

Yonge North Subway Extension IBC Option 3 Refinement: Supplementary Analysis

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Executive Summary

The Initial Business Case (IBC) for the Yonge North Subway Extension studied three feasible alignment options that could achieve the overall project objectives within its \$5.6 billion announced funding envelope. The IBC evaluated the alignment as initially proposed (Option 1) and included two alternative alignments (Options 2 and 3) in the analysis. The resulting Benefit-Cost Ratio (BCR) ranged from 0.73 to 0.93, generating between \$3.7 billion to \$4.0 billion worth of economic benefits.

The IBC demonstrated that Option 3 would have maximized the benefits of the extension while achieving the lowest cost for the minimum project scope, including Steeles, Bridge (at-grade), and High Tech (at-grade) stations; as well as one additional Neighbourhood Station. Option 3 was the only alignment included in the IBC that accommodates a Neighbourhood Station within the announced funding envelope.

The Option 3 alignment as presented in the IBC saved on the costs of building tunnels and underground stations by leveraging an existing transportation corridor. The alignment is proposed to curve east of Yonge Street in the northern segment of the extension to emerge at the surface north of Langstaff Road to run parallel with CN/GO railway line. The proposed Bridge Station and the alignment and stations north of it would have operated on the surface within the CN/GO rail corridor. The alignment would have passed under a portion of the Royal Orchard community and a small section of Holy Cross Cemetery before reaching the portal north of Langstaff Road.

Metrolinx recognizes there could be sensitivities associated with construction and operations on or near cemetery lands. With those issues in mind, further analysis of the northern section of the Option 3 alignment was advanced immediately after the findings of the IBC were considered by the Metrolinx Board of Directors. The refined alignment proposal presented below, alongside the Initial Business Case will form part of the analysis that is presented in the Preliminary Design Business Case, which will guide the next phase of the project. It represents refinements to the Option 3 alignment to avoid tunneling under Holy Cross Cemetery and any associated land requirements.

This report presents a high-level evaluation of this refined alignment under the four cases of the IBC framework.

The refined Option 3 alignment advancing for further analysis is approximately 150 metres longer than what was presented in the IBC. The refinement applies to the section of the alignment that curves away

from Yonge Street and runs underground to the proposed subway tunnel portal north of Langstaff Road. Any alignment or stations north of the proposed Bridge Station would operate on the surface in and adjacent to the CN/GO rail corridor. The refined alignment continues to allow for four stations within the project funding envelope.

The analysis is consistent with the recently completed IBC. Notably, the Economic and Financial Cases are based on a representative combination of stations that includes Cummer, Steeles, Clark and Bridge.

Figure 1: Yonge North Subway Extension - Option 3 Refinement

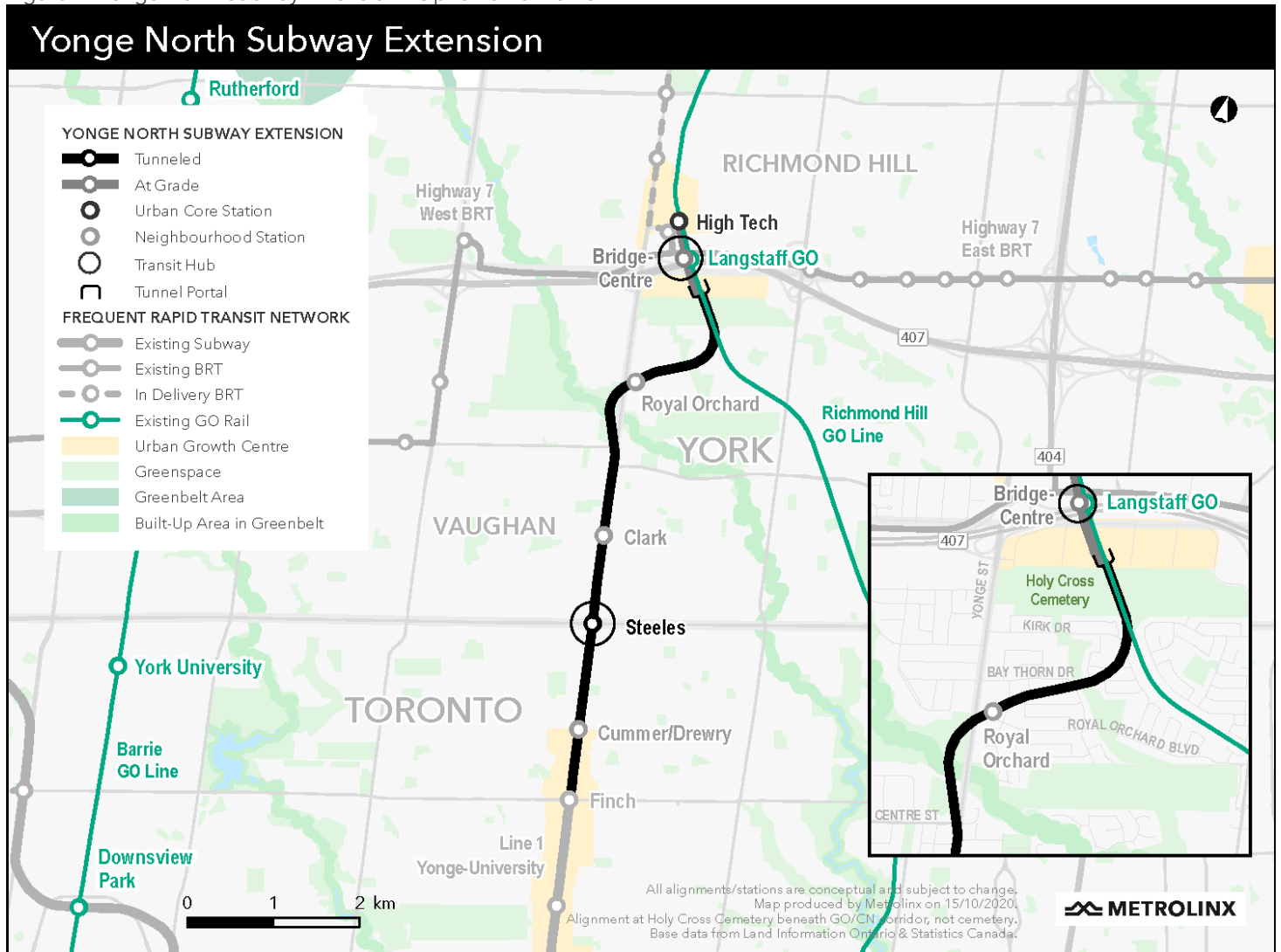


Table 1 summarizes the findings of the evaluation. The refined Option 3 alignment offers improvements compared to a Business as Usual scenario; of note are 835,000 person- minutes daily travel time savings, and \$3,666.5 M worth of economic benefits. The Benefit-Cost Ratio is between 0.74 and 0.86, with an expected BCR of 0.79. The project is expected to be delivered under a Public-Private Partnership (P3) delivery model.

Table 1: Summary of Yonge North Subway Extension Analysis - Option 3 Refinement

Refined Option 3 Alignment	
Strategic Case	
Strong Connections	<ul style="list-style-type: none"> • 94,100 daily riders¹
Complete Travel Experiences	<ul style="list-style-type: none"> • 835,000 person-minutes daily travel time savings compared to BAU • 22 minutes saving on a trip from Langstaff Gateway area (Langstaff/Ruggles) to Downtown Toronto (Yonge/Queen) compared to BAU
Economic Case	
Total Economic Impacts (Benefits) (\$2020, Present Value)	\$3666.5 M
Total Costs (\$2020, PV)	\$4,386.3 M to \$5,135.5 M
Net Present Value (\$2020, NPV)	\$-1,358.6 M to \$-607.9 M
Benefit-Cost Ratio	0.74 to 0.86
Financial Case (\$2020, PV)	
Total Revenue Adjustment	114.4 M
Capital Costs²	\$4,625.0 M
Operating and Maintenance Costs	\$ -39.0 M
Total Costs	\$4,447.1 M
Deliverability and Operations	
Constructability Matters	<ul style="list-style-type: none"> • Coordination with the York Durham Sewage System (YDSS) at Steeles • East Don River Crossing • Construction within the busy Yonge Street corridor • Maintaining services on Line 1 during construction • Interface with the Highway 7 and 407 Corridor
Property Impacts	<ul style="list-style-type: none"> • No tunneling under Holy Cross Cemetery
Operations	<ul style="list-style-type: none"> • Integrated into current Line 1 Operations • Fully automated operation allows for higher service frequencies

Notes:

1- The number of ridership assumed to remain the same as that of Option 3. This is subject to further refinement.

2- Capital costs in the table above are calculated using net present value and presented in economic terms. Therefore, the costs shown are different from the Province's expected investment to construct the project and the project's budget. Treasury Board submissions use year-of-expenditure, escalated to mid-point of construction.



Strategic Case

The refined Option 3 alignment advancing to the preliminary design phase of analysis is approximately 150 metres longer than what was presented in the IBC and thus offers longer travel time by approximately 42 seconds over a one-way trip. However, the impact on ridership is expected to be negligible. The alignment is assumed to attract 94,100 daily subway riders. Ridership modeling includes consideration of travel time on the choices that existing and prospective transit users might have.

A high-level evaluation of the alignment reveals that, even with the slightly longer travel time, passengers still save 835,000 person-minutes per day compared to the Business as Usual scenario. This result is based on the number of people impacted by the longer trip multiplied by the additional travel time associated with the refined alignment.

Station Access - Royal Orchard

Refinements made to the Option 3 alignment result in the location of the potential Royal Orchard Station shifting slightly to accommodate the alignment. It is important to note that the station is still well-located to provide reasonable access for walk-in transit users from the local area and is generally consistent with previously identified sites for a station to serve this community. Station design should ensure that transfers from buses are properly accommodated.

There is a possibility that the revised station location would offer slightly improved access for the Housing York (Thornhill Green) subsidized housing complex with its location east of Inverlochy Boulevard.

It is expected the potential Royal Orchard Station would have similar levels of passenger usage as in the alignments explored in the IBC. Royal Orchard has reasonable levels of walk-in usage, and relatively low passenger transfers from bus. It is notable that Royal Orchard Station is not expected to have significant levels of egress in the morning peak period, suggesting that access to employment is not a key function of the station.

Passenger Experience

The number of curves called for in the alignment refinement result in longer track and slightly slower speeds. A detailed analysis of the passenger impact of the refined Option 3 refinement is underway and results will be presented through the Preliminary Design Business Case.

Impact on other Strategic Measures

Based on the analysis so far, the refined alignment is not expected to have significant differences in transit metrics like mode share, proximity to residents, access to employment opportunities and reduction in carbon emissions.



Economic Case

The table below summarizes costs, benefits and overall performance through the Benefit Cost Ratio (BCR) and the Net Present Value (NPV) calculation.

To maintain consistency, the same stations used in the representative alignment for Option 3 in the Initial Business Case were used to model the refined version of the alignment. These stations are **Cummer, Steeles, Clark, and Bridge (at-grade)**. Therefore, the costs for construction of Royal Orchard Station and its associated benefits were not included in this analysis. In the IBC, Royal Orchard Station was introduced as a “**Neighbourhood Station**”. Further analysis on alignments and station choices will be conducted through the Preliminary Design Business Case.

Table 2 - Economic Case Summary - Option 3 Refinement

Impact Type	Potential Option 3 Refinement (\$2020 PV)
Total Costs (\$2020, PV)	\$4,386.3 M to \$5,135.5 M
Capital Costs	\$4,038.5 M to \$4,716.7 M
Rehabilitation Costs	\$401.8 M to \$472.8 M
Operating and Maintenance Costs	-\$54 M to -\$54 M
Total Impacts	\$3,666.5 M
User Impacts	\$3,654.1 M
External Impacts	\$12.4 M
Fare Revenue Adjustment	\$112 M
Benefit-Cost Ratio (BCR)	0.74 to 0.86
Expected BCR	0.79
Net Present Value (\$2020, NPV)	-\$1,358.6 M to -\$607.9 M



Financial Case

The following is a summary of the overall financial impact of the investment based on the assumptions listed above. Costs below reflect the stations assumed in the IBC - **Cummer, Steeles, Clark, and Bridge (at-grade)**.

Table 3 - Financial Case Summary - Option 3 Refinement

Financial Case Metric	Potential Option 3 Refinement (\$2020 PV)
Total Revenue Impacts	\$114.4 M
Total Capital Costs	\$4,625.0 M
Total Operating and Maintenance Costs	\$-39.0 M
Total Costs	\$4,447.1 M
Net Revenue	\$(4,332.7) M
Total Cost Recovery Ratio	0.03
Operating Cost Recovery Ratio (R/C Ratio)	-2.93

The costs for construction of Royal Orchard Station were not included in this analysis, as this station was introduced as a Neighbourhood Station in the IBC.

Project Cost and Scope

The refined Option 3 alignment can be delivered for approximately \$5.2 billion in capital expenditure, and includes the two Primary Stations at Steeles, and Bridge (at-grade) and one Complementary Urban Core Station at High Tech (at-grade). At this cost, the refined alignment provides the opportunity for one Neighbourhood Station to be included in the project scope and maintain costs within the \$5.6 billion infrastructure budget. Each additional Neighbourhood Station is estimated to cost between \$400 and \$500 million.



Deliverability and Operations Case

The refined Option 3 alignment simplifies property requirements for the project by increasing the length of the infrastructure within the CN/GO railway corridor and avoiding the need to tunnel under Holy Cross Cemetery. Careful planning and project design will still be required, as this alignment will still travel at depth under residential properties before it reaches the portal to the surface north of Langstaff Road.

The subway is proposed to be constructed with a tunnel boring machine at a depth where there would be no direct impact on the homes above. There is the potential for minimal noise and vibration during construction and operations. A noise and vibration study will be undertaken as part of the Transit Project Assessment Process (TPAP) and will identify any required design or mitigation measures to minimize these impacts.

Metrolinx will advise the key community and stakeholder groups to collect their input and engage with those most closely impacted by the work.

CN/GO Rail Corridor

The CN/GO corridor is an important passenger and freight corridor in the region. Geotechnical work will be undertaken to inform the design and any potential impacts because of ground settlement. Engineering solutions and engagement with CN will be critical to address any potential impacts. It will also be critically important to ensure that safety is considered.

East Don River Crossing

The proposed crossing of the East Don River is to occur at significant depth. There should not be additional impact beyond what would be associated with an alignment under Yonge Street.

Operations

At the IBC level of analysis, the longer alignment results in a marginal increase in operational requirements. Additional costs associated have been taken into account in the Operating and Maintenance Costs under the Economic and Financial cases.

The full impact of on operations on the proposed alignment will be reviewed in detailed design. These will include rolling stock, traction power substations and tunnel ventilation and emergency exit.

The proposed alignment is not expected to impact the integration of the extension with existing Line 1 operations.