

Scarborough Subway Extension

Initial Business Case

June 2016

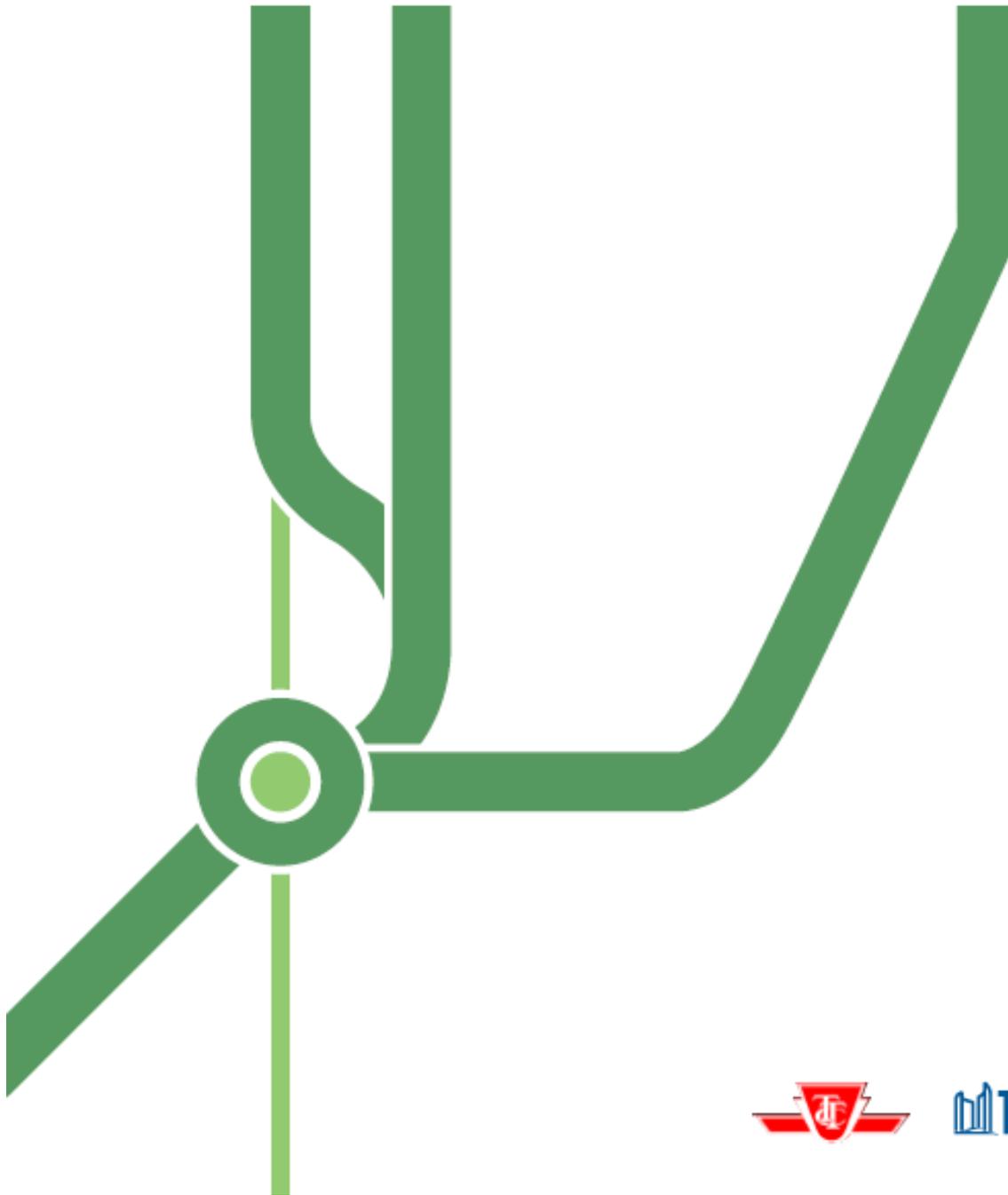


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1. Executive Summary

The Scarborough Subway Extension (SSE) is one of Toronto's priority transit projects with committed funding of \$3.56 billion (escalation based on service beginning late 2023). City Council confirmed its support for a three-stop subway extension of Line 2 along the McCowan Corridor in October 2013 ([2013.CC39.5](#)), with the final alignment and station locations to be determined through the Environmental Assessment process.

In January 2016, Executive Committee ([2016.EX11.5](#)) directed the Chief Planner & Executive Director, City Planning Division, to review an optimized transit network for Scarborough, including an express subway to Scarborough Town Centre (STC) and an LRT extension on Eglinton Avenue East from Kennedy Station to the University of Toronto Scarborough Campus (UTSC). The optimized network proposal was developed as a potential alternative for assessment, as a result of changes in the planning context for Scarborough. These changes include the introduction of SmartTrack, GO Regional Express Rail (RER), and a change in timing for the Sheppard East LRT. In March 2016, City Council considered the report, *EX13.3 Developing Toronto's Transit Network Plan: Phase 1* ([2016.EX13.3](#)) and directed staff to continue planning and technical studies to determine a preferred corridor for the SSE.

This initial business case examines options for the SSE from a four case perspective: strategic, economic, financial, and deliverability. Option 1 is the City Council approved 3-stop subway extension along the McCowan Corridor. Options 2A, 2B, and 2C are variations of an express option that were developed and assessed based on direction from Executive Committee in January and City Council in March 2016. Alternative express subway options (via Brimley Corridor) were also identified but have not been included as part of this business case analysis. These options may be included in future phases of work (see Appendix 3).

Table 1: SSE Initial Business Case Options

3- Stop Option	Express Options		
Option 1 (Base)	Option 2A	Option 2B	Option 2C
3-stop extension of Line 2 along McCowan between Kennedy and Sheppard	Express extension of Line 2 along McCowan between Kennedy and Scarborough Centre	Express extension of Line 2 along Midland between Kennedy and Scarborough Centre	Express extension of Line 2 along SRT Corridor between Kennedy and Scarborough Centre

The preferred option as a result of this initial business case analysis is Option 2A, the express extension of Line 2 along McCowan between Kennedy and Scarborough Centre. In the initial screening of the options, Options 2B and 2C were screened out from the deliverability case perspective due to the cost and impacts of a required SRT shutdown during the construction period. Option 2A performs better in all four cases of this initial business case relative to the base case Option 1.

Figure 1: IBC Preferred Option - Option 2A



Summary of Findings:

The **Strategic Case** evaluated the performance of the options based on the City's *Feeling Congested?* evaluation framework, with a focus on supporting growth and development at Scarborough Centre. A summary of the strategic case evaluation is presented in Table 2 below.

Table 2: Strategic Case Summary

	Option 1 (Base Case) McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
Supporting growth and development in Scarborough Centre				
Supporting Growth				
Shaping the City				
Choice				
Experience				
Public Health and Environment				
Social Equity				
Neighbourhood Impact				
STRATEGIC CASE SUMMARY				

Through the evaluation, Option 2A emerged as a strong option. It would best serve development on both sides of McCowan with the one station, would offer the fastest connection from Kennedy Station to Scarborough Centre, and would not require the shutdown of the SRT and replacement bus operations during construction.

When future development opportunities are considered, Options 2B and 2C presented greater potential to support future growth in Scarborough Centre, as they would allow for the future

extension of the subway to the east side of McCowan. Option 2B, like Option 2A, would offer the fastest connection between Kennedy Station and Scarborough Centre, and has the least impact on neighbourhoods. However, both Options 2B and 2C would require the shutdown of the SRT during the full period of construction of the subway, which would be a disincentive to transit riders.

Option 1 performed weakest as it would offer the slowest connection between Kennedy Station and Scarborough Centre, has greater property impacts, and greater mitigation requirements related to environmental impacts on the Highland Creek system.

The **Deliverability & Operations Case** assessed the performance of each option with respect to technical, engineering and operations considerations. In the deliverability and operations case evaluation, it was determined that both Options 2B and 2C would require an SRT shutdown that would result in significant cost and service impacts, removing the options from further consideration.

Bus replacement for the SRT service during the construction period would require 63 additional buses and infrastructure requirements such as a bus facility to accommodate the additional bus fleet, and bus terminal expansions at Scarborough Centre and Kennedy Station. The cost of shutting down the SRT during the construction period would amount to approximately \$171 million (YOE/Escalated \$). The SRT shutdown would also result in slower and less reliable transit service, which would be likely to deter users from using public transit. As a result of these impacts, Options 2B and 2C were screened out from further consideration in this initial business case due to this key deliverability and operations challenge.

In advancing the design work from 0% to approximately 5% since 2013, several engineering issues were identified that affect the cost and deliverability of Option 1 (see Financial Case section). These challenges include a significantly more complex Lawrence station requiring that it be built 30 metres below surface due to the topography of the area (compared to typical depth of 16 metres). Additional technical challenges were identified for the other two station locations for Option 1.

Option 1 also presented greater deliverability impacts and challenges due to the larger scope for the project (2 additional stations, extension to Sheppard Avenue). As such, Option 2A was identified as the preferred option from the deliverability and operations case perspective.

The **Financial Case** evaluated the options based on the overall capital costs associated with each option based on approximately 5% design. A high order-of-magnitude operating and maintenance cost estimate was also developed to identify the potential lifecycle costs associated with each option. These estimates will require further refinement, as there is currently no defined service concept and operations plan for the SSE. The preliminary financial case evaluation indicates that Option 2A-McCowan Express to Scarborough Centre is approximately \$1.5B (\$YOE/Escalated) less than the 3-Stop McCowan subway to Sheppard (Option 1).

Preliminary estimates for Options 2B and 2C indicates the cost for these options would be greater than Option 2A. Options 2B and 2C would also require the SRT to be shutdown, which presented both a cost and key deliverability challenge that removed the options from further consideration. As a result, detailed cost estimates were not developed for these options.

Table 3: Capital Cost Expenditure (Class 4 Estimate) (\$millions)

	Option 1 3 Stop McCowan	Option 2A Express McCowan	Difference: Option 1 – Option 2A
Constant 2016\$	\$3,695	\$2,545	\$1,150
Net Present Value 2016\$	\$3,834	\$2,639	\$1,195
YOE/Escalated \$	\$4,605	\$3,159	\$1,446
Notes:			
<ul style="list-style-type: none"> • SSE Cost estimates prepared by the TTC. Estimates include cost to construct. • Costs do not include financing, lifecycle and operations/maintenance. • Assumes line in service by late 2025, with construction taking approximately 6 years (2020-2025). Note this is a preliminary schedule based on City Council approving the preferred alignment in July 2016. Any delay may result in future adjustments to the preliminary schedule, estimated opening of the subway, and added costs due to escalation. • Cost estimates have been developed at approximately 5% design and are a Class 4 cost estimate (per AACE guidelines). Class 3 estimates are required to establish the project budget baseline. • Potential risks include the incorporation of a single tunnel design and the increased depth of the station(s), which could affect the expected accuracy of the estimates. • Costs assume traditional procurement approach. A separate analysis on project delivery options is underway per City Council direction. 			

The financial case demonstrates that the current cost estimate for Option 1 (\$4.60B, YOE/Escalated \$) is not affordable within the City Council approved funding envelope of \$3.56B (YOE/Escalated \$). The initial budget approval for the 3-stop McCowan option was based on 0% design (Class 5 estimate), with an assumed project completion date of 2023. These costs were identified as preliminary by TTC staff at the time. Since 2013, further design work has been completed bringing the project to approximately 5% design (Class 4 estimate), which has provided refined cost estimates. The refined cost estimate for the 3-stop McCowan subway is approximately \$1.04B (YOE/Escalated \$) greater than the original estimate. Option 2A is estimated to cost \$3.16 billion (YOE/Escalated \$) at approximately 5% design. From a financial case perspective Option 2A is the preferred option.

The **Economic Case** evaluated the performance of Option 2A in comparison to the base case Option 1. Options 2B and 2C were not evaluated as a result of being screened out through the Deliverability and Operations Case. The economic analysis indicates that relative to the 3-stop McCowan subway, the Express McCowan subway option provides better value for money. Option 1 has a higher lifecycle cost than Option 2A, while providing only slightly better benefits. In summary, for every two dollars saved in delivering Option 2A over Option 1, approximately one dollar in benefits is given up. As a result, Option 2A is preferred based on the economic case analysis outlined in section 5.

Since the 3-stop McCowan subway is the Council approved base case for assessment, the economic case evaluation did not assess the benefits and costs of a subway relative to a different technology.

Conclusion & Next Steps

In conclusion, the SSE IBC indicates that Option 2A, the express subway with a McCowan alignment and station at Scarborough Centre is preferred to the other subway options considered. Option 1, the 3-stop subway option is recommended to be removed from further consideration. The findings from this business case will be considered in the context of the overall transit network plan for Scarborough.

2. Background and Context

Rapid transit was first introduced to Scarborough in 1968 when Line 2 (Bloor-Danforth Subway) was extended from Woodbine Station to Warden Station, near Warden Avenue and St. Clair Avenue East. In 1980, the subway was further extended to Kennedy Station, near Kennedy Road and Eglinton Avenue East. Further investment in transit expansion in the early 1980s, resulted in the Scarborough Rapid Transit (SRT) line being constructed between Kennedy Station and Scarborough Centre at McCowan Road using Intermediate Capacity Transit System (ICTS)¹ technology to provide a rapid transit connection to Scarborough Centre. The SRT opened in March 1985 and has consistently served as a vital connection between Scarborough Centre and Kennedy Station.

Replacing the Scarborough Rapid Transit Line

The SRT has operated at capacity in the peak hour for the majority of its 30 years and the vehicle fleet is approaching the end of its design life. Since the SRT's fourth year of operation, it has consistently served approximately 39,000² passengers every weekday. In the mid-2000s the line carried between 4200 and 4300 riders per hour, peak direction in the busiest hour in the morning rush. A higher capacity rapid transit line to serve the SRT connection has been a key objective of recent transit planning in Scarborough as the line reaches the end of its design life.

Replacing the existing SRT vehicles with buses is not a desirable option. A bus replacement scenario would result in several impacts, including:

- much slower and less reliable transit service;
- overcrowding at bus terminals at Scarborough Centre Station and Kennedy Station;
- the need to purchase approximately 63 more buses;
- decreased access to Scarborough Town Centre and other destinations, including office buildings, in Scarborough Centre; and
- decreased incentive for new development in Scarborough Centre; and
- Significant increase to bus traffic on streets including Eglinton Avenue East, Midland Avenue, Brimley Road, Danforth Road and McCowan Road.

The connection between Kennedy station and Scarborough Centre is also particularly important. The majority of current SRT riders (90%) enter or leave the SRT at Kennedy Station, and nearly 70% of riders enter or leave the SRT at Scarborough Centre Station. The SRT is currently the only rapid transit option serving this link.

¹ ICTS was developed and owned by Urban Transportation Development Corporation Ltd. (UTDC), a Government of Ontario Crown Corporation. UTDC assets are now owned and managed privately. ICTS has been significantly updated and is still being built in markets around the world, but the vehicles now used on the SRT fleet are no longer available.

² This counts passengers travelling in both directions

Importance of Scarborough Centre

Scarborough Centre is one of five mixed-use growth areas identified in Toronto's Official Plan as a high-density urban centre. High density urban centres are areas well-served by transit, where more transit access can be provided and where there is great development potential. Toronto's Official Plan envisions Scarborough Centre as the "*urban focal point for eastern Toronto where employment, housing, institutional, cultural, recreational, commercial and community services and transit will be concentrated in a dynamic mixed-use location.*"³ This direction is supported by the Provincial Policy Statement and the Province's Growth Plan for the Greater Golden Horseshoe, as well as other provincial and local planning policies.

In the future, Scarborough Centre will continue to develop as a meeting place; a location for cultural facilities; public institutions; and services for people from across Scarborough and neighbouring districts and municipalities. Providing excellent transit is one ingredient of a successful plan for the future of Scarborough Centre. Other improvements for Scarborough Centre will be identified through the upcoming Transportation Master Plan study that will consider refinement of the street network, greater consideration of multi-modal options including quality connections to transit, as well as the upcoming Public Art Plan that will seek to enhance the area with high quality public art in support of the City's Official Plan policies, local precinct plans and the Scarborough Centre Public Space and Streetscape Master Plan.

Providing a convenient, high speed rapid transit connection to this urban growth centre is a key objective of the City's Official Plan⁴, to ensure Scarborough has the same degree of mobility opportunities that exist in other urban centres (such as North York and Yonge – Eglinton) and that are otherwise planned (including Six Points in Etobicoke). The key transit planning priority for Scarborough Centre is to create better connection to the rest of the Toronto city region in order to:

- Encourage high-quality employment and residential growth in the Centre; and
- Enhance the accessibility of Scarborough Centre by improving the speed, reliability and convenience of transit service linking Scarborough Centre and key destinations in the Toronto city region.

Existing Travel Patterns

On an average weekday, approximately 1.15 million individual trips begin within Scarborough and 206,000 of these trips are made by transit. Data show that a large number of all trips that begin in Scarborough also end in Scarborough (692,000 or 60%), while a much smaller number of trips that begin in Scarborough end in downtown Toronto (72,000 or 6%).

Figure 2 illustrates where all transit trips originating in Scarborough are destined. Of the 206,000 transit trips, 48,000 or 23% end in downtown Toronto. This means that 66% of all trips that use transit begin in Scarborough and end in downtown Toronto (48,000 of 72,000) (and only 34% use a different mode).

³ Policy 1.1, [Scarborough Centre Secondary Plan](#)

⁴ Section 2.2.2 of [Toronto's Official Plan](#)

Figure 2: Destinations of all transit trips originating in Scarborough (Source: 2011 TTS)

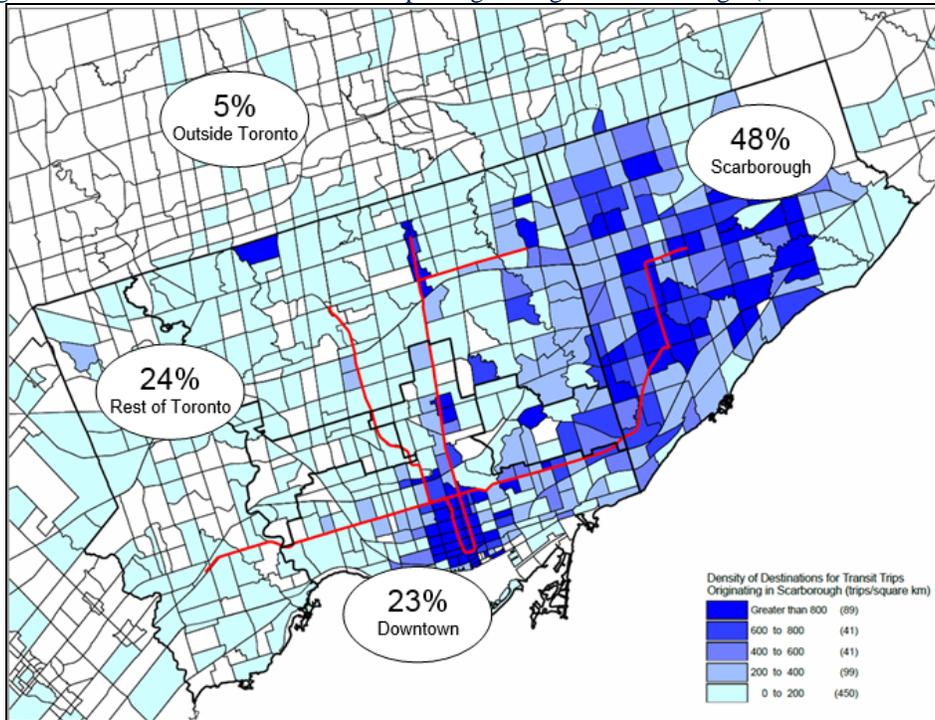
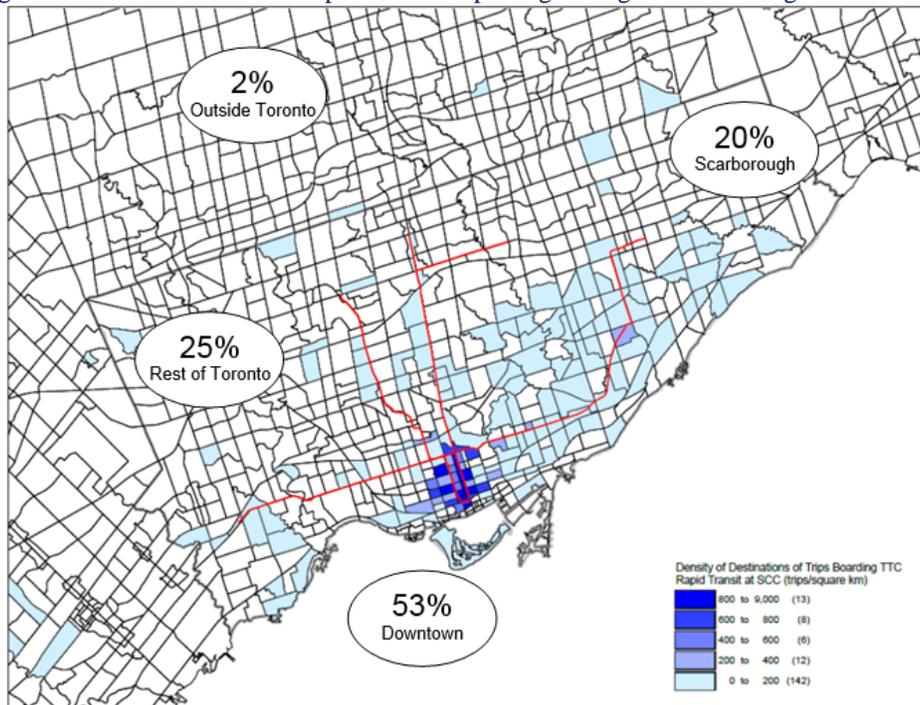


Figure 3 shows the destination of all rapid transit trips originating at Scarborough Town Centre Station. 53% of these trips are destined for downtown and another 25% are destined for elsewhere in Toronto. These observations suggest improving the convenience of the transit connection between Scarborough and downtown Toronto is an important priority since transit is the primary mode for making this trip. Second, increasing the number of rapid transit choices for travelling between Scarborough and downtown Toronto is also important.

Figure 3: Destinations of all rapid transit trips originating at Scarborough Town Centre



Problem Statement

The current rapid transit connection (SRT) has operated at capacity in the peak hour for the majority of its 30 years and the vehicle fleet is approaching the end of its design life. The SRT requires replacement with a higher capacity rapid transit connection.

A rapid transit connection is also required to improve Scarborough Centre's connectivity, and is critical to its success as a vibrant urban node and regional gateway. New development in Scarborough Centre will enable the creation of new walkable complete communities. Providing an improved rapid transit connection to Scarborough Centre will encourage businesses and institutions to locate there and will enable people who live there to reach destinations in other regional centres.

Decision History on Options Development

The development of options to address Scarborough's rapid transit needs and the requirement to replace the SRT has been underway for nearly ten years. In 2007, the TTC introduced the Transit City program, which proposed an LRT network for Toronto including the following lines in Scarborough:

- Scarborough LRT to replace Line 3 and extending to Sheppard Avenue East near Markham Road
- Eglinton Crosstown LRT connecting Kennedy Station to midtown Toronto and central Etobicoke along Eglinton Avenue, and offering a connection to the Scarborough LRT
- Sheppard East LRT extending Line 4 from Don Mills Station to Meadowvale Avenue along Sheppard Avenue East
- Scarborough-Malvern LRT connecting to Kennedy Station and running along Eglinton Avenue East, Kingston Road and Morningside Avenue to Sheppard Avenue East.

Environmental Assessments (EA) were approved by City Council in 2009 for the Scarborough-Malvern LRT in 2009 ([2009.PG31.3](#)) and the Eglinton Crosstown LRT ([2009.CC42.7](#)). In 2010, City Council approved the EAs for the Scarborough LRT replacement of the RT ([2010.EX44.23](#)).

On May 19, 2010, Metrolinx adopted the "5 in 10" plan that included funding for four LRT projects in the City of Toronto including the Eglinton Crosstown LRT, Scarborough RT conversion to LRT, Sheppard East LRT, and the Finch West LRT.

In 2012, City Council affirmed its support for the LRT priority plan for Toronto ([2012.CC17.1](#)), and approved the terms of an agreement ("The Master Agreement") for the delivery of four light rail transit (LRT) projects, which includes the conversion of the Scarborough RT to LRT technology (Scarborough LRT) ([2012.CC27.6](#)). The Master Agreement between the City, TTC and Metrolinx was signed on November 28, 2012, and provides the legal framework for the delivery of the \$8.7 billion⁵ Metrolinx LRT Program. The Eglinton Crosstown is currently under

⁵ The \$8.7 B program is comprised of \$8.4B in provincial and \$0.3B in federal funding under the Building Canada Fund (BCF).

construction and scheduled to open in 2021. The Finch West LRT is currently in procurement, and the Sheppard East LRT project has been deferred in schedule.

Subway Technology Options

A number of reports were requested by City Council and the TTC Board in 2013, to provide an expedited assessment of subway and LRT technology for replacement of the Scarborough RT. These reports are listed below:

January 21, 2013	TTC Report, January 2013 : <i>"Response to Commission Enquiry: Service/Technology Choices for Sheppard East and Scarborough RT Corridors"</i>
July 12, 2013	2013.CC37.17 : <i>"Scarborough Rapid Transit Options"</i>
September 25, 2013	TTC Report, September 2013 : <i>"Scarborough Subway Options"</i>
October 8, 2013	2013.CC39.5 : <i>"Scarborough Rapid Transit Options: Reporting on Council Terms and Conditions"</i>

Based on the level of information available at the time, it was concluded that an LRT or Subway could effectively serve the Scarborough RT corridor. The staff reports also noted that replacing the SRT with a subway would offer the benefits of a transfer-free ride through Kennedy Station and a higher speed than light rail.

On September 25, 2013, the TTC Board supported the SSE with three stations following an alignment along the McCowan Road corridor. In October 2013, City Council approved the three stop extension of the Bloor-Danforth subway line from Kennedy Station to Scarborough Centre and Sheppard Avenue (the "Scarborough Subway Extension"), in place of the Scarborough LRT ([2013.CC37.17](#) and [2013.CC39.5](#)). The final alignment and stations locations were to be considered further through the Environmental Assessment process. Direction was given to the City Manager to work with the Province and Metrolinx to amend the Master Agreement and remove the Scarborough LRT, and redirect the \$1.48 billion (\$2010) in provincial funding to the SSE project. Following City Council approval of the subway, an environmental assessment process was launched to determine the preferred corridor and alignment. Early design and engineering work also started, as the project did not have a business case or detailed feasibility study completed at the time of Council approval.

In 2015, City Council gave direction to review SmartTrack and the Province announced \$13.5 billion to the Regional Express Rail program. The Province also deferred the timing of implementing the Sheppard East LRT. As a result of the change in the transit network planning context in Scarborough, the Chief Planner & Executive Director, City Planning brought forward a report to Executive Committee in January 2016, proposing an express subway option for study as part of an optimized Scarborough transit network plan ([2016.EX11.5](#)). Executive Committee directed the Chief Planner to report in June 2016 on the proposal, which included an extension of Line 2 express to Scarborough Centre and an easterly extension of the Eglinton Crosstown LRT to the University of Toronto, Scarborough Campus (UTSC).

On March 31, 2016, City Council confirmed its support to review the express subway option, and directed staff to report back in June 2016 on a potential alignment and station(s) for the SSE ([2016.EX13.3](#)). City Council also directed staff to eliminate the Bellamy corridor from further consideration, and to assess whether all or portions of the SSE could be built at-grade in the analysis of potential alignments of the subway extension.

Options under Assessment

In summary, a long list of options have been presented to City Council and the TTC Board over the last several years. Per City Council direction, City and TTC staff have focused on subway technology options for the replacement of the SRT.

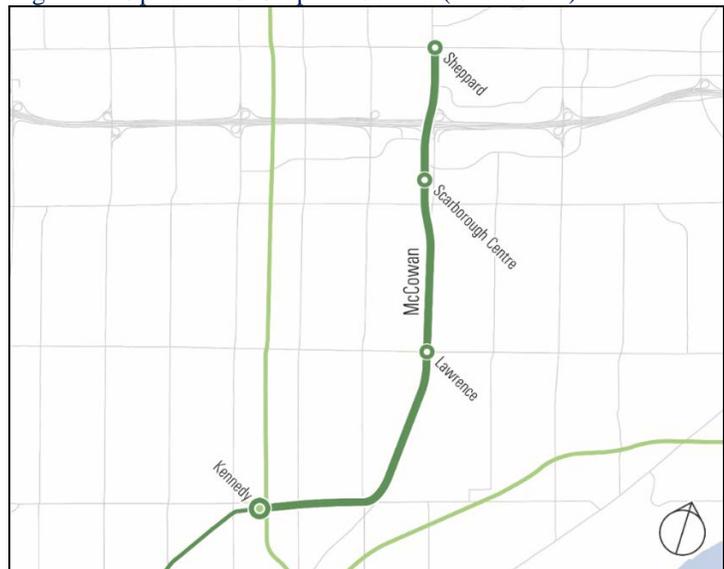
Four options for the SSE were developed and assessed in this initial business case in order to make a staff recommendation on a preferred option. Options development considered project planning objectives and City Council direction. Option 1 is the City Council approved 3-stop extension of Line 2 along McCowan Road and is the base case option in this business case analysis. Options 2A, 2B, and 2C are variations of an express option that were developed and assessed in light of Executive Committee's direction in January and City Council direction in March 2016.

Option 1 is the base case for assessing potential express options. The approximately 7.9 kilometre 3-stop subway on McCowan was approved by City Council in 2013.

The subway provides a connection from Kennedy Station to Sheppard Avenue, with two additional stations at Lawrence and Scarborough Centre.

The option assumes a continuation of line 2 subway service.

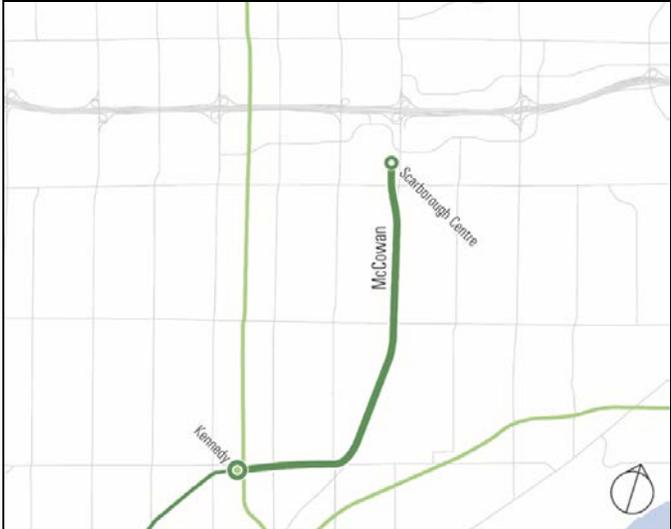
Figure 4: Option 1: 3-Stop McCowan (Base Case)



Option 2A is approximately 6.2 kilometre express subway with connection from Kennedy Station to Scarborough Centre along the McCowan corridor. The entire length of the subway extension is below-grade.

The option assumes a continuation of line 2 (Bloor-Danforth) subway service.

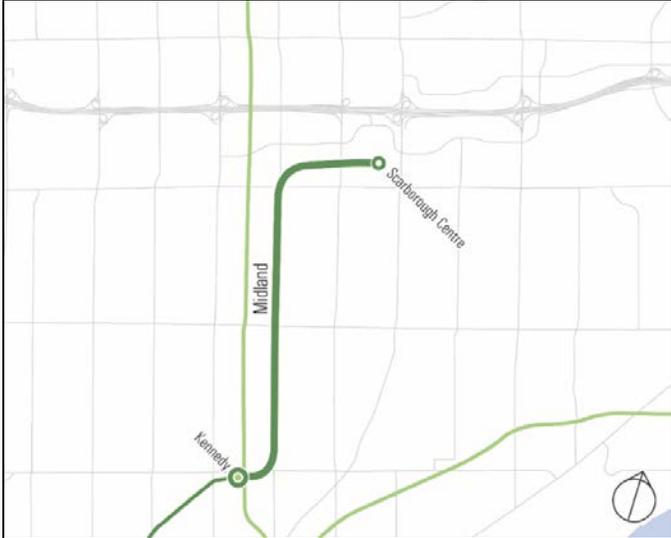
Figure 5: Option 2A: Express Extension via McCowan Road



Option 2B is approximately 6.1 kilometre express subway with connection between Kennedy and Scarborough Centre along the Midland Corridor. The entire length of the subway extension is below-grade.

The option assumes a continuation of line 2 (Bloor-Danforth) subway service with a travel time roughly equivalent to Option 2A.

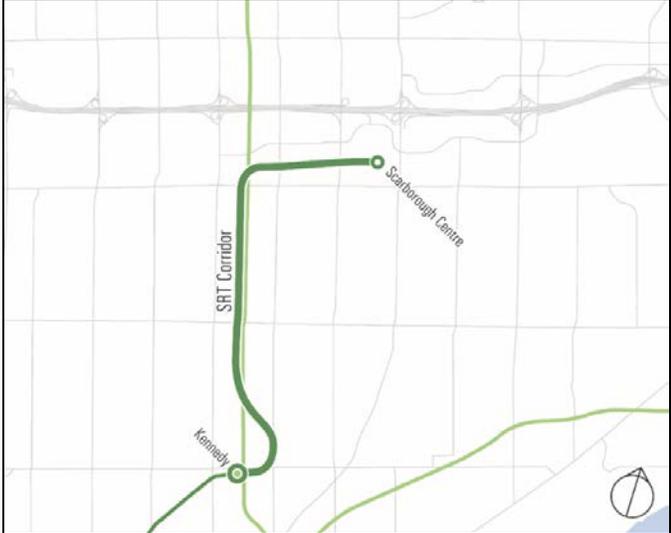
Figure 6: Option 2B – Express Extension via Midland



Option 2C is approximately 6.7 km express connection along the SRT corridor, with approximately 1.4 km at-grade.

The option assumes a continuation of line 2 subway service and would have the longest travel time of the three express subway options due to greater length and more curves.

Figure 7: Option 2C – Express Extension via SRT Corridor



Option 2C is included in response to City Council's March 2016 direction to assess whether all or portions of the SSE could be built at-grade. Two options were evaluated prior to selection of the SRT corridor as the at-grade option to be included in this business case. The selected option was one of two SRT corridor options that were evaluated and would extend the subway east from Kennedy station and access the SRT corridor via a large loop (Figure 7). The other option considered would involve complete demolition and reconstruction of Kennedy Station to allow more direct access to the SRT corridor as proposed by Metrolinx in 2013.

The option proposed by Metrolinx was ruled out because, of the two, it would be much more costly and have more significant construction impacts. The option would have resulted in a longer alignment constructed on the surface but would require a temporary closure of the subway east of Warden Station. In addition to demolishing and reconstructing Kennedy Station, the approaching tracks would need to be lowered beginning west of Kennedy Road to allow the subway to pass under the Eglinton Crosstown LRT line and access the SRT corridor.

The option that was carried forward as Option 2C maintains Kennedy Station, but requires a large loop at the south end from Kennedy Station to return to the SRT corridor. In this option, the subway would be at-grade for roughly 1.4 kilometres before having to transition to tunnel again to pass under the GO tracks. It would remain in tunnel, with the station constructed below grade, in the location of the existing bus terminal at Scarborough Centre SRT Station.

Among the options assessed, there are distinctive differences in the station locations serving Scarborough Centre. Figure 8 illustrates the two possible locations of the initial station. The red alignment represents Options 1 and 2A (along McCowan Road) and would result in a station oriented north-south in the Commercial Precinct of Scarborough Centre. The blue alignment represents Options 2B and 2C (along the SRT corridor and Midland Avenue) and would result in a station oriented east-west, straddling the Commercial and Civic Precincts of Scarborough Centre, on the south side of the Scarborough Town Centre.

Figure 9 illustrates the possible future extension of each of these alignments. The red alignment (Options 1 and 2A) would extend north with a potential future station north of Highway 401, while the blue alignment would extend east with a potential future station in the McCowan Precinct of Scarborough Centre.

Figure 8: Station Location for all Options



Figure 9: Possible Extension Opportunities SSE



Table 4. Options Summary Description

	OPTION 1 (Base): 3 Stop McCowan to Sheppard	OPTION 2A Express McCowan to STC	OPTION 2B Express Midland to STC	OPTION 2C Express SRT Corridor to STC
Corridor & Alignment	McCowan	McCowan	Midland	SRT corridor
Length of Alignment	Approximately 7.9 km	Approximately 6.2 km	Approximately 6.1 km	Approximately 6.7 km
Station Locations	Lawrence, Scarborough Centre (station oriented North-South), Sheppard	Scarborough Centre (station oriented North-South)	Scarborough Centre (station oriented East-West)	Scarborough Centre (station oriented East-West)
Service Concept	Continuation of all Line 2 services	Continuation of all Line 2 services	Continuation of all Line 2 services	Continuation of all Line 2 services
Infrastructure Requirements	<ul style="list-style-type: none"> • 7.4 km Tunneling • 0.5 km cut & cover • 3 new subway stations with associated off-street bus terminals • Subway fleet • On line vehicle storage 	<ul style="list-style-type: none"> • 6.0 km tunneling • 0.2 km cut & cover • 1 new subway station with expanded off-street bus terminal • Subway fleet • On line vehicle storage 	<ul style="list-style-type: none"> • 5.9 km tunneling • 0.2 km cut & cover • 1 new subway station with expanded off-street bus terminal • Subway fleet • On line vehicle storage 	<ul style="list-style-type: none"> • 3.7 km tunneling • 1.4 km surface • 0.7 km cut & cover • 0.8 km portal • 1 new subway station with expanded off-street bus terminal • Subway fleet • On line vehicle storage
Network Assumptions	Bus network in north Scarborough reconfigured to improve linkages to new terminus at Sheppard-McCowan Station; some other re-routing of some buses to better serve new subway stations.	Bus network largely unchanged in north Scarborough, continuing to focus on Scarborough Centre Station; re-route some buses terminating at Lawrence to Kennedy; some other bus re-routings to ensure good connections to the subway.	Bus network largely unchanged in north Scarborough, continuing to focus on Scarborough Centre Station; re-route some buses terminating at Lawrence to Kennedy; some other bus re-routings to ensure good connections to the subway.	Bus network largely unchanged in north Scarborough, continuing to focus on Scarborough Centre Station; re-route some buses terminating at Lawrence to Kennedy; some other bus re-routings to ensure good connections to the subway.

Other Options

Alternative options were also considered but not included in this initial business case analysis, including two options along the Brimley corridor. A description of these options is attached as Appendix 1 to this initial business case.

3. Strategic Case Evaluation

Evaluating the Strategic Case

The strategic value of transit investments in Toronto can be viewed and understood through a framework developed through *Feeling Congested?*, the recent review of Transportation Policies in Toronto's Official Plan. The framework focuses on three principles—*Serving People*, *Strengthening Places* and *Supporting Prosperity*. These three principles are further articulated as eight criteria outlined below.

Serving People

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

Strengthening Places

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

Supporting Prosperity

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

This framework provides guiding principles for the Strategic Case evaluation of the SSE. The criteria presented above have been re-ordered to reflect the strategic importance of each to the SSE.

Supporting Growth

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

The SSE serves the key growth areas around Scarborough Centre and Kennedy Station. Option 1 also has stations along McCowan Road at Lawrence Avenue East and Sheppard Avenue East. The Lawrence East Station is not in or near an employment growth area. While the area on the north side of Sheppard East Station is an employment area, this area is designated as such due to its close proximity to Highway 401 and the rail corridor to the north, making it an important area for lower density industrial uses. Introducing a subway station in this location may bring office development to the area, but strategically, high-density office development should be directed to Scarborough Centre, so connection to Sheppard Avenue East may be detrimental from a Supporting Growth perspective.

While strategically it is most important to evaluate a project's impact on supporting growth by how the project would serve employment growth areas, it is also possible to predict employment density that would be served by the project. Existing employment density can be used as a proxy for what future employment density may be, and models are used to project future employment density. It is noted that these projections are based on observed trends, so they do not capture the positive incentives that rapid transit infrastructure would provide to businesses in the future, and may not be able to predict some employment growth.

Option 1 is projected to serve the most jobs within walking distance of stations in the future (18 500), while Option 2A is projected to serve the highest density of jobs (18 500 jobs/km²). This difference is due to the fact that the jobs served by Option 1 are spread across three station areas.

The SSE will increase the number of jobs that people can access on transit. Options 2A, 2B and 2C would allow the average person in the Greater Toronto and Hamilton Area to access slightly more jobs than Option 1 (+0.3%).

Scarborough Centre has significant development potential with the entire Centre designated mixed-use by the Official Plan. In Options 1 and 2A, Scarborough Centre Station would be located 38m closer to the centroid of Scarborough Centre than in Options 2B and 2C (see Figure 8 and 9). The options 1 and 2A station would also be closer to the McCowan Precinct where significant development is expected in the future. This station location would bring slightly more of the Centre within walking distance of a subway station (0.6km² vs. 0.5km²). The station would be approximately 200m from existing office buildings and development blocks on the east side of McCowan Road. From these perspectives, Options 1 and 2A offer improved proximity to people's workplaces, and support economic development slightly more than Options 2B and 2C (Figure 9).

The opportunity to extend the SSE in the future due to the station location (Figure 9) represents a significant difference in the options being considered. Due to the North-South orientation of the Scarborough Centre Station in Options 1 and 2A, the subway could be extended north. However, there are no designated mixed-use growth areas most suitable for high-density employment growth north of Highway 401. In contrast, Options 2B and 2C could be extended east with additional stations in the McCowan Precinct of Scarborough Centre and at Centennial College (Progress Campus) east of Scarborough Centre. The increased accessibility that these additional stations provide could incent employment growth in these locations, and present significant strategic benefits of Options 2B and 2C.

The two subway alignments were evaluated to estimate their potential impact on transit-oriented high-density employment development within Scarborough Centre. This analysis is beyond the growth projected by the population and employment models, and can be understood as the potential directly related to the construction of subway stations. Since it is not possible to determine a future proportion of residential and employment uses in a mixed use area, a conservative assumption of ten percent of all future development has been anticipated for retail and office use.

The station associated with Options 1 and 2A could yield approximately 130 000 square metres of transit-oriented employment development while the initial station in Options 2B and 2C could yield approximately 115 000 square metres. A future station east of McCowan Road associated with Options 2B and 2C could result in an additional 78 250 square metres of transit-oriented employment development.

Options 2B and 2C are preferred from the perspective of Supporting Growth primarily due to the opportunity to provide additional stations within Scarborough Centre in the future.

Table 5: Supporting Growth Measures

Measure	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
<i>Service to Employment Growth Areas</i>	Single station planned for Commercial Precinct of Scarborough Centre – a mixed-use growth area. Station will encourage residential intensification and urbanization of the Centre.	Single station planned for Commercial Precinct of Scarborough Centre – a mixed-use growth area. Station will encourage residential intensification and urbanization of the Centre.	Single station planned for Commercial Precinct of Scarborough Centre – a mixed-use growth area. Station will encourage residential intensification and urbanization of the Centre. Future potential station possible in McCowan Precinct of the Centre, which would encourage further development.	Single station planned for Commercial Precinct of Scarborough Centre – a mixed-use growth area. Station will encourage residential intensification and urbanization of the Centre. Future potential station possible in McCowan Precinct of the Centre, which would encourage further development.
<i>Proximity to geographic centre of Scarborough Centre</i>	151 m	151 m	189 m	189 m
<i>Potential for the alignment to be extended and</i>	No Potential	No Potential	High Potential	High Potential

Measure	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
<i>support future additional stations within SC at the urban stop spacing (e.g. 700-900 m)</i>				
<i>Positive and negative impacts to parcels with intensification potential in the vicinity of potential future station location(s)</i>	N/A	N/A	Potential Station location under Progress Avenue west of West Highland Creek is central to the McCowan Precinct and therefore provides good access and short walks to the surrounding proposed development blocks. It could be integrated with the proposed road network of the McCowan Precinct and could be integrated from a land use perspective.	Potential Station location under Progress Avenue west of West Highland Creek is central to the McCowan Precinct and therefore provides good access and short walks to the surrounding proposed development blocks. It could be integrated with the proposed road network of the McCowan Precinct and could be integrated from a land use perspective.
<i>Area of land within walking distance of stations designated for Employment growth</i>	0.6 km ² (mixed use) 0.1 km ² (Employment, Institutional and Regeneration Lands)	0.6 km ² (mixed use) 0.0 km ² (Employment, Institutional and Regeneration Lands)	0.5 km ² (mixed use) 0.0 km ² (Employment, Institutional and Regeneration Lands)	0.5 km ² (mixed use) 0.0 km ² (Employment, Institutional and Regeneration Lands)
<i>Proportion of land within walking distance of stations designated for employment growth</i>	38.5% (mixed use) 7.9% (Employment, Institutional and Regeneration Lands)	71.4% (mixed use) 2.7% (Employment, Institutional and Regeneration Lands)	65.4% (mixed use) 0% (Employment, Institutional and Regeneration Lands)	65.4% (mixed use) 0% (Employment, Institutional and Regeneration Lands)
<i>Existing Jobs within walking distance of the stations</i>	15 500 jobs	12 100 jobs	9300 jobs	9275 jobs
<i>Projected Job</i>	3000 jobs	2500 jobs	2300 jobs	2300 jobs

Measure	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
<i>Growth within walking distance of stations</i>				
<i>Projected Future Jobs within walking distance of stations</i>	18 500 jobs	14 500 jobs	11 600 jobs	11 600 jobs
<i>Existing Employment Density within walking distance of the stations</i>	9900 jobs/km ²	15 400 jobs/km ²	11 800 jobs/km ²	11 800 jobs/km ²
<i>Projected Increase in Employment Density within walking distance of the stations</i>	1900 jobs/km ²	3100 jobs/km ²	2900 jobs/km ²	2900 jobs/km ²
<i>Projected Future Employment Density within walking distance of the stations</i>	11 800 jobs/km ²	18 500 jobs/km ²	14 700 jobs/km ²	14 700 jobs/km ²
<i>Change in Jobs Accessibility</i>	N/A	+251 jobs/person (increase of 0.3%)	+251 jobs/person (increase of 0.3%)	+251 jobs/person (increase of 0.3%)
<i>Potential for Transit-Oriented employment Development within 500m of Scarborough Centre Station</i>	130 000m ²	130 000m ²	115 000m ²	115 000m ²
<i>Potential for Transit-Oriented employment Development within 500m of future station</i>	N/A	N/A	78 250m ²	78 250m ²

Shaping the City

Similar to the Supporting Growth perspective, transit investments can play a very significant role in the residential development of the city. The SSE serves the key growth areas around Scarborough Centre and Kennedy Station. Option 1 also has stations along McCowan Road at

Lawrence Avenue East and Sheppard Avenue East. Neither of these station areas is within or near residential growth areas.

The population of Scarborough Centre more than doubled between 2001 and 2011, expanding at a rate faster than that of either Etobicoke Centre, or Yonge-Eglinton Centre. Analysis undertaken as part of City Planning's [Growing Up Study](#) shows that Scarborough Centre houses the highest percentage of families with children of all the Centres (35%), and the highest percentage of families with children owning their own homes (73% compared with North York at 60%, Etobicoke at 26% and Yonge-Eglinton at 24%). Together these factors reveal Scarborough Centre to be more family-oriented and less transient than other Centres.

Options 1 and 2A would bring slightly more land designated for population growth within walking distance of a station (0.6km² vs. 0.5km²). Option 1 would bring a subway station within walking distance of 7200 people in the future, but these people are split over three stations. In terms of future population density within walking distance of a station, Options 2B and 2C are preferred, at 8400 people/km².

The number of people that an average person can access on transit is a proxy measurement that represents the broad range of services and other destinations that people regularly access. The number of people someone can access is an appropriate proxy because where there are dense populations, there are also a variety of destinations.

The SSE would increase the number of people that the average person could access by transit. Options 2A, 2B and 2C would allow the average person in the Greater Toronto and Hamilton Area to access an additional 1 700 people on transit compared to Option 1.

A high-level analysis of potential transit-oriented development around the stations was undertaken and focussed on potential growth beyond the population projected by the population and employment models. It can be understood as the potential directly related to the construction of subway stations. Since it is not possible to determine a future proportion of residential and employment uses in a mixed use area, an assumption of 90 percent of all future development has been anticipated for residential uses.

Applying the typical lot coverage for recent developments in Scarborough Centre to available land around the station associated with Options 1 and 2A, suggests that it is possible to develop approximately 12 500 residential units within 500 metres of the station. These units include already-approved developments, sites in the pipeline, and underutilized sites but excludes the land inside the ring road around Scarborough Town Centre. This compares to the opportunity to develop approximately 9 900 residential units within 500m of the initial station associated with Options 2B and 2C.

Similar to the Supporting Growth perspective, the potential to extend the subway eastward and create a second station in Scarborough Centre in the future is the most significant strategic factor. Potential for approximately 11 000 additional transit-oriented residential units is estimated around a future station in the McCowan Precinct.

From a Shaping the City perspective, Options 2B and 2C are preferred, primarily due to the opportunity to provide additional stations within Scarborough Centre in the future.

Table 6: Shaping the City Measures

Measure	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
<i>Service to Residential Growth Areas (see further detail in "Service to Employment Growth Areas")</i>	Single station planned for Commercial Precinct of Scarborough Centre – a mixed-use growth area. Station will encourage residential intensification and urbanization of the Centre.	Single station planned for Commercial Precinct of Scarborough Centre – a mixed-use growth area. Station will encourage residential intensification and urbanization of the Centre.	Single station planned for Commercial Precinct of Scarborough Centre – a mixed-use growth area. Station will encourage residential intensification and urbanization of the Centre. Future potential station possible in McCowan Precinct of the Centre, which would encourage further development.	Single station planned for Commercial Precinct of Scarborough Centre – a mixed-use growth area. Station will encourage residential intensification and urbanization of the Centre. Future potential station possible in McCowan Precinct of the Centre, which would encourage further development.
<i>Area of land within walking distance of stations designated for population growth</i>	0.6 km ² (mixed use)	0.6 km ² (mixed use)	0.5 km ² (mixed use)	0.5 km ² (mixed use)
<i>Proportion of land within walking distance of stations designated for population growth</i>	38.5% (mixed use)	71.4% (mixed use)	65.4% (mixed use)	65.4% (mixed use)
<i>Existing Population within walking distance of the stations</i>	5800 people	3200 people	5400 people	5400 people
<i>Projected Population Growth within walking distance of stations</i>	1400 people	1300 people	1100 people	1100 people
<i>Projected Future Population within walking distance of the stations</i>	7200 people	4400 people	6600 people	6600 people
<i>Existing Population Density within walking distance of the stations</i>	3700 people/km ²	4000 people/km ²	6900 people/km ²	6900 people/km ²
<i>Projected Increase</i>	900 people/km ²	1600 people/km ²	1400 people/km ²	1400 people/km ²

Measure	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
<i>in Population Density within walking distance of the stations</i>				
<i>Projected Future Population Density within walking distance of the stations</i>	4600 people/km ²	5600 people/km ²	8400 people/km ²	8400 people/km ²
<i>Potential for Transit-oriented Residential Development within 500m of Scarborough Centre Station</i>	12 500 units	12 500 units	9 900 units	9 900 units
<i>Average number of people-people connections within 60 minutes of transit</i>	N/A	+1,700 persons/persons (increase of 0.7%)	+1,700 persons/persons (increase of 0.7%)	+1,700 persons/persons (increase of 0.7%)
<i>Potential for Transit-oriented Residential Development within 500m of future station</i>	N/A	N/A	11 000 units	11 000 units

Choice

The project's impact on choice can be understood both in terms of how many opportunities there are to transfer to other rapid transit lines that serve destinations that people want to travel to (more opportunity is positive), and how many transfers riders need to make to reach their destinations (fewer transfers is positive). The key transit connection points in Scarborough are Scarborough Centre and Kennedy Station. Both of these points are identified as Mobility Hubs by Metrolinx, and should be planned as important connection points in the future. Both hubs act as intermediary points on many transit trips to downtown Toronto and elsewhere in the city.

With the future implementation of GO Regional Express Rail (RER) and SmartTrack, GO Stations will also become increasingly important connection points for riders destined for downtown Toronto and elsewhere in the city. GO Stations in Scarborough include Scarborough, Eglinton, Guildwood and Rouge Hill on the Lakeshore East line, and Kennedy, Agincourt and Milliken on the Stouffville line.

The SSE would connect Scarborough Centre and Kennedy Station (currently the terminus of Line 2, Bloor-Danforth Subway). This connection is currently made by Line 3 (SRT) and is critical for the network. Scarborough Centre is the focal point for many local bus routes serving northern and eastern Scarborough and is also the easterly gateway into Toronto offering

connections to Durham Region and other points further east. Kennedy Station is currently the extent of the TTC subway system that connects to downtown Toronto and all of the other Centres in Toronto, and provides a direct connection to the GO network, which serves Mobility Hubs and Urban Growth Centres across the Greater Golden Horseshoe.

The ability of each option to provide convenient bus transfers is also a consideration from the perspective of Choice. Options 2B and 2C offer better opportunities to accommodate a large bus terminal that does not impinge on development opportunity or the public realm within Scarborough Centre. This bus terminal would be located along Triton Road, in the vicinity of the existing Scarborough Centre Station bus terminal. Options 1 and 2A would require a large bus terminal to be constructed in a new location on land that would otherwise be used for development or public space.

All options being considered connect Kennedy Station and Scarborough Centre, however, Option 1 would connect to the future Sheppard East LRT and local buses at Sheppard Avenue East and Lawrence Avenue East. The value of this potential connection to the Sheppard East LRT is difficult to identify due to uncertain timing of the project. Moreover, Option 2A could easily be extended to Sheppard Avenue East in the future, should the LRT be constructed and connection to it offer sufficient value. Options 2B and 2C could also be extended to Sheppard Avenue East in the future, although at a point further east than McCowan Road and at a greater cost.

Table 7: Choice Measures

Measure	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
<i>Connections between Scarborough Centre and other UGCs/Mobility Hubs</i>	Connection between Scarborough Centre and Kennedy Mobility Hub	Connection between Scarborough Centre and Kennedy Mobility Hub	Connection between Scarborough Centre and Kennedy Mobility Hub	Connection between Scarborough Centre and Kennedy Mobility Hub
<i>Change in average number of transfers made</i>	1.8	1.8	1.8	1.8
<i>Change in number of connections available</i>	Line 2, Line 5, Future SmartTrack, Future GO RER, Future Sheppard East LRT	Line 2, Line 5, Future SmartTrack, Future GO RER	Line 2, Line 5, Future SmartTrack, Future GO RER	Line 2, Line 5, Future SmartTrack, Future GO RER
<i>Ability to provide bus terminal</i>	Significant impacts of providing 26-bay Scarborough Centre bus terminal	Significant impacts of providing 34-bay Scarborough Centre bus terminal	34-bay Scarborough Centre bus terminal built in same place as existing terminal	34-bay Scarborough Centre bus terminal built in same place as existing terminal

The number of connections to major walking and cycling infrastructure is also related to transportation choice. Examples of this type of infrastructure include downtown's PATH system for pedestrians, the Waterfront Trail system or the West Toronto Rail Path. Option 1 would

connect to the Gatineau Hydro Corridor Recreational Trail at Lawrence East Station, while other options would not impact or connect to any such pedestrian or cycling facilities.

Due to the connection to a future Sheppard East LRT and local buses, Option 1 is preferred from a choice perspective.

Experience

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

It is estimated that compared to the SRT, the SSE would incent between 3100 and 4500 net new daily riders to use transit in 2031. Relative to Option 1, Options 2A, 2B and 2C incent an additional 1400 riders to change their travel mode (mostly auto), which would minimally reduce congestion on roadways in Scarborough or freeing up road capacity for other travellers to make trips. This increase in overall transit system ridership is partly due to an estimated reduction in travel time over the base case (SRT approximately 12 minutes from Scarborough Centre to Kennedy) by up to 5 minutes (which does not include a transfer at Kennedy Station⁶), allowing people to access further locations by transit in less time.

For Options 2A, 2B and 2C, all day boardings at Scarborough Centre Station in 2031 are projected to be approximately 31 000. AM peak hour boardings at Scarborough Centre Station in 2031 are projected to be approximately 7300. Projected AM peak hour boardings are similar to projected AM peak hour boardings at Kipling Station (approximately 6000) and would represent the second highest projected AM peak hour boardings on Line 2 (after Yonge Station and approximately equal to boardings at Kennedy Station).

In Options 2A, 2B and 2C, projected AM peak hour boardings at Scarborough Centre Station are the same as peak point ridership (approximately 7300). In Option 1, the projected peak point ridership in 2031 is approximately 11 100. This peak point ridership would occur between Lawrence East Station and Kennedy Station. Given that overall transit system ridership increases for Options 2A, 2B and 2C, many of the additional projected riders of Option 1 are not lost to the transit system but are projected to use alternate transit routes if the express extension is built.

⁶ TTC assumes transfers are perceived as equal to an additional 10 minutes of in-vehicle travel time
Developing Toronto's Transit Network Plan to 2031
Attachment 4

Table 8: Experience Measures

Measure	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
<i>Connections between Scarborough Centre and other UGCs/Mobility Hubs⁷</i>	Approximately 7.5 – 8.5 minutes connection between Scarborough Centre and Kennedy Mobility Hub	Approximately 6.5 – 7.5 minutes connection between Scarborough Centre and Kennedy Mobility Hub	Approximately 6.5 – 7.5 minutes connection between Scarborough Centre and Kennedy Mobility Hub	Approximately 7.0 to 8.0 minutes connection between Scarborough Centre and Kennedy Mobility Hub
<i>Transit Ridership Change</i>	3,100 new riders	4,500 new riders	4,500 new riders	4,500 new riders

Public Health & Environment

Transit has a very positive impact on public health and the environment due largely to enabling issues and encourage sedentary lifestyles. However, large infrastructure projects like rapid transit may also have detrimental impacts to natural features, which must be avoided or mitigated.

The Highland Creek system is a significant natural feature of the SSE study area. The SSE would cross the creek once between Kennedy Station and Scarborough Centre. Express Options (2A, 2B and 2C) do not present significant risks to the Highland Creek system, as they would tunnel beneath it. Options 2B and 2C would cross the creek in the vicinity of Brimley Road. At this point, the creek is channelized and the subway tunnel would be of typical depth. Option 2A would cross the creek just north of Lawrence Avenue East and requires a tunnel of appropriate depth under the creek.

The Highland Creek system is a significant natural feature of the SSE study area. SSE Express Options 2B and 2C would cross the creek once between Kennedy Station and Scarborough Centre on the section north of Ellesmere Road. Express Option 2A would cross the creek twice - once north of Lawrence Avenue and once on the section south of Lawrence Avenue. These crossings do not present significant risks to the Highland Creek system, as they would tunnel beneath it. For options 2B and 2C, the creek is channelized and the subway tunnel would be of typical depth. The creek crossings for Option 2A requires a tunnel of appropriate depth to avoid any impact.

Option 1 has the same crossings as Option 2A, plus conflicts with the creek north of Sheppard Avenue. In the case of Sheppard East Station, the open cut section required for the station box, special track work and Tunnel Boring Machine (TBM) portal launch site would be within the creek's floodplain, requiring significant mitigation during construction.

The change in Auto Mode Share is an important objective. By providing a fast and efficient service, which is well connected to key destinations, it will help incentivize existing auto users to

⁷ Reported travel times between Scarborough Centre Station and Kennedy Station represent high-level estimates and should not be considered actual travel time that would be experienced by customers on the subway. Estimates continue to be refined as design of the subway progresses. Reported travel time estimates vary slightly from travel time inputs used by the GTHAv4.0 model to generate ridership projections.

consider using transit. Through this shift in mode choice, it will result in a reduction of emissions, and improve air quality. All options equally result in the same change to auto mode share.

Table 9: Public Health & Environment Measures

Measure	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
<i>Significant Environmental Challenges</i>	Conflict with West Highland Creek at Lawrence East Station and at Sheppard East Station.	Mitigation required	None	None
<i>Change in Auto Mode Share</i>	0.55	0.55	0.55	0.55

Express Options (2A, 2B and 2C) are preferred from the perspective of Public Health and the Environment as they require far less mitigation to avoid impacts to the Highland Creek system.

Social Equity

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

The SSE would directly serve very few residents of NIAs (up to 3100). Option 1 has one more station (Lawrence East Station) adjacent to a NIA than the express options, however this station would be within walking distance of only several dozen single-family homes, and as such, offers no significant increase in service to the NIA. It is also important to note that Lawrence East Station would also be within walking distance to nearby condos and the Scarborough Hospital.

Although Options 2A, 2B and 2C would increase the number of jobs that the average person in the Greater Toronto and Hamilton Area can access on transit, these options would decrease the number of jobs that an average person living in an NIA could access. Compared to Option 1, the average NIA resident would be able to access 1 140 fewer jobs.

On the other hand, modelling shows that Options 2A, 2B and 2C would improve the number of people that the average NIA resident could access compared with Option 1 – increasing the number by 3 200 people.

Due to the extremely small differences in all Social Equity measures, all options perform equally well with respect to this criteria.

Table 10: Social Equity Measures

Measure	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
<i>Change in disadvantaged residents served</i>	3100 people	1700 people	2800 people	2800 people
<i>Change in Jobs Accessibility</i>	N/A	-1,140 jobs/person (decrease of - 0.8%)	-1,140 jobs/person (decrease of - 0.8%)	-1,140 jobs/person (decrease of - 0.8%)
<i>Average number of people to people access within 60 minutes of transit</i>	N/A	+3200 persons/persons (increase of 0.6%)	+3200 persons/persons (increase of 0.6%)	+3200 persons/persons (increase of 0.6%)

Neighbourhood Impact

Just as transit investments can be a powerful force in shaping the city, they can also have long-term detrimental impacts on existing, stable neighbourhoods. The majority of the SSE study area outside of Scarborough Centre is recognized as stable neighbourhoods, to which adding a subway station could bring unwanted development pressure and change.

Apart from the key growth areas served by the SSE (Scarborough Centre and Kennedy Station), Option 1 also has stations along McCowan Road at Lawrence Avenue East and Sheppard Avenue East.

While only 0.3km² of the area around Lawrence East Station is designated as Neighbourhood, in fact the entire area surrounding the station is considered stable – additional land is park and a hospital. The area on the south side of Sheppard East Station is also designated as stable neighbourhood, while the area on the north side of Sheppard East Station is earmarked for employment land uses, which cannot be converted to residential use. Thus, subway stations in these areas could have a detrimental effect on surrounding stable land uses.

Impacts to private property is a significant consideration. Option 1 is least preferred, as it would have significant impacts to private property around Lawrence East and Sheppard East stations, in addition to property impacts along the route and at Scarborough Centre Station. Option 2B is preferred over Options 2A and 2C due to fewer impacts along the corridor as detailed in Table 11.

Option 2B is preferred with regards to Neighbourhood Impact.

Table 11: Neighbourhood Impact Measures

Measure	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT
<i>Private Property Impacts</i>	Greater impacts than Option 2A due to additional requirements at Lawrence East Station and between Scarborough Centre Station and Sheppard Avenue East.	Total: 91 Number of Single Family Homes Impacted: (Below Surface Impacts): - Partial/sliver <2m: 42 - Partial/sliver >2m: 21 - Complete: 5 Number of Residential Buildings/complexes Impacted: (Below Surface Impacts): - Partial/sliver <2m: 1 - Partial/sliver >2m: 3 - Complete: 0 Business & Developable properties Impacted: Surface Impacts - Partial/sliver <2m: 0 - Partial/sliver >2m: 4 (1.36Ha) - Complete: 0 Below Surface Impacts - Partial/sliver <2m: 7 (0.05 Ha) - Partial/sliver >2m: 8 (1.91Ha) - Complete: 0 - Total: 3.31 Ha	Total: 33 Number of Single Family Homes Impacted (Below Surface Impacts): - Partial/sliver <2m: 1 - Partial/sliver >2m: 5 - Complete: 4 Number of Residential Buildings/complexes Impacted (Below Surface Impacts): - Partial/sliver <2m: 0 - Partial/sliver >2m: 0 - Complete: 0 Business & Developable properties Impacted: Surface Impacts - Partial/sliver <2m: 0 - Partial/sliver >2m: 7 (1.58Ha) - Complete: 0 Below Surface Impacts - Partial/sliver <2m: 0 - Partial/sliver >2m: 14 (2.60Ha) - Complete: 1 (0.16Ha) - Total: 4.34 Ha	Total: 92 Number of Single Family Homes Impacted (Below Surface Impacts): - Partial/sliver <2m: 3 - Partial/sliver >2m: 17 - Complete: 29 Number of Residential Buildings/complexes Impacted (Below Surface Impacts): - Partial/sliver <2m: 0 - Partial/sliver >2m: 0 - Complete: 0 Business & Developable properties Impacted: Surface Impacts - Partial/sliver <2m: 0 - Partial/sliver >2m: 29 (3.11Ha) - Complete: 0 Below Surface Impacts - Partial/sliver <2m: 0 - Partial/sliver >2m: 11 (3.36Ha) - Complete: 1 (0.16Ha) - Total: 6.47 Ha
<i>Area of land within walking distance of stations designated as Neighbourhoods</i>	0.3 km ²	0.0 km ²	0.0 km ²	0.0 km ²
<i>Proportion of land within walking distance of stations designated as Neighbourhoods</i>	20.2%	0.2%	4.1%	4.1%

Strategic Case Evaluation Conclusion

The SSE is required to replace the rapid transit connection between Scarborough Centre and Kennedy Station currently provided by Line 3, which will maintain connection between the Centre and the rest of the rapid transit network. The subway is needed not only to meet the needs of existing riders of Line 3, but also to expand its capacity and to incentivize growth and development. The extension supports Scarborough Centre developing into a vibrant urban node as envisioned by Toronto's Official Plan. All subway options considered in this initial business case offer significant strategic benefits.

Option 2A performed strongly, as it would best serve development on both sides of McCowan with one station, and would offer (like Option 2B) the fastest connection from Kennedy Station to Scarborough Centre. When future development opportunities are considered, Options 2B and 2C offer the best strategic fit due to the station location as they would enable a future easterly extension of the subway with the potential of an additional station in the Centre to further improve accessibility and therefore incentivize development. Option 2B also offers the fastest service between Scarborough Centre and Kennedy Station, while impacting the fewest property owners. Option 2B, the Express SSE via Midland Avenue, is preferred from the strategic case perspective.

Table 12. Strategic Case Summary

	Option 1 McCowan-3	Option 2A Express via McCowan	Option 2B Express via Midland	Option 2C Express via SRT	Comments
Project Objectives					
Supporting growth and development in Scarborough Centre					2B/2C offer the greatest potential to support growth and development in the Centre with the addition of a future second station in the McCowan Precinct of Scarborough Centre
Feeling Congested Criteria					
Supporting Growth					All express options improve the average number of jobs accessible by transit. 2B/2C could generate significant employment growth with the addition of a future second station in the McCowan Precinct of Scarborough Centre
Shaping the City					All express options improve the average number of people accessible by transit. 2B/2C could encourage significant residential development with the addition of a future second station in the McCowan Precinct of Scarborough Centre.
Choice					Option 1 connects to Sheppard East LRT and local buses.
Experience					2A and 2B provides the fastest connection and attracts the highest net new riders.
Public Health and Environment					Option 1 requires greater mitigation to avoid impacts on the Highland Creek system.
Social Equity					All options perform equally. Express options decrease accessibility to jobs, but increase the accessibility to other destinations.
Neighbourhood Impact					Option 2B has the least property impacts
Strategic Case Summary					

4. Financial Case Evaluation

The Financial Case evaluation assesses the costs associated with each option. The cost estimates were developed based on approximately 5 percent design, resulting in Class 4 cost estimates according to industry standards (see Appendix 2: Cost and Schedule Estimate Classification). Several assumptions were made to develop these costs and are detailed below.

Capital Cost Estimates

The preliminary cost estimates indicate that Option 2 is less costly than Option 1 due to the reduced scope of the express option. In order to develop capital cost estimates (in YOE/Escalated \$) for each project, assumptions were also made regarding the potential construction start and in-service date for this project. These are noted in Table 13 below. The costs presented do not include cost for design build finance contracting or risk allowance.

Although a preliminary schedule has been developed and is based on starting detailed design in July 2016, escalation may be impacted as a detailed schedule is developed.

Table 13: Capital Cost Expenditure (Class 4 Estimate) (\$ millions)

	Option 1 3 Stop McCowan	Option 2A Express McCowan	Difference: Option 1 – Option 2A
Constant 2016\$	\$3,694	\$2,545	\$1,150
Net Present Value 2016\$	\$3,834	\$2,639	\$1,195
YOE/Escalated \$	\$4,605	\$3,159	\$1,446
Notes:			
<ul style="list-style-type: none"> • SSE Cost estimates prepared by the TTC. Estimates include cost to construct. • Costs do not include financing, lifecycle and operations/maintenance. • Assumes line in service by late 2025, with construction taking approximately 6 years (2020-2025). Note this is a preliminary schedule based on City Council approving the preferred alignment in July 2016. Any delay may result in future adjustments to the preliminary schedule, estimated opening of the subway, and added costs due to escalation • Cost estimates have been developed at approximately 5% design and are a Class 4 cost estimate (per AACE guidelines). Class 3 estimates are required to establish the project budget baseline. • Escalation rate applied for year of expenditure (YOE/Escalated \$) is based on 4% assumption • Discount rate applied for Net Present Value calculation is based on 3.3% assumption • Potential risks include the incorporation of a single tunnel design and the increased depth of the station(s), which could affect the expected accuracy of the estimates. • Costs assume traditional procurement approach. A separate analysis on project delivery options is underway per City Council direction. 			

Under Option 2A, two options were identified for the bus terminal at Scarborough Centre Station, an at-grade solution and a stacked solution. The at-grade is approximately \$100M less than the stacked version, but the stacked is preferable from a planning perspective. For the purpose of the business case, the at-grade solution is being used as the base case for Option 2A. In an effort to bridge the cost between the two solutions, it is intended that the developer be approached to determine if there may be interest in contributing to the stacked solution, in which case it will be considered further.

Early on, it was determined that the Options 2B and 2C alignments would require shutdown of the SRT during the construction period. The cost associated with an SRT shutdown is estimated

to be \$171M (YOE/Escalated \$), with additional service impacts that would have additional negative implications for transit and road users. As such, Options 2B and 2C were not carried forward in the detailed costing exercise. However, preliminary estimates show that the costs for Options 2B and 2C would be greater than Option 2A.

Option 2C would be significantly more costly than Option 2B and 2A due to the greater track length (approximately 0.5km longer than Option 2B). Option 2C would also require additional costs associated with taking the tunnel boring machine out of the ground and then re-launching it before and after the 1.4 kilometre surface section.

The initial \$3.56B budget for the 3-stop SSE was approved in 2013 based on 0% design (Class 5 estimate). This was based on an initial cost estimate that had been developed in response to a request by City Council to assist in their discussions related to, and ultimate approval of, subway technology in place of the aging SRT line. As there was no design information specific to this project on which to base the cost estimates, and insufficient time to allow design details to be developed, the cost estimate was based on historical cost information for other projects. This was a non-traditional approach to developing cost estimates for large capital infrastructure projects, but was necessary due to the circumstances at that time. As noted in the July 2013 report, TTC staff indicated that the cost estimates were preliminary and based on historical cost per km to be confirmed at 30% design. Given the level of design (0%), TTC staff noted that the accuracy of these estimates should be considered +/- 30% per industry standards. (*See: [2013.CC37.17.Scarborough Rapid Transit Options](#)*). Costs were also developed based on the assumption that the subway extension to be designed and built for an opening in late 2023.

Since 2013, design for this project has advanced to approximately 5%. The associated cost estimate has increased by approximately \$1B (YOE/Escalated \$) more than the original estimate of \$3.56B (YOE/Escalated \$). This is primarily due to two reasons. First, the subway stations were found to be much more complex than the 'typical' stations assumed in the initial estimate. For example, a subway station at Lawrence Avenue East had been assumed to be a typical depth of about 16 metres (the height of a 5-to-6 storey building), but given the topography in that area, the station would actually have to be built about 30 metres below the surface – roughly equivalent to the height of a 10-storey building. The other two stations were also found to require greater depth than originally assumed, though not as dramatic as at Lawrence. In addition, after a thorough assessment was made of the bus services in this area, and how those routes could be modified to feed the greatest number of customers directly to these new subway stations, the associated bus terminal designs were much larger than assumed prior to conducting this necessary study. The added station complexity made up about two-thirds of the extra cost.

The remaining 1/3 of the cost estimate increase relates to the project schedule – now estimated to be 2 years later, in late 2025. The current work has been delayed by approximately one year from the original schedule, which estimated that design could begin in summer of 2015. This was primarily due to key tasks that were added to the original schedule such as the City's development of a new demand forecasting model, and evolving transit plans in Scarborough that resulted in project scope changes. An additional year has also been assumed given the added complexity of the stations, and the potential greater time that could be required due to design-build contracting. The considerable increase in the cost estimate resulting from these factors means the 3-stop approved subway extension is no longer affordable within the approved \$3.56B funding envelope.

Lifecycle Cost Estimate Summary

Operating and maintenance costs (including recapitalization costs) were developed to illustrate potential the lifecycle costs for these options. Lifecycle costs were also developed for Options 1 and 2A based on the traditional 60-year lifecycle assumed for public transit infrastructure (2026-2085). These costs are based on the following assumptions:

- Numbers reported represent the change in costs from the existing Line 2 service currently in operation
- Existing Line 2 headways have been maintained
- The speed used for Option 2A is conservative
- Each option assumes a 6-car train
- Bus and streetcar service changes have not been included
- The operating and maintenance costs are offset by the existing costs to operate and maintain Line 3 (SRT) approximately \$15 million
- Escalation rate applied for Operating and Maintenance was 2%.
- Escalation rate applied for Recapitalization was 4%.

Table 14: Operating, Maintenance & Recapitalization Costs - (YOE/Escalated \$, millions)

	Option 1	Option 2A
Operating & Maintenance	\$4,447	\$2,499
Recapitalization	\$19,446	\$15,439
Total	\$23,893	\$17,938

Table 15: Life Cycle Expenditure (NPV \$2016 millions)

	Option 1	Option 2A
Capital Costs	\$3,834	\$2,639
Operating & Maintenance	\$1,935	\$1,087
Recapitalization	\$2,404	\$1,765
Total	\$8,172	\$5,491

Summary

From a financial case perspective Option 2A- McCowan Express is the preferred option. The \$1B cost estimate increase for Option 1 is a 29% increase in the original cost estimate in 2013 when the initial budget (\$3.56B, YOE/Escalated \$) 3-stop subway extension was approved. The cost of the 3-stop option is now estimated to be \$4.6B (YOE/Escalated \$), with an opening date of 2025. It should be noted this increase is within the +35% range per industry guidelines; and within the original range identified by TTC in 2013. Option 2A is estimated to cost \$3.16 billion (YOE/Escalated \$), and falls within the currently approved budget for the SSE project.

5. Economic Case Evaluation

The economic case evaluation quantifies and monetizes the costs and benefits of a proposed project. The services of a third party were obtained to undertake the economic case assessment using the Metrolinx Business Case Methodology Guidance. It is important to note that the economic case evaluation uses Metrolinx recommended values for economic parameters such as discount rates and inflation. These assumptions are included as Appendix 2.

In this IBC, the economic case evaluation assessed Option 2A in comparison to Option 1 (3-stop McCowan SSE). The economic benefits and costs for Option 2A are therefore expressed relative to Option 1. As noted in the deliverability case evaluation (section 6), significant operational and service implications associated with the requirement to shut down the current SRT screened both Options 2B and 2C out from further consideration. As such, these options were not evaluated in the economic case. The results of the economic case evaluation are summarized in Tables 16 and 17 below.

Through the economic analysis, a Benefit-Cost Ratio (BCR) is generated that compares the economic benefits options over a 60-year project lifecycle. The BCR is determined by dividing the Present Value of the Benefits (PVB) by the Present Value of the Costs (PVC). A BCR that is greater than 1 indicates that benefits cover the costs of the project over the project's lifecycle. BCRs can be useful in assessing the value for money of options under study. A BCR was not determined for Option 2A due to the negative PVB relative to Option 1. This is not surprising as user benefits decrease through the loss of two stations in Option 2A.

The Net Present Value (NPV) of an option is the difference between benefits and costs (PVB-PVC), and offers insight into the present value of the various options under study.

The NPV for Option 2A is \$679,147 (\$2015, thousands) relative to Option 1. This means that, even when factoring in the capital, operating and recapitalization costs, and loss in benefits, Option 2A generates a \$679,147 (\$2015, thousands) in savings over the project's lifecycle. Caution should be applied when comparing the BCRs and NPVs of different projects presented in different business cases due to potentially different base assumptions for business cases. A summary of the economic measures included in this analysis is included in Tables 16 and 17.

The economic evaluation included the following benefits:

- User Benefits: Travel time savings, travel cost savings, crowding relief, etc.
- Producer Benefits (incremental fare revenue)
- External benefits (i.e. Road decongestion, accident prevention, GHG emissions due to reductions in Vehicle Kilometres Travelled (VkT), etc).

Table 16: Summary of Option 2A Incremental Benefits

Benefit	Option 2A (\$2015, 000s)
User Benefits	
Travel Time Savings	-\$698,370
Fare Savings	-\$9,031
Crowding Relief	\$50,388
Producer Benefits	
Incremental Fare Revenue	\$34,432
External Benefits	
GHG Emissions	-\$1,083
CAC Emissions	-\$217
Accident Prevention	-\$7,578
Road Decongestion	-\$90,360
Rail Safety	\$0
Auto Costs	-\$85,302
Total PV of Benefits	-\$807,120

Table 17: Summary of Economic Case

Overall Indicators	Option 2A (\$2015, 000s)
Operating Cost	-\$252,078
Capital Cost	-\$999,743
Recapitalization Cost	-\$234,446
PV of Total Lifecycle Cost ⁸ (PVC)	-\$1,486,267
PV of Benefits (PVB)	-\$807,120
Net Present Value (PVB-PVC)	\$679,147
Benefit to Cost Ratio	N/A

The costs associated with Option 2A, the express option, is lower than Option 1 (3-stop McCowan). The economic benefits associated with the 3-stop option are greater due to the additional station stops. Option 2A offers marginally faster service but less connectivity that would be provided by the two extra stations. This results in a trade-off between faster journey times for through passengers and the better access connectivity of more stations.

A key consideration when evaluating a reduced cost option, as is the case between Option 2A and Option 1, is the proportion of the cost savings relative to the economic benefit that is lost through those savings. Based on the current cost assumptions, it has been estimated that Option 2A has 60 year lifecycle costs that would be approximately \$1.5 billion lower than the three-stop option. In contrast, approximately \$0.8 billion in benefits is lost through the express option cost savings. This means that for every two dollars saved in delivering Option 2A approximately one dollar in benefits is given up. As such, Option 2A offers better value for money than Option 1.

6. Deliverability and Operations Case Evaluation

The Deliverability and Operations Case considers key challenges to implementing a project. Implementation challenges have been highlighted for each option from a technical/engineering perspective, operational perspective, and project delivery and governance perspective.

This is an initial business case intended to support the screening of options. As the project progresses and the preferred option is selected and further refined through more design and project risk assessment, the Deliverability and Operations Case will be further developed. The

⁸ The costs included in the financial case evaluation were utilized in this evaluation, the evaluation is based on 2015\$ and applies a discount rate of 3.5% whereas the financial case section applies a discount rate of 3.3%.

purpose of this section of the initial business case is to identify emerging deliverability and operational issues which may impact the selection of a particular option and identify next steps.

In the initial screening of the options, Options 2B and 2C were screened out due to deliverability challenges associated with the requirement to shutdown the SRT during the construction period. An SRT shutdown would result in large service and cost impacts, and was considered a large challenge to implementing Options 2B and 2C. As such, Options 2B and 2C were removed from further consideration in this initial business case. A discussion of these challenges and other deliverability challenges is included below.

Operation and Service Planning Considerations

An SRT shutdown would be required for Options 2B and 2C which would result in additional cost and service impacts according to a plan developed during the Transit City period. This plan identified the transit service requirements in the event of an SRT shutdown for the conversion of the existing SRT line to LRT, which indicated that the TTC would require 63 (includes 8 spares) additional buses and infrastructure requirements such as a bus garage facility to accommodate the additional bus fleet, and bus terminal expansions at Scarborough Centre Station and Kennedy Station to accommodate the replacement bus service. The total cost of shutting down the SRT during the construction of the SSE would result in costs of \$171M (2016\$, YOE) in addition to service impacts that would be experienced by transit and road users.

Service

Currently 39,000⁹ customer trips are taken each weekday on Line 3. The shutdown of the SRT would have significant impacts to service quality to both the transit user as well as the average road user.

The transit user will experience much slower and less reliable transit service. Travel time between Scarborough Centre and Kennedy station on the SRT is 12-minutes. A bus ride between the same two stations would take approximately 18-minutes. The average increase in travel time resulting from the SRT shutdown would be 6.4 minutes per trip. Service quality may also be impacted at transfer points due to overcrowding at Kennedy Station and Scarborough Centre station where the majority of SRT users currently transfer. Additional travel time may be required at these transfer points as a result of the location of the expanded bus terminal. Ultimately, the service impacts experienced by current SRT riders may deter them from using public transit which does not support the City's transit planning objectives.

Offering transit capacity comparable to the SRT through a replacement bus service would require the addition of 55 buses to the transit network during peak periods along major arterials like Brimley Road, Midland Avenue, Eglinton Avenue East, Danforth Road, and McCowan Road.

From a road-user perspective, this would have traffic impacts on major arterials like congestion, resulting in social and environmental impacts contrary to the City's transit planning objectives.

⁹ This counts passengers travelling in both directions
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Engineering/Technical Considerations

In terms of constructability, Option 1 is more complex to construct and will also have a greater impact on the community due to the additional stations. Both options are challenged by the station depths on the McCowan alignment, which is a derivative of the topography. However, both Options 1 and 2A are technically feasible.

There are similar impacts for the construction of emergency exit buildings (EEB) and a substation for both options. For the segment between Lawrence and McCowan, Option 1 would require the construction of Lawrence Station, which would involve significant impacts to the operation of the Lawrence/McCowan intersection. The area around Lawrence would be used as a launch/extraction shaft for the tunneling machines. The construction of Lawrence station was also identified as particularly complex due to the topography that would require a deeper station to be built (approximately 30m below surface) than originally assumed. Similar challenges were found, though to a lesser extent, for the other two Option 1 stations. Option 2A would require an EEB, substation and fan shaft. There would be minimal impact to the community as these would all be located off-street.

At Scarborough Centre, Option 1 and 2A will both impact the mall and road infrastructure. However, the impacts of a Scarborough Centre station for Option 1 would be smaller given the smaller bus terminal requirement. In contrast, a Scarborough Centre station in Option 2A would be a terminal station, requiring a larger bus terminal. There would also be more significant impacts at Scarborough Centre with Option 2A since the tunneling would start at this location. A tunnel work site has been identified for Ellesmere and McCowan.

Additional tunneling and construction of EEBs would also be required for Option 1 for the segment beyond Scarborough Centre to Sheppard Avenue and McCowan Road. Moreover, the construction of Sheppard will require some work under Sheppard Avenue. The work zone would be adjacent to the station, on lands that would have to be acquired for the bus terminal. These challenges are not applicable to Option 2A.

Capital Project Delivery Considerations

In May 2015, City Council considered the report, [EX 5.6 Scarborough Subway Extension-Project Delivery Options](#), and directed the City Manager, in consultation with the CEO, TTC and the Deputy City Manager and Chief Financial Officer to report to City Council with a recommendation on whether to proceed with a Design-Bid Build or Design-Build-Finance option for project procurement. Direction was also given to provide recommendation on project management, delivery and governance. Authorization was provided to retain the services of Infrastructure Ontario to support the Procurement Options Analysis (POA) for the SSE. Due to the change in the SSE project scope, further review is required and the requested report to City Council recommending the preferred procurement, project delivery and governance model will be provided to City Council in fall 2016.

7. Conclusions and Next Steps

Table 18: Initial Business Case Analysis Summary

	Criteria	Option 1 (Base Case)	Option 2A	Option 2B	Option 2C
Strategic	Supporting growth and development in Scarborough Centre				
	Supporting Growth				
	Shaping the City				
	Choice				
	Experience				
	Public Health and Environment				
	Social Equity				
	Neighbourhood Impact				
	STRATEGIC CASE SUMMARY				
Financial	Capital Cost (NPV, \$2016, millions)	\$3,834	\$2,639	N/A	N/A
	Operating and Maintenance (NPV, \$2016, millions)	\$1,935	\$1,087		
	Recapitalization (NPV, \$2016, millions)	\$2,404	\$1,765		
	Total NPV	\$8,172	\$5,491		
Economic	Total PV Benefits (PVB) (2015, \$millions)	Option 1 is the Base Case. Option 2A evaluation is incremental to Option 1	-\$807	N/A	N/A
	Total PV Costs (PVC)** (2015, \$millions)		-\$1,486		
	Net Present Value (PVB-PVC) (2015, \$ millions)		\$679		
Deliverability		Greater construction impact than Option 2A due to longer route and additional stations. Station depths greater than anticipated. Both Option 1 and 2A are feasible.	Less Impact than Option 1 due to shortened route. Both Option 1 and 2A are feasible.	Option screened out based on high negative impact to operations due to SRT Shutdown.	Option screened out based on high negative impact to operations due to SRT Shutdown.
		Not recommended	Carry Forward	Screened out.	Screened out.

**Different discount rate used in Financial Case and Economic Case. Financial Case uses discount rate of 3.3% while economic case uses a discount rate of 3.5%.

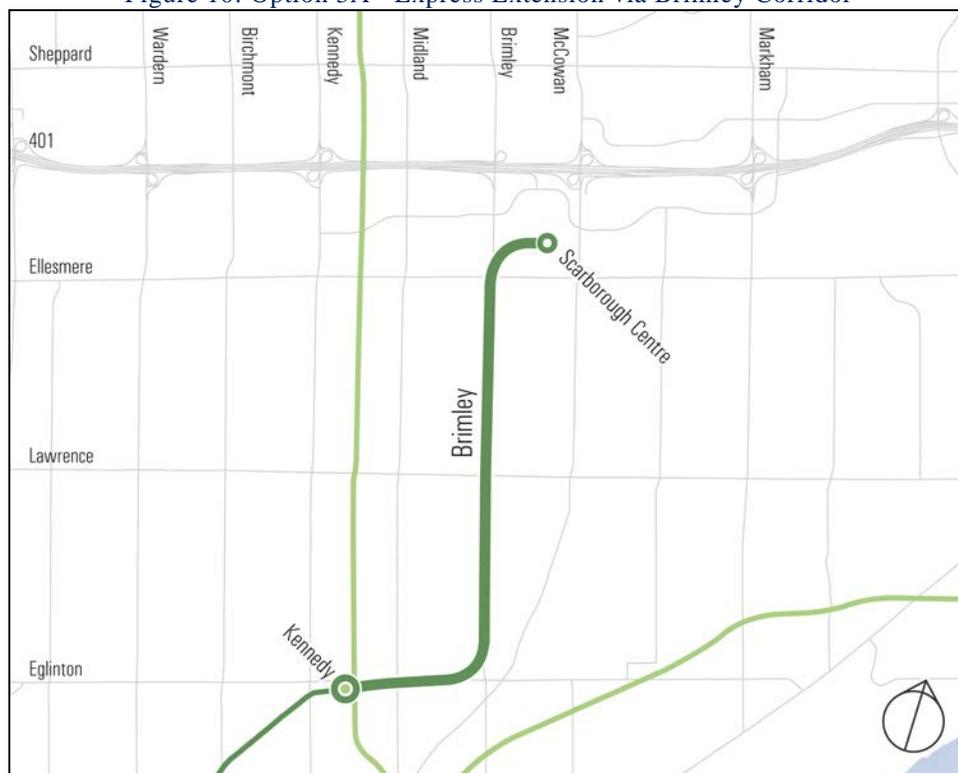
Appendix 1: Alternative Options

Two potential alignments utilizing the Brimley Road corridor have been identified as potential alternatives to the options assessed in this business case.

An alignment via Brimley (Option 3A), similar to Midland (Option 2B), would connect to Kennedy Station, travel north beneath Brimley Road, turn to the east once north of Ellesmere, following the existing SRT alignment to its terminus at a subway station oriented east-west under the existing bus terminal at Scarborough Centre Station (Figure 11). The station would be located at the same location as in Options 2B and 2C.

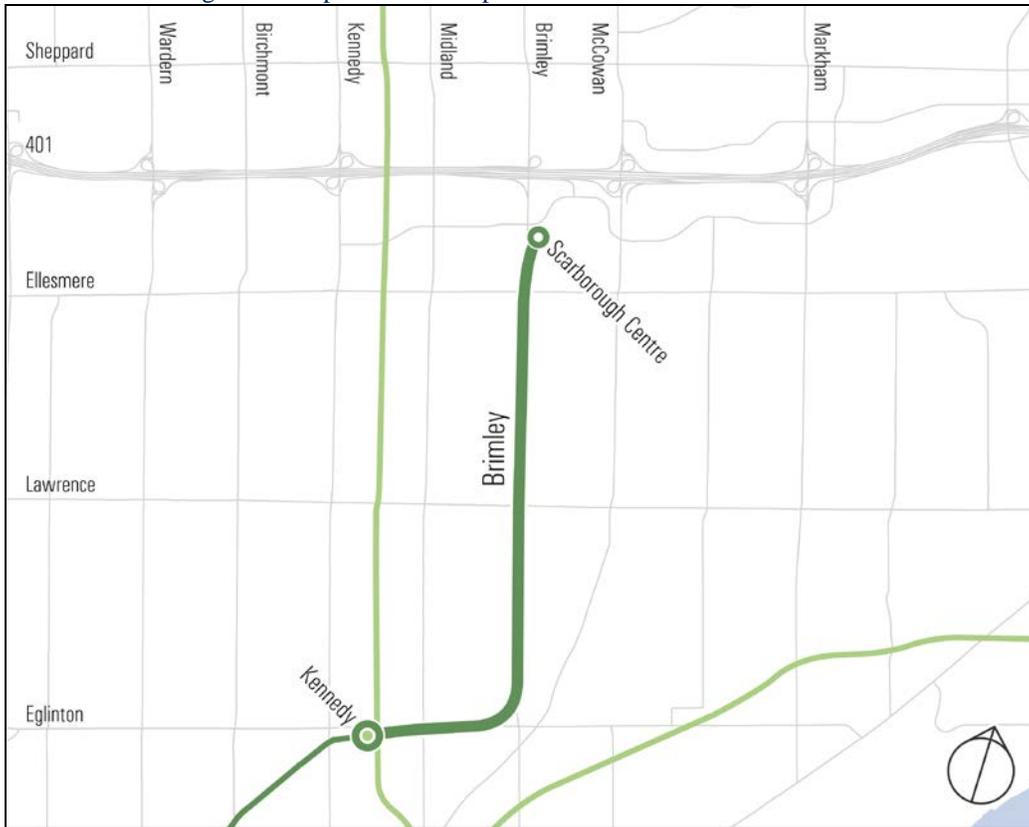
This alignment has been screened out of consideration because it did not offer any benefit over Option 2B and presented more constructability challenges and property impacts around the curve connecting Brimley and the SRT corridor. For example, it would require a very tight turn required around condominium buildings on the east side of Brimley Road.

Figure 10: Option 3A - Express Extension via Brimley Corridor



A variation of the Brimley alignment would connect to Kennedy Station, travel north beneath Brimley Road and terminate on the north side of the SRT corridor (Option 3B). Scarborough Centre Station would be located on the west side of the Scarborough Town Centre in vacant lands, and be oriented towards the north-east. An advantage of this option is it would eliminate the need to close the SRT during the construction of the subway and allow for a relatively unconstrained area for station construction (Figure 12).

Figure 11: Option 3B – Express Extension via SRT Corridor



Appendix 2: Economic Case Assumptions

Table 19: Economic Case Parameters and Value Assumptions

Parameter	Value	Source / Comments
Discount Year	2015	Business Case Development Handbook (BCDH), Metrolinx
Discount Rate	3.50%	BCDH Tier 2 v0.2, pg44, section 10.3.4
Appraisal period (yrs)	60	BCDH Tier 2 v0.2, pg23, section 6.2.2
Auto operating cost savings (\$/veh-km)	\$0.63	Metrolinx recommended value
Auto operating cost savings annual growth (%)	0.7%	BCDH Tier 2 v0.2, pg47, section 10.5.1
Accident value (\$/veh-km)	\$0.07	BCDH Tier 2 v0.2, pg47, section 10.5.1
Accident value annual growth (%)	0.0%	BCDH Tier 2 v0.2, pg47, section 10.5.1
Greenhouse Gas (\$/veh-km)	\$0.010	BCDH Tier 2 v0.2, pg48, section 10.5.2
Greenhouse Gas annual growth (%)	0.0%	Assumed (Value not specified in BCDH)
Air Quality (\$/veh-km)	\$0.002	BCDH Tier 2 v0.3, pg42, table 10.1.5 (not specified in v0.2)
Air quality value annual growth (%)	0.0%	Assumed (Value not specified in BCDH)
Annualization factor	300	BCDH Tier 2 v0.2, pg44, section 10.3.3
Value of Time - Non-working (Commuting) \$ per hour	\$16.13	BCDH Tier 2 v0.2, pg46, section 10.4.2
Value of Time growth (pa)	1.600%	BCDH Tier 2 Draft 0.2, pg46, section 10.4.2
Costs Real or Nominal	Nominal	
Inflation	2.0%	BCDH Tier 2 v0.2, pg22, section 6.2.1

Appraisal Year	Buildup
1	35%
2	70%
3	100%
4	100%
5	100%
6	100%
7	100%
8	100%
9	100%
10	100%

Appendix 3: Background Documents

Reports to Committee and City Council

June 8, 2010 EX44.23 Scarborough Rapid Transit – Transit Project Assessment Study
<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2010.EX44.23>

February 8, 2012 CC17.1 Metrolinx Transit Projects in Toronto
<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2012.CC17.1>

October 30, 2012 CC27.6 Metrolinx-City of Toronto-Toronto Transit Commission Master Agreement for Light Rail Transit Projects
<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2012.CC27.6>

January 21, 2013 TTC Report Response to Commission Enquiry: Service/Technology Choices for Sheppard East and Scarborough RT Corridors
http://www.ttc.ca/About_the_TTC/Commission_reports_and_information/Commission_meetings/2013/September_25/Supplementary_Reports/Scarborough_Subway_O.pdf

July 16, 2013 CC37.17 Scarborough Rapid Transit Options
<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.CC37.17>

October 8, 2013 CC39.5 Scarborough Rapid Transit Options: Reporting on Council Terms and Conditions
<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.CC39.5>

January 28, 2016 EX11.5 Scarborough Transit Planning Update
<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2016.EX11.5>

March 31, 2016 EX13.3 Developing Toronto's Transit Network Plan: Phase 1
<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2016.EX13.3>

Appendix 4: Cost and Schedule Estimate Classification

Classification of Cost Estimates

Cost estimate classification systems are used throughout the estimating industry to categorize cost estimates based on the maturity level of project definition. As project development proceeds; estimate accuracy ranges narrow. This is due to the fact that as project design becomes further developed, more is known about the project and there is a corresponding reduction in risk and uncertainty in the cost estimate.

[The Association for Advancement of Cost Engineering \(AACE\)](#) provides the most generally accepted industry guidelines for cost estimate classification systems. Table 20 depicts AACE's Cost Estimate Classification system which provides general principles for using cost estimates to evaluate, approve and/or fund projects.¹⁰ Table 20 illustrates typical ranges of accuracy. The +/- represents typical variation of actual costs from the cost estimate after application of contingency for given scope. A Class 5 cost estimate is based on the lowest degree of project definition, and a Class 1 cost estimate is based on a the highest maturity of project definition (full project definition). In addition to the degree of project definition, estimate accuracy is also driven by other systemic risks such as familiarity with the technology in the project; complexity; quality of reference cost estimating data; unique nature of the project, etc.

Table 20. AACE International Recommended Practice- Cost Estimate Classification Matrix ([AACE 18R-97](#)), 2016)

Estimate Class	Maturity of Project Definition <i>Expressed as % of complete definition</i>	End Usage <i>Typical purpose of estimate</i>	Methodology <i>Typical estimating method</i>	AACE Classification Expected Accuracy Range <i>Typical variation in low and high ranges</i>	MOTI BC Classification Expected Accuracy Range <i>Typical variation in low and high ranges [a]</i>
Class 5	0% to 2%	Concept Screening.	Parametric models; judgement or analogy	L: -20% to -50% H: +30% to +100%	+/- 35%
Class 4	1% to 15%	Study or feasibility.	Parametric; Elemental factored	L: -15% to -30% H: +20% to +50%	
Class 3	10% to 40%	Budget authorization or control.	Semi-detailed unit costs	L: -10% to -20% H: +10% to +30%	+/- 20%
Class 2	30% to 75%	Control or bid/tender.	Detailed costing	L: -5% to -15% H: +5% to +20%	+/- 10%
Class 1	65% to 100%	Check estimate or bid/tender.	Detailed costing	L: -3% to -10% H: +3% to +15%	

Notes [a] Confidence interval 90% (i.e. expected accuracy 90 times out of 100)

¹⁰ The Association for the Advancement of Cost Engineering (AACE), (2016) http://www.aacei.org/toc/toc_18R-97.pdf
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The estimate level is important in terms of when it is appropriate to establish the project budget. The Ministry of Transportation and Infrastructure (MOTI), Government of British Columbia ([MOTI BC Guidelines](#)) has an established guideline that indicates at minimum 10 to 40% design should be complete (Class 3, AACE Estimate) in order for the estimate to become the basis for developing the project budget. This also is consistent with AACE Cost Classification Standards ([AACE RP No.17R-97](#)).

Further refinement of the cost estimates for the recommended scope of each project is required once further design has been completed, including undertaking project risk assessment processes.

Schedule Estimate Classification

The estimated project schedule also has an impact on estimated project cost. Assumptions based on historical project information were made with respect to the schedule for constructing each project in order to calculate the present value cost for each project.

AACE has published guidelines on recommended practice for the development of project schedules for the purpose of improving the understanding among stakeholders involved with preparing, evaluating and using project schedules for decision-making purposes. Table 21 outlines the AACE Schedule Classification Matrix, which uses the degree of project definition as the primary characteristic to define "Schedule Class". A Class 5 schedule is based on the lowest degree of project definition, and a Class 1 schedule is based on the highest maturity of project definition (full definition).

Table 21. AACE International Recommended Practice- Schedule Classification Matrix¹¹

Schedule Class	Maturity of Project Definition <i>Expressed as % of complete definition [1]</i>	End Usage <i>Typical purpose of estimate</i>	Methodology <i>Scheduling Methods Used</i>
Class 5	0% to 2%	Concept Screening.	Top down planning using high level milestones and key project events.
Class 4	1% to 15%	Study or feasibility.	Top down planning using high level milestones and key project events.
Class 3	10% to 40%	Budget authorization or control.	"Package" top down planning using key events. Semi-detailed.
Class 2	30% to 70%	Control or bid/tender.	Bottom up planning. Detailed
Class 1	70% to 100%	Check estimate or bid/tender.	Bottom up planning. Detailed.

Note [1] AACE RP NO. 18R-97 provides the range in percentages for each class.

¹¹ AACE International Recommended Practice No. 27R-03, (2010), "Schedule Classification System".
http://www.aacei.org/toc/toc_27R-03.pdf