Kennedy Station, thus improving subway access for residents in Scarborough compared to Business As Usual.

More than 38,000 people are projected to live within 800 metres (approximately a ten-minute walk)⁵ of the new stations in 2041. Findings are summarized in Table 5.

The SSE will serve both existing residents and future residents at under-construction and planned developments as the alignment passes through Scarborough communities. Table 4 shows the forecasted 2041 AM peak hour ridership at the three new stations.

Table 4 Boardings by Station AM Peak (1hr) 2041 (both directions)

Station	Eastbound Boardings AM Peak (1hr)	Westbound Boardings AM Peak (1hr)	Total Boardings AM Peak (1hr)
Lawrence and McCowan	900	2,900	3,800
Scarborough Centre	1,500	3,600	5,100
Sheppard and McCowan	-	5800	5,800

Table 5: "Bring rapid transit closer to Scarborough residents" Summary

Criteria	Scarborough Subway Extension
How many people would gain walking distance access to rapid transit? Projected 2041 residents within a 10-minute walk of the line who wouldn't have walking distance access to Rapid Transit under the Business As Usual scenario	38,000 people
How many new users people will use the SSE? 2041 GGHm v4 outputs	52,000 boardings by new users daily

⁵ All metrics related to walking distance access were calculated using an 800m radius buffer (as the crow flies distance) around stations, where an 800m walk is considered to take approximately ten minutes at the standard average walking speed (5 km/hour).

OUTCOME 1: STRONG CONNECTIONS

BENEFIT 2: Increase access to existing economic opportunities and support the important employment centre at Scarborough Centre

The Scarborough Subway Extension extends Line 2 and increases access to Downtown Toronto (including connections to Line 1) and all points along the Bloor Danforth corridor when compared to the Business as Usual. Kennedy Station on Line 2 is a connection point with the Crosstown LRT serving the Eglinton Corridor and GO Transit Stouffville line providing a direct connection with Toronto's Union Station. SSE riders will have a faster ride to all points along Line 2 (including Kennedy) when compared with the BAU scenario.

34,000 jobs are projected to be located within a 10-minute walk from the SSE stations in 2041. Jobs within proximity to rapid transit are attractive to transit users from across the city, this is a positive for both employees and employers.

Projections for employment density in the area served by the Scarborough Subway Extension are illustrated in Figure 4 below. Table 7 summarizes the economic benefits achieved by connecting these station areas to the subway network.

Station at Sheppard and McCowan

The Sheppard and McCowan station area, while home to existing retail and car dealership uses, could transform to a more urbanized condition subject to municipal approvals. Beyond the immediate station area, but in relatively close proximity 500m -2500m, are employment areas along Commander Boulevard Milner Avenue and Nugget Avenue. These areas feature a range of industrial, office and other commercial uses, and the nature and intensity of uses will likely respond to the introduction of improved transit. Again, any land use changes in these area would be dependant on market conditions and subject to municipal approvals.

Sheppard can be expected to serve as the connection point for those accessing jobs further to the north, including York Region and employment areas along Sheppard. These jobs would be accessed via bus connections that would be provided at the station. The SSE station at this location would help spur the transition to a more urbanized condition, and provide greater connectivity (via shorter bus connections) to the employment area within the access shed.

Station at Scarborough Centre

Scarborough Centre stands out as an area where employment density is considerable.

Findings in the City of Toronto's most recent (2018) Employment Survey highlight the importance of this area. Employment in Scarborough Centre totaled 17,980 jobs in 2018, comprising 1.2% of the City's total. Statistics from 2017 to 2018, showed 770 additional jobs, representing a 4.5% increase for the Centre.

Scarborough Centre is also the transit gateway to the employment and educational destinations of Centennial College's Progress Campus (13,250 students and 2,300 staff and faculty) and the University of Toronto Scarborough Campus (more than 13,000 students, 1,000 full time staff and faculty), which are served by bus connections. The SSE station at Scarborough Centre would be within close proximity to the employment area at Scarborough Centre and allow for shorter bus connections to these academic institutions than under BAU.

Station at Lawrence and McCowan

A dominant feature of the station at Lawrence and McCowan is the presence of the Scarborough Health Network General Hospital. The hospital is a major employer in Scarborough with more than 2,000 employees and 500 volunteers. It provides a range of inpatient services and offers close to 300 beds. The SSE will provide residents across Scarborough and Toronto with a seamless connection to this important health care facility. Within walking distance of the station area are a mix of institutional, commercial, and residential uses. The SSE station at Lawrence would provide rapid transit connectivity to these employers.

Figure 4 2041 Employment Density

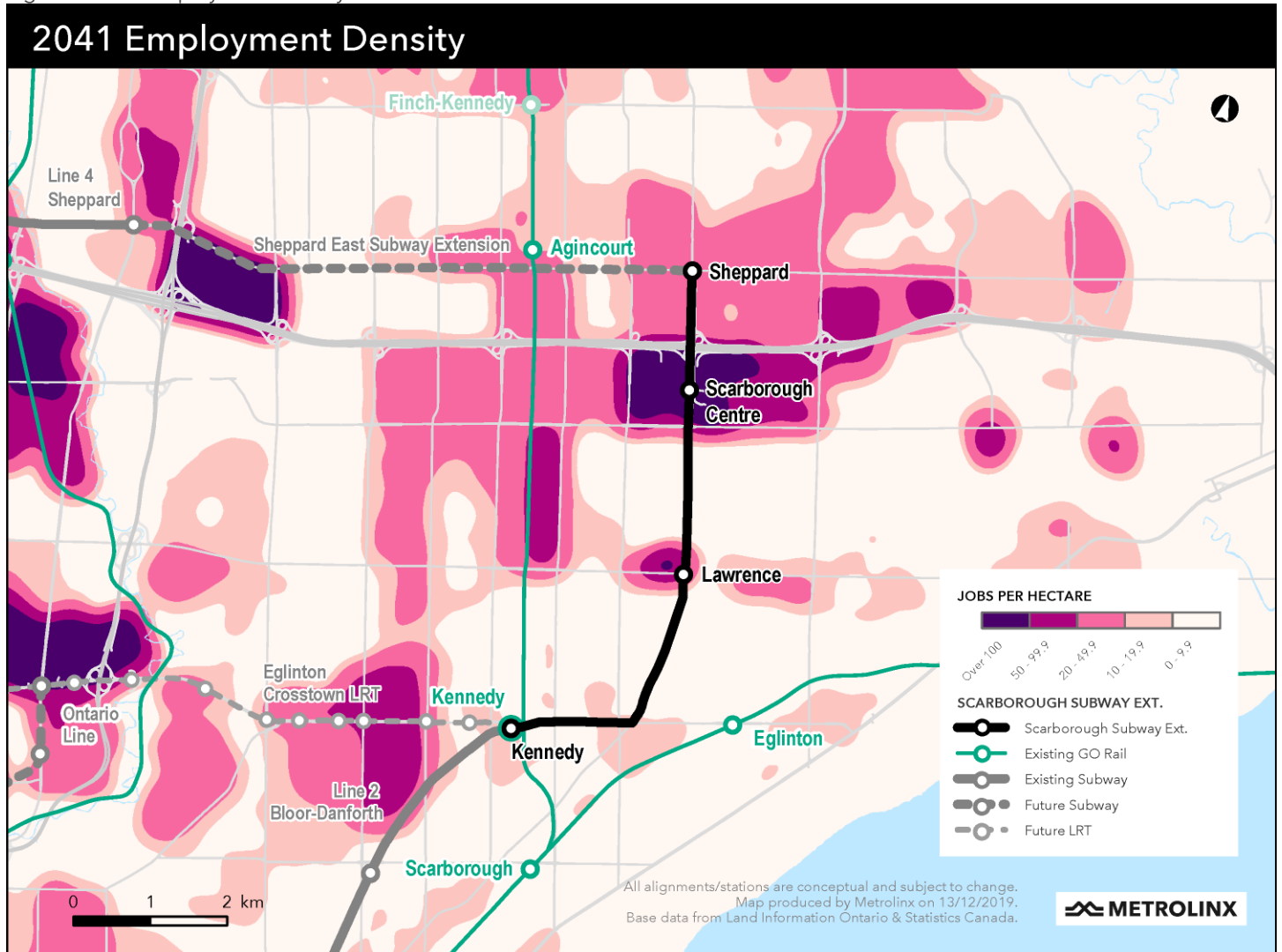


Table 6: "Increase access to existing economic opportunities and support the important employment centre at Scarborough Centre" Summary.

Criteria	Scarborough Subway Extension
<p>How will the option serve areas of planned employment growth?*</p> <p>* GGHm v4 outputs</p>	<p>34,000 projected jobs within a 10-minute walk of the extension</p>
<p>How does the line increase access to employment centres along the corridor and the wider Scarborough area?</p>	<p>The upgraded station at Scarborough Centre will allow walk out access to existing and planned employment centres in the close proximity with transit connections to the Progress employment area as well as the University of Toronto Scarborough Campus.</p> <p>New stations will provide walk out and transit access to employment areas, the Scarborough Health Network - General Hospital and provide connections to transit on Lawrence East and Sheppard to serve employment centres further afield.</p>

OUTCOME 1: STRONG CONNECTIONS

BENEFIT 3: Support planned development in Scarborough

For the extension to attract ridership, it needs to be built where people reside and jobs are located today, and where there is potential for growth in the future. Transit infrastructure has been found to encourage development activities in all categories of use, generating further economic benefits for communities and the region. This growth and development, in turn, generates more transit ridership.

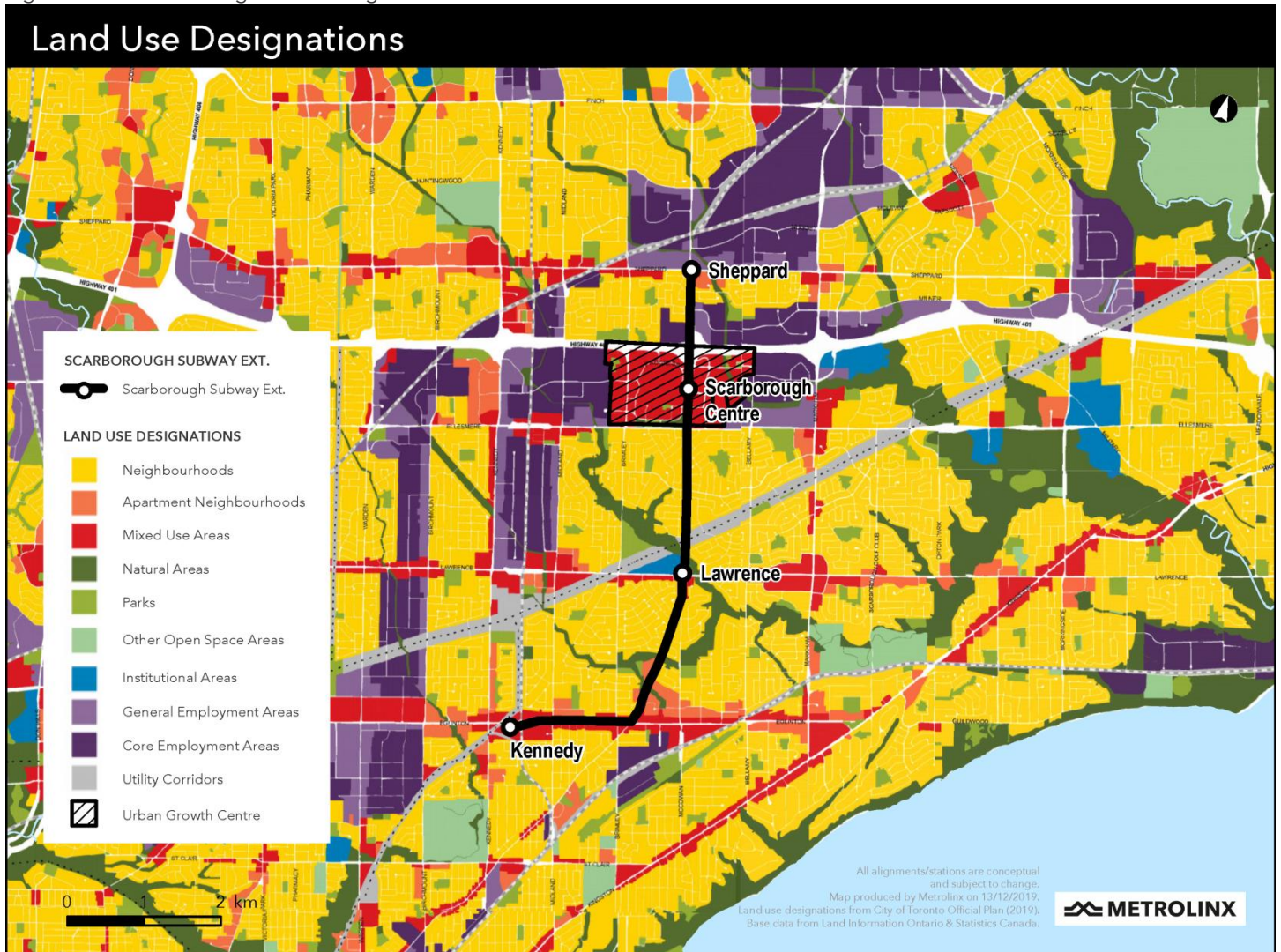
The Scarborough Subway Extension connects two Urban Growth Centres (UGC) : Scarborough Centre and the Downtown Toronto UGC to other areas in the region by providing a rapid transit connection. Figure 5 below shows the land use designations around the SSE corridor and notes where the Scarborough Centre UGC is located.

Within the City of Toronto, the major policy guiding development is the *Toronto Official Plan* (the "Official Plan") which contains policies that direct growth in areas identified as "Avenues", and "Centres".

The Secondary Plan for Scarborough Centre has a strong focus on transportation and transit. It reads in part; "The Secondary Plan is based on the provision of higher order transit facilities and an extensive network of local and regional bus services. A high degree of transit usage will be encouraged by optimizing the access between land uses and the transit system." Additionally, the Secondary Plan emphasizes "a compact, high density, transit-oriented development pattern, based upon a high standard of urban design".

The increased levels of rapid transit accessibility can be expected to strengthen the many communities of Scarborough. The Stations at Sheppard and McCowan, Scarborough Centre (at Ellesmere), and Lawrence and McCowan are all expected to attract a significant portion of their ridership from bus users. Connecting express bus services on Finch and Steeles with SSE stations further extends the impact of the Scarborough Subway Extension.

Figure 5: Land Use Designations along SSE



Population projections for the area served by the Scarborough Subway Extension suggest that Scarborough Centre will continue to evolve into a mixed use community with densities above 200 people per hectare (pph). **Error! Reference source not found.** shows that the residential development is expected to be centered around Scarborough Centre station.

The extension of a rapid transit line will improve the speed, frequency and reliability of transit service in the study area. Combined, these will enhance the overall travel experience for customers and make transit a more attractive travel mode.

Outcome 2: COMPLETE TRAVEL EXPERIENCES

This section will compare the options' performance on three objectives that support the realization of Outcome 2 "Complete Travel Experiences":

4

Improve Travel Time and Reliability

Do the options make transit travel faster and more dependable?

5

Build an Integrated Transit Network

Do the options provide a seamless travel experience?

OUTCOME 2: COMPLETE TRAVEL EXPERIENCES

BENEFIT 4: Improve Travel Time and Reliability

Moving people quicker and offering reliable travel is at the heart of the *2041 Regional Transportation Plan*. The Scarborough Subway Extension brings rapid transit closer to where transit users live and work compared to BAU. This means that for some, some or all of the time spent on buses, in mixed traffic, under BAU, is replaced with time spent on a subway train; travelling faster and in better conditions.

For Toronto, SSE results in 575, 000 person-minutes travel time saving daily on transit trips. To better understand the significance of such benefits on transit users, the below example illustrates the time savings experienced at an individual scale:

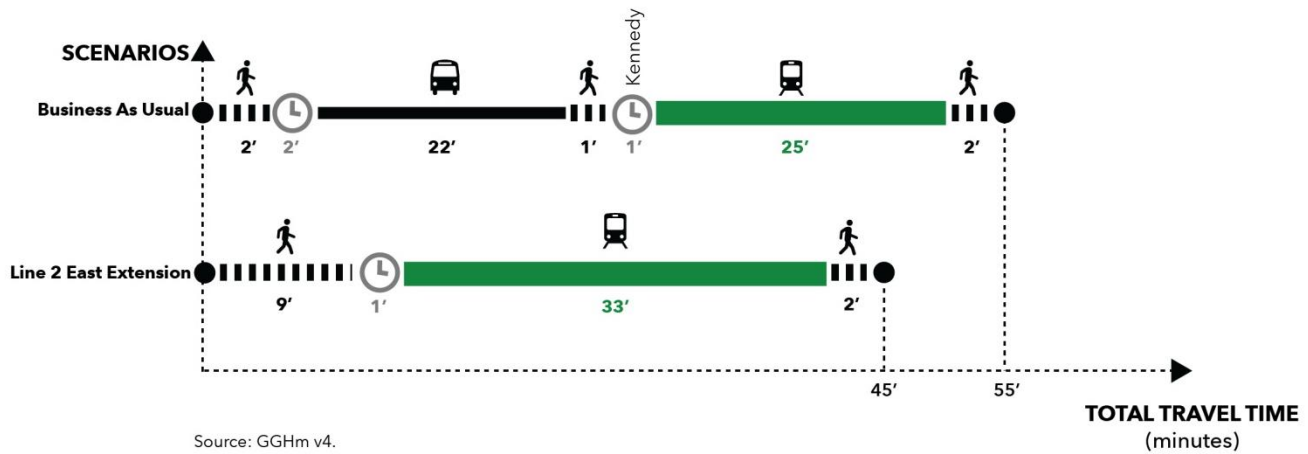
Passengers walking to Access the Subway at a New Station

Scarborough Centre is a maturing mixed use community, with a large number of existing residents and even more planned to call it home. A resident who travels to Yonge and Bloor will save significant time on their journey. Without the SSE in place they would spend 22 minutes on the bus portion of their journey to connect with Line 2 at the Kennedy Station, and would have a total journey time of 55 minutes. With the SSE in place they will have direct access to the subway. In this example, we are imagining a resident in one of the residential complexes on Borough Drive, including a 9 minute walk to the station, they would be at Yonge and Bloor in just 45 minutes with the SSE. Those that live closer to the station would save even more time.

Figure 6 Comparison of Trip Times for Scarborough Centre Resident.

How would travel to Downtown Toronto be affected?

Example: a trip from Scarborough Centre to Bloor/Yonge

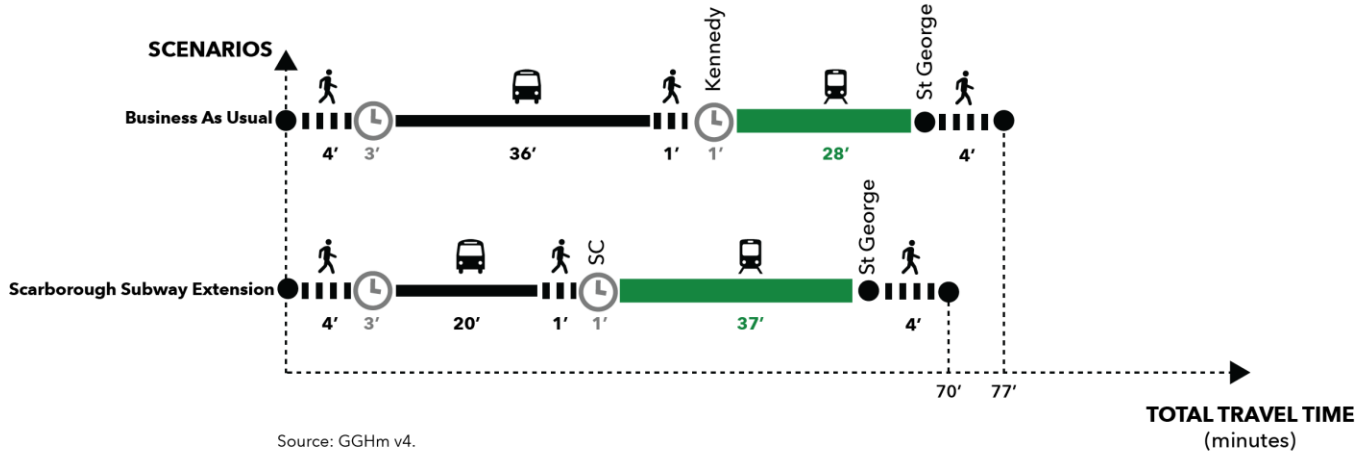


Similar time savings are available to those who live in other areas of the City of Toronto, but work at Scarborough Centre. With three new stations, the Scarborough Subway Extension would provide one-seat rides to numerous origin and destination pairs, as discussed in Outcome 1 of this chapter. Of course, the Scarborough Subway Extension also makes additional trips possible with a single transfer for transit riders living in proximity to a new station.

For a second example, we consider a transit user making the journey between University of Toronto's Scarborough Campus and Varsity Stadium at the school's downtown Campus via the St. George Subway Station. In the Business As Usual scenario, the transit rider could use the TTC's express bus and have a 36 minute journey before transferring to Line 2 at Kennedy Station. With the SSE in place, the same user could take a 20 minute bus trip to Scarborough Centre and transfer to Line 2 there. Even with the longer time on the subway they would still have a 7 minute savings in total travel time due to shorter travel times on the bus.

Figure 7 Comparison of Trip Times between University of Toronto Scarborough and St. George Campuses

How would travel between UofT Campuses be affected?
 Example: a trip from UTSC to Varsity Stadium



With the expected bus network that would complement the SSE, thousands of residents across Scarborough would be a short bus ride away from a Line 2 station, rather than having to make an extended trip to Kennedy Station. These residents will have a one transfer ride to all points along the Bloor - Danforth corridor. With Line 2 interchanging with both branches of the Line 1 subway, the Ontario Line, as well as Line 5 and the GO Rail Stouffville corridor Scarborough residents have improved access to destinations to served by Toronto’s rapid transit network.

The subway is also expected to serve residents in adjacent areas of York and Durham Region, providing for improved access to points within Scarborough and beyond.

For regional travelers, the seamless link provided by an extended Line 2 means quick, convenient and reliable access to the GO Transit and Durham Regional Transit bus networks at Scarborough Centre. Intercity and specialty bus operators are expected to continue to serve this important transit hub. Scarborough Centre is expected to be only a transfer point between regional routes, but also a destination for travelers.

Crowding Relief - Improving the Customer Experience

In the BAU, the volume of buses needing to be operated to replace the SRT in Scarborough is significant. These buses are competing for space with other vehicular traffic on many north-south corridors. Passengers on these buses are prone to delays from weather, road construction, collisions as well as general traffic congestion. The SSE in contrast provides a reliable service that is generally immune from disruptions at the surface level.

Transit users experience an improved transit experience on subways compared to buses. Due to lower levels of comfort and reliability, time spent travelling on a bus is perceived to be longer. The introduction of the SSE will mean not only a reduction in journey time, but an additional perceived travel time savings due to an improvement in journey quality.

Crowding relief on buses accessing Kennedy station will be realized as the bus network is adjusted to better distribute routes to closer subway stations. This benefit will be realized not only by the passengers on buses that are accessing a closer subway station, but by passengers on buses that continue to access Kennedy Station who should experience fewer delays getting in and out of the terminal.

Table 7: Improved Travel Time and Reliability

Criteria	Scarborough Subway Extension
How will the option affect travel time to Yonge and Bloor from Scarborough Centre ?	10 minute savings
What are the resulting total travel time savings daily? * total travel time savings for all transit trips in Toronto, morning peak hour (perceived time). GGHm v4 outputs.	575,000 person-minutes

OUTCOME 2: COMPLETE TRAVEL EXPERIENCES

BENEFIT 5: Build an Integrated Transportation Network

The Scarborough Subway Extension is designed to run as part of the existing transit network with a TTC fare. Connection with existing Line 2 will be seamless with trains running from the extension directly onto the existing subway line.

The subway will create or upgrade connections with the transit network. At Scarborough Centre the functioning of the existing multi-modal hub will be strengthened. This hub will include access to the GO Bus Network in particular the cross regional Highway 401 Services. Scarborough Centre, which currently acts as a GO Transit hub, can be expected to have an increasing role as service frequency increases and the network expands.

Scarborough will also be the interchange point between the subway and Durham Region Transit. These services are expected evolve as identified in the Durham - Scarborough BRT Initial Business Case.

At the Sheppard and McCowan station, it is expected that the Scarborough Subway Extension will ultimately provide an interchange with an extension of the Sheppard Subway (Line 4). Modeling suggest riders would use the extended Line 4 to connect with the Line 2 extension. It would introduce flexibility and redundancy into the network that will serve the customer as well as providing options to the operator to reroute customers during planned or unplanned service disruptions..

SSE will also provide a connection with a number of bus services operated by the TTC and York Region Transit.

The Toronto Transit Commission have been developing an Express Bus Network to make trips across the City of Toronto faster and more reliable. The Scarborough Subway Extension is expected to interface with a number of these priority services. At Scarborough Centre there are express routes to Centennial College Progress Campus and along Ellesmere to University of Toronto Scarborough Campus. Lawrence and McCowan Station will have connections with express bus services on Lawrence Avenue. At Sheppard and McCowan Station, there are expected to be connections not only to Sheppard Express buses, but also the Finch and Steeles express bus network. The Express Bus Network connections at SSE stations will bring together two important initiatives designed to upgrade the transit experience for riders.

Surface Integration

Integration with the surface route network is essential to ensure convenience for passengers and to avoid shifts to less sustainable travel modes. The Scarborough Subway Extension provides new bus to subway connections at the newly constructed stations that would replace bus to subway connections further west/south.

The most significant transfer stations between surface routes and the subway are at Sheppard and McCowan and at Scarborough Centre. Sheppard and Mc Cowan as the new terminus of Line 2, will support a bus network that serves a larger portion of north Scarborough and adjacent areas of York Region. Scarborough Centre is expected to attract riders from areas south of Highway 401, accessing high volume destinations including the Progress Campus of Centennial College and University of Toronto Scarborough Campus, and will also attract riders from Durham Region. The Lawrence and McCowan station has somewhat lower transfer volumes but will serve as an important connection point for residents along the Lawrence corridor. See Table 8 for projected 2041 daily transfers from buses onto SSE.

Table 8: 2041 Daily Transfers from Bus (source: GGHm v4)

Station	Daily Bus Transfers to SSE
Lawrence and McCowan	19,700
Scarborough Centre	37,700
Sheppard and McCowan	46,000

Unauthorized Park and Ride activity at Scarborough Centre has been included in Daily Transfer from Bus estimates at Scarborough to reflect the likely scenario with increased enforcement.

Table 9: "Build an Integrated Transportation Network" Summary

Criteria	Scarborough Subway Extension	
How well does the option connect with existing rapid transit?	Line 2	Seamless through connection at Kennedy
	Line 1	at Bloor and St. George stations
	Stouffville GO	at Kennedy station
	Lakeshore East GO	at Danforth GO / Main TTC stations
	Eglinton Crosstown (Line 5)	at Kennedy station
How well does the option connect with planned rapid transit?	Line 4 Sheppard Subway Extension	at Sheppard and McCowan station
	Durham-Scarborough BRT	at Scarborough Centre station
	Ontario Line	At Pape Station
How attractive are transfers with transit along the extension corridor?	158,000 daily transfers between buses and the Scarborough Subway Extension	

Outcome 3: SUSTAINABLE AND HEALTHY COMMUNITIES

The addition of a new rapid transit service will support the development of sustainable communities and travel patterns along the corridor.

This section will compare the options' performance on three objectives that support the realization of Outcome 3 "Sustainable and Healthy Communities":

6

Move People with Less Energy and Pollution

Do the options lead to a reduction in energy use for transportation?

7

Improve Quality of Life and Public Health

Do the options create conditions for healthy lifestyles and communities?

OUTCOME 3: SUSTAINABLE AND HEALTHY COMMUNITIES

BENEFIT 6: Move People with Less Energy and Pollution

Transit moves people more efficiently and sustainably than individual motorized vehicles, meaning it reduces the space and cost of getting people to their destinations. That is why a key objective of the SSE is to shift as many bus and auto trips as possible to subway, to relieve road congestion and to minimize energy consumption in the process. Subways make use of electric trains, which will reduce the amount of energy spent per trip and per passenger compared to automobile and current bus modes. Electric buses on the TTC network will likely positively impact energy use in the BAU - but this has not been reflected in the analysis. Travel demand forecasting shows that building Scarborough Subway Extension could result in 12,000 net new transit riders during the morning peak hour, compared to the BAU scenario with a replacement bus network in place.

Vehicle Kilometres Travelled (VKT) measure the total distance travelled by cars, capturing traffic volumes as well as length of trips. A decrease in VKT in the Toronto Region gives an indication of congestion and Greenhouse Gas emissions reductions. The SSE is estimated to reduce Toronto’s total number of VKT during the morning peak hour by 30,000, compared to Business As Usual (Table 10).

Table 10: “Move People with Less Energy and Pollution” Summary

Criteria	Scarborough Subway Extension
What impact will the option have on taking cars off the road?* <small>*reduction in total Vehicle Kilometres Travelled during morning peak hour in Toronto. Source: GGHm v4 outputs.</small>	30,000 km compared to BAU
How many more people will use transit during the morning peak hour compared to BAU?* <small>* Source: GGHm v4 outputs.</small>	12,000 net new transit riders

OUTCOME 3: SUSTAINABLE AND HEALTHY COMMUNITIES

BENEFIT 7: Improve Quality of Life and Public Health

The new investment should reduce negative impacts to health and create appropriate conditions for healthy habits as compared to Business As Usual. Building transit close to people and jobs encourages transit usage, as well as walking as an access mode, rather than driving. A shift in travel mode to active transportation or transit reduces the amount of transportation-related Greenhouse Gases (GHG) emissions. Such a shift has the added social benefit of increasing physical activity among the population with a positive effect on general health. Travel demand projections show that building the Scarborough Subway Extension could result in a yearly decrease in auto-generated GHG emissions of more than 10,000 tonnes of CO², compared to BAU.

Beyond healthy commuting practices, new rapid transit can be leveraged to encourage the development of more active and healthy commuting options. Walking and cycling activity is highly dependent on convenience, density, built form and supportive infrastructure.

The Scarborough Subway Extension reestablishes higher quality transit service to Scarborough Centre. Such transit is critical to seeing mixed use area to intensify in a manner that is not only supportive of transit use and but also encourages walking and cycling.

See Table 11 for summary.

Table 11: "Improve Quality of Life and Public Health" Summary

Criteria	Scarborough Subway Extension
What is the option's impact on air quality and auto-related emissions?*	- 10,000 tonnes of auto-generated GHG emissions yearly compared to BAU
How does the option impact the public realm?	Tunnelled alignment along 7.4 kilometres in built-up presents minimal challenges and impacts to public realm.
How do the options support walkable communities?	Scarborough Subway Extension brings rapid transit to dense and/or intensifying auto-centered areas, thus encouraging active modes for access.

Strategic Case Summary

Table 12: Summarizing the Strategic Case

OUTCOME	OBJECTIVE	SCARBOROUGH SUBWAY EXTENSION
Strong Connections	Bring rapid transit closer to Scarborough residents	The extension to Line 2 is able to attract more than 105,000 daily boardings at the extension stations and provides walk in access to 38,000 people
	Increase access to existing economic opportunities and support the important employment centre at Scarborough Centre	The line is characterized by its significant improvement of access to Scarborough employment opportunities for Toronto residents (+34,000 jobs within a 10 minute walk from a SSE Station compared to BAU)
	Support planned development in Scarborough	The line serves Scarborough Centre and adjacent communities in Scarbrough.
Complete Travel Experiences	Improve travel time and reliability	The line generates 575,000 person-minutes of daily travel time savings compared to BAU by bringing rapid transit closer to where people live and work.
	Improve comfort and safety	The Scarborough Subway Extension reduces the amount of time transit users spend on buses that at times may be crowded or moving slowly in mixed traffic. Crowding at the existing Kennedy terminus will be reduced.
	Build an	The SSE represents a seamless extension of Line 2 which

**integrated
transportation
network**

provides access to the existing and future connections with Toronto's other rapid transit lines. It integrates with express bus routes along the corridor.

**Improve quality
of life and
public health**

The introduction of rapid transit to auto-oriented areas encourages healthier transportation habits. Construction of this significant impact has a potential for disruption, although the underground alignment will likely minimize impacts. Careful design will be required for at grade elements adjacent to sensitive features.

5

Economic Case



Introduction and Assumptions

The Economic Case is one of two chapters focused on the rationale for pursuing an investment (the other being the Strategic Case). While the Strategic Case evaluates options based on a project specific policy/plan oriented evaluation framework, the Economic Case determines if the expected benefits of this investment exceed the costs required to deliver it, and articulates the overall benefit to society of pursuing each investment option.

This analysis considers the magnitude of costs and benefits for a 60-year lifecycle (the evaluation period) as well as:

- Benefit Cost Ratio (BCR) - the net benefits divided by the net costs, which is used to indicate benefits that are realized per dollar spent
- Net Present Value (NPV) - the net benefits minus net costs, which is used to indicate total net benefits to the region

Assumptions set out in Table 13 are provided by the Metrolinx Business Case Guidance.

Table 13: Economic Case Assumptions

Input	Impact Type
Analysis Approach	All benefits/costs are expressed in real terms in 2020\$. Appraisal begins in 2020. It includes ten years of construction (2020-2029), with an opening year of 2029, and 60 years of operation (2029-2088) for the Scarborough Subway Extension.
Evaluation Period	60 years
Economic Discount Rate	3.5%
Real Inflation	0%
Value of Time (VoT) (2020\$)	\$18.42/hour
VoT Growth Rate	0%
Auto Occupancy	1.077
Auto Operating Cost Savings (2020\$)	Total operating cost: \$0.67/km Marginal operating cost: \$0.09/km
Decongestion Benefit (2020\$)	0.01 hours/vehicle-km (peak) 0.0013 hours/vehicle-km (off-peak)
Safety Improvements (Accident Mitigation) (2020\$)	\$0.10/km
GHG Value (2020\$)	\$0.01/km

Other assumptions:

- Property costs do not require rehabilitation
- Fleet costs have been scaled based upon line and train lengths
- Fleet cost growth per year is 1% real (same as construction)
- Rehabilitation and refurbishment are assumed to continue for the full 60 year evaluation period, but no terminal value is assumed

- Transit-Oriented Development is not reflected outside the growth assumptions in the land use model in the costs or benefits

Costs

The costs or 'required investment' to deliver the Scarborough Subway Extension are divided into the following categories:

- **Capital Costs:** fixed one-time costs incurred during the implementation of the investment. The capital costs include the labour and materials required for construction; as well as contingency. Property acquisition costs are excluded from the economic analysis.
- **Operating and Maintenance Costs:** ongoing costs required to operate the service, provide day to day maintenance.
- **Rehabilitation Costs:** Complete major rehabilitations to restore infrastructure to ensure operational conditionals throughout the project's lifecycle.

The capital, operating, maintenance and rehabilitation costs for the entire lifecycle of the Scarborough Subway Extension investment are listed in Table 14 below. These costs are incremental to the BAU scenario and have been discounted based on the approach defined earlier in this chapter.

All cost estimates include contingency in the range of 20%-30% (depending on its level of design) to cover unknown risk events. The cost estimates include a range of 9%-18% uplift to individual cost items in order to balance optimism bias. Optimism bias is the tendency of individuals to expect better than average outcomes. In the context of infrastructure projects, optimism bias can lead to underestimation of costs and project duration.

Table 14: Summarizing Economic Costs

Economic Costs (\$2020 NPV)	Scarborough Subway Extension
Capital Costs*	\$ 4,210M to \$4,668 M
Rehabilitation Costs*	\$421 M to \$469 M
Operating and Maintenance Costs	\$906 M
Total Present Value of Costs	\$5,537 M to \$6,043 M

* Cost estimates reflect a range representing low to high forecasts to account for optimism bias at the early stages of project design

User Impacts

User Impacts are a key area of analysis for transport investments. They capture how the investment will improve the welfare of transport network users or travellers. This includes both Scarborough Subway Extension riders and all other transportation network users since both groups benefit from travellers switching to transit from other modes.

The Scarborough Subway Extension investment will impact the following groups:

- **Existing Subway Passengers:** The investment will reduce the generalized cost of travel below the current cost of travel by expanding the subway network across Toronto. This investment will provide a direct benefit to existing users, specifically bus users who have new opportunities to shift their journeys from buses to the subway. As noted, the Business as Usual scenario does not include the existing Scarborough Rapid Transit, so these users are considered as bus users in this analysis.
- **New Subway Passengers:** The investment will reduce the generalized cost of travel on transit. This will attract new users to transit that used to travel via other modes. These new users will receive a benefit equal to the difference in what they were willing to pay and the new generalized cost of travel on transit.
- **Auto Users:** The investment will attract some auto users off of local roads; this will generate congestion reduction benefits when compared to the business as usual for the remaining auto users.

All user impacts included in this analysis, which is summarised in Table 18, are 'net impacts' across the investment, that is, the a sum of benefits and disbenefits to users.

Table 15: Communicating Present Value of User Benefits

User Type*	Impact Type (\$2020, NPV)	Scarborough Subway Extension
Transit	Travel Time Benefits	\$1,086M
	Crowding	\$1,515M
Automobile	Congestion Reduction	\$ 154M
	Auto Operating Cost Reduction	\$ 97M

*Please note, the benefits of extending operations of the SRT are not included

External Impacts

The Scarborough Subway Extension would also generate external (also known as 'societal') impacts based on wellbeing and environmental impacts. The benefit categories are health, environmental GHG emission reductions, and safety (accident reductions on the road network).

External impacts are estimated through the mode changes generated by the proposed investment. If travellers move from a less efficient mode to subway then there is an impact equivalent to the externalities per trip on the new subway, minus the externalities on their previously used mode. These benefits are calculated based on the change in automobile Vehicle Kilometres Travelled (VKT).

Table 16: Communicating Present Value of External Impacts

Impact Type	Impact*	Scarborough Subway Extension (\$2020, NPV)
Health & Safety	Accident Reduction	\$ 29M
Environment	Greenhouse gas Reductions	\$ 11M

*Please note, the benefits of extending operations of the SRT are not included

Economic Case Summary

The following table summarizes the option's costs and benefits and their overall performance through the Benefit Cost Ratio and the Net Present Value calculation.

Table 17: Summarizing the Economic Case

Impact Type	Scarborough Subway Extension
Total Costs (\$2020, NPV)	\$5,537 M to \$6,043 M
Capital Costs	\$4,210 M to \$4,668 M
Rehabilitation Costs	\$421 M to \$469 M
Operating and Maintenance Costs	\$906 M
Total Impacts (\$2020, NPV)	\$2,891 M
User Impacts	\$2,851M
External Impacts	\$ 40M
Fare Revenue Adjustment	\$ 743M
Benefit-Cost Ratio (BCR)	0.60 to 0.66
Net Present Value (\$2020, NPV)	-\$2,409 M to -\$1,902 M

Notes on Table 20:

1. Cost estimates reflect a range representing low to high forecasts to account for optimism bias at the preliminary design phase of a project.
2. The benefits of extending operations of the SRT are not included
3. It is assumed in this business case that 6 train sets will be purchased at a cost of \$27,234,000 each, measured in 2020\$

Economic Parameters Sensitivity Tests:

The sensitivity tests are focused on uncertainties that have a substantial impact on the business case.

The values of key economic parameters were varied to determine how the options would perform under different circumstances to reflect these uncertainties.

*Using the standard Metrolinx Assumptions BCR = 0.60 to 0.66

Table 18: Sensitivity Analysis

Parameter	MX Assumption*	Tested Value	BCR (Scarborough Subway Extension)
Value of Time Growth Rate			
A parameter used to escalate the Value of Time across the investment lifecycle. Value of Time is a factor used to monetize changes in generalized time to determine the overall welfare benefit to transport network users.	0.0%	0.7%	0.69 to 0.75
Economic Discount Rate			
Over time, the value of a cost or benefit will decrease - as a result, an economic discount rate is applied. The economic discount rate reflects society's timepreference for money.	3.5%	2.5%	0.73 to 0.84
Ridership Growth Rate			
A parameter used to escalate ridership throughout the investment lifecycle.	2%	1%	0.59 to 0.64
		3%	0.62 to 0.67
Operating Cost Growth Rate			
A parameter used to escalate operating costs throughout the investment lifecycle.	1%	0%	0.62 to 0.68
		3%	0.55 to 0.60

These tests noted the following conclusions:

- Ridership growth rate tests had minimal impacts on the BCR and benefits.
- In the scenario where Operating Costs growth rate is 3% over the investment lifecycle, th BCR can reduce to 0.55 to 0.60. Higher operating costs could occur for a range of reasons including increases in maintenance costs for example.
- If the Economic Discount Rate is lower than assumed in the PDBC, the BCR could increase to 0.73 to 0.84

6

Financial Case



Introduction

The Financial Case assesses the overall financial impact of proposed investment options. While the Strategic Case and Economic Case outline how an investment achieves organizational goals and social value, the Financial Case is one of two cases (the other being the Deliverability and Operations Case) that focuses on the requirements to successfully deliver an investment. This includes a review of total revenue (fares) gained and expenditures (capital, operating and maintenance) required over the lifecycle of the investment incremental to the base case scenario. The Financial Case is agnostic with regard to procurement and delivery method but cost estimates are prepared based on a traditional design-bid-build approach.

Assumptions

Table 19 sets out the assumptions used in this Financial Case.

Table 19: Financial Case Assumptions

Parameter	Value
Discount Rate	5.5% (nominal)
Inflation Rate	2%

Capital Costs

The capital cost of building and delivering the proposed investment options forms the largest component of overall project costs. Estimates of probable capital costs were estimated in 2020\$ (see Table 20). They include an allowance for property acquisition, as well as a professional services allowance to account for the completion of designs, procurement activities and support activities during construction. Cost estimates were prepared on a top-down, factor-based parametric approach and should be considered Class 5 estimates.

All cost estimates reflect 30% contingency to cover unknown risk events. The high end of the cost estimates also include an average of 20% uplift to individual cost items in order to balance optimism bias.

Table 20: Capital Costs: Infrastructure NPV (2020\$)

Line Item (\$2020, NPV)	Scarborough Subway Extension
Stations	\$1,110.1 M
Sheppard East Station & Bus Terminal	\$418.4 M
Scarborough Centre Station & Bus Terminal	\$340.3 M
Lawrence Centre Station & Bus Terminal	\$291.2 M
Kennedy Station	\$60.2 M
Running and Ancillary Structures	\$671.1 M
Utilities	\$201.5 M
System Wide Element	\$260.3 M
Indirects	\$671.2 M
Contingency	\$620.6 M
Property	\$216.6 M
SRT	\$230.8 M
SRT Demolition/Decommissioning	\$91.3 M
SRT Life Extension	\$139.5 M
TOTAL	\$3,982 M

Notes on Table 20:

1. Indirects: Includes Professional Services, Taxes, Insurance
2. Contingency: 20%-30% applied based on design completion

Table 21: Capital Costs per Kilometre: Infrastructure NPV (2020\$)

Line Item (\$2020, NPV)	Scarborough Subway Extension
Length (km)	8
Infrastructure Cost per KM	\$497.8 M

Table 22: Capital Cost Summary

Line Item (NPV, 2020\$)	Scarborough Subway Extension
Infrastructure	\$3,982.1 M
Fleet*	\$231.6M
Rehab	\$421.8M
Terminal Value	-\$53.1M
Bus Fleet	-\$7.6M

*It is assumed in this business case that 6 train sets will be purchased at a cost of \$27,234,000 each, measured in 2020\$

Table 23: Capital Costs in \$YOE (Year of Expenditure)

Line Item (Total Cost, \$YOE)	Scarborough Subway Extension
Infrastructure	\$5,497.9 M
Subway Fleet*	\$866.1 M
Rehab	\$3,649.1 M
Terminal Value	\$-2,022.5 M
Bus Fleet	\$-55.7 M

Operating and Maintenance Costs

The operation and maintenance of a new subway will bring additional project costs, over the entire operational lifecycle of the investment. The operation and maintenance of a subway extension will bring additional project costs, over the entire operational lifecycle of the investment. Operating and maintenance costs cover all aspects of operating the subway extension including staffing, vehicle, track and station maintenance, and power. For this extension the NPV (\$2020) of the Operating and Maintenance Costs for the extension has been calculated at \$1.04 B.

Table 24: Operating and Maintenance Costs

Line Item (NPV, 2020\$)	Scarborough Subway Extension
Bus Operating Costs (Savings)*	-119.7 M
Total Operating Costs (NPV \$2020)	\$926.5 M

*Savings on the Bus Network, due to change in Bus Terminus from Kennedy Station to locations closer to bus origin locations in the "Do Something" scenario

There are also operating costs reductions due to the reduced bus requirements generated by the Scarborough Subway Extension. It is important to remember that these savings are associated with the replacement bus network that was identified to replace the Scarborough Rapid Transit for the Business As Usual scenario. Generally there are less bus routes having to access Kennedy Station, as they

having their terminus at a new subway station closer to their origin, and this translates into shorter routes, requiring fewer buses. These reductions combined result in a Net Present Value for bus operating costs of -\$119.7 M.

Table 25: Operating and Maintenance Costs in Financial Terms

Line Item (NPV, 2020\$)	Scarborough Subway Extension
Incremental Project Revenue	\$758.5M

Summary Statistics

The Incremental Network Cost Recovery Ratio and the Return on Investment are presented in Table 28.

Table 26: Summary Statistics

Line Item	Scarborough Subway Extension
Incremental Network Cost Recovery Ratio	0.82
Return on Investment	0.14

Table 27: Summary Financial Case

Financial Case Metrics	Scarborough Subway Extension
Total Revenue Impact (\$2020 NPV)	\$758.5 M
Total Capital Costs (Total Expenditure, \$YOE)	\$7,935.0 M
Total Capital Costs (\$2020 NPV)	\$4,635.5 M
Total Operating and Maintenance Cost (\$2020 NPV)	\$926.5 M
Net Present Value (\$2020 NPV)	-\$4,742.8

7

Deliverability and Operations Case



Introduction

The Deliverability and Operations Case is an analysis of investment delivery, operations and maintenance, service plans and any other issues that may prevent the realization of an option. This includes delivering the project from original concept through to planning, design, environmental assessment, stakeholder engagement, procurement, construction and operations. The Deliverability and Operations Case is one of two cases (the other being the Financial Case) focused on requirements for delivering the investment.

The Deliverability and Operations Case will continue to evolve as Metrolinx advances the management of the project. The following outlines some key aspects of the project based on available information.

Project Delivery

How advanced are the designs for Scarborough Subway Extension?

The Scarborough Subway Extension builds on work undertaken from 2014 to 2019 by the City of Toronto and the Toronto Transit Commission.

A one-stop 'McCowan Express' concept was developed to approximately 100% of tunnel design and 60% of station design. A Transit Project Assessment Process (TPAP) was completed in 2017 for the 1-stop Scarborough Subway Extension, prepared jointly by the Toronto Transit Commission (TTC), and the City of Toronto. A TPAP addendum was completed in 2018 for the relocation of a standalone traction power substation. This addendum was determined to be "Not Significant".

The design for the three stop subway is currently being advanced by Metrolinx in preparation for Treasury Board approvals to start procurement. A TPAP addendum is currently underway for the new stations, including the extension to Sheppard and McCowan, and the scope changes along the original alignment (e.g. revised SCS location, launch shaft at Kennedy and Midland). This addendum will be completed by the Tunnel Contract Request For Proposal release date.

What project and program dependencies exist?

As an extension of Line 2, there are a number of interdependencies with the existing Line 2 infrastructure. There are also interface issues with the existing SRT infrastructure.

Impacts During Construction

- Line 2 - Operations at Kennedy Station will be significantly impacted during construction due to the limited overrun distance once re-alignment of the tail track in the transition section begins.

The reduced overshoot distance requires a reduced speed on arrival onto the platform during construction. To mitigate this impact, the Kennedy pocket track/transition structure must be built in stages.

- SRT- The SRT will require life-extension upgrades in order to extend its operational period until revenue service of the SSE starts. If this is not possible, then replacement bus operations will be required as per the base case.

How will the tunnel be constructed?

The indicative construction schedule assumes the use of two tunnel boring machines (TBM), with one launched southward from the future station box at Sheppard and McCowan and another launched eastward on Eglinton Avenue East between Midland Road and Commonwealth Avenue. The tunnel drive logistics are based on an analysis that indicates that a 2 TBM scenario represents a schedule savings compared to a single TBM schedule.

The first TBM will proceed south along McCowan Road to an extraction shaft located on the Scarborough Rouge Hospital property immediately north of Lawrence Avenue East. The second TBM will proceed east and north along Eglinton Avenue East, Danforth Road and McCowan Road, to the same extraction shaft. Open cut construction methods are expected to be used, with appropriate support of excavation, for the launch and extraction shafts, the three stations, all emergency exit building locations as well as the transition area between Kennedy Station and the south TBM launch shaft.

How could the project be procured and delivered?

In the interest of accelerating project delivery and reducing risk through creation of appropriately sized contract packages, Metrolinx and Infrastructure Ontario have elected to procure two separate contracts for the SSE, including:

1. Advanced Tunnel Contract

- design and procurement of TBMs
- design, manufacture and installation of tunnel liners
- design and construction of launch and extraction shafts
- design and construction of headwalls for EEBs, stations and special trackwork,
- tunneling operations

2. Design and construction of the balance of the works including but not limited to stations, surface facilities, EEB's, Kennedy tailtrack, systems installation and testing and commissioning.

An early works package at Kennedy Station will also be procured, including:

- construction/installation of the West Fan Plant
- Traction Power Substation expansion
- modification of Systems rooms

Are there any major constructability issues?

- The project will require crossing under Highway 401.
- Construction will take place adjacent to Scarborough Town Centre, one of Ontario's largest shopping centres.
- The project will be built within several significant arterial roads including Eglinton Avenue West, Danforth Avenue and McCowan. Continued work will be required to minimize disruptions to resident, business and traffic during construction.
- Tunnel boring machine launch sites need to be identified and confirmed.