

To: York Region Rapid Transit Corporation Board of Directors

From: Mary-Frances Turner, President

Subject: **Yonge Subway Extension Conceptual Design – Draft Final Report**

Ref: YORK-#3479546

## Recommendations

It is recommended that:

1. The Board endorse the findings of the Yonge Subway Extension (YSE) Conceptual Design Draft Final Report.
2. The Board authorize the release of the Draft Final Report to the stakeholder municipalities and agencies including Vaughan, Richmond Hill and Markham staff for review and comment.
3. Staff finalize the conceptual design based on the input of all the stakeholders and bring back the final report for board approval no later than December 2011.

## Purpose

This report:

- Provides the Board with the findings of the Yonge Subway Extension (YSE) Conceptual Design Draft Final Report and seeks approval to release the Report for review and comment from the stakeholder municipalities and agencies.
- The Draft Final Report will be finalized for Board approval by the end of 2011 based on input received from the stakeholder municipalities and agencies.

## Background

***An update of the findings of the Yonge Subway Conceptual Design Study was provided to the Board at the May 5, 2011 meeting. The update included:***

- A station design philosophy that provides high quality architecture, increases the potential for TOD, and is reflected in the cost estimate.
- The preferred alignment for the 14 train storage facility to be located adjacent to the CN right-of-way, north of Richmond Hill Centre Station.
- A recommendation that given the complexity and importance of the relationship between TOD and transit facilities, more work needs to be undertaken as part of the next stage of design for the bus terminal located at Richmond Hill Centre.
- The rationale as to why Royal Orchard Station should not be included as part of the YSE.
- The status on the work related to downstream capacity as identified in the Metrolinx initial YSE Benefits-Cost Analysis (BCA).
- The capital cost estimate for the YSE is expected to be in the order of \$3 billion (in 2011 dollars) based on the current level of design (approximately 3 to 5 percent) and the magnitude of contingency being carried in the estimate.

## Analysis

***The key findings in the YSE Conceptual Design Draft Final Report are consistent with the overview provided in May and are summarized as follows:***

- The results of the updated ridership projections show that a subway is warranted for the Yonge corridor, between Finch and the Richmond Hill Centre, within the next 10 years (see Attachment 1 – Executive Summary).
- There is no road capacity to add additional buses to Yonge Street, between Richmond Hill Centre and Finch Station. There is currently a York Region bus every 30 seconds (116 buses per hour) between Finch and Steeles, and a bus every 38 seconds (96 buses per hour) between Steeles and Richmond Hill Centre.
- The minimum ridership required to warrant a subway is approximately 10,000 passengers during the peak hour. Within the next 10 years (i.e. before the

year 2021), over 12,000 peak hour passengers are expected to board or depart at RHC station alone. By 2031, ridership at RHC is expected to increase to 14,000 peak hour passengers. By contrast, the maximum capacity of a BRT on Yonge Street in the proposed subway corridor is approximately 4,200 passengers per hour.

- Based on limited redevelopment opportunities and low station ridership projections, Royal Orchard Station should not be built as part of the YSE.
- The station design philosophy is to provide high quality architecture, urban design, streetscape, and landscape architecture within stations that are integrated with existing and future transit oriented development.
- The conceptual designs for each of the five stations have been coordinated to ensure that there are no conflicts with major utilities such as the York-Durham Sewage System (YDSS) which cannot be mitigated.
- It is recognized that more design and planning work is required for the bus terminal and passenger pick up and drop off (PPUDO) at Richmond Hill Centre Station given the complexity and importance of the relationship between transit-oriented development (TOD) and transit facilities within the area.
- In order to satisfy the requirements of the Subway Rail Yard Need Study (SRYNS), a subway train storage facility is planned to be located north of the Richmond Hill Centre Station.
- The design of the storage facility, the tunnel alignments, and the overall subway extension will not preclude a future extension north of Richmond Hill Centre.
- A short list of structural and operationally feasible options has been developed for the East Don River Bridge which will frame discussions during the next stage of design for the incorporation of heritage elements.
- The capital cost estimate for the YSE, including the 5 proposed stations, has been developed based on the conceptual designs for each project element, including the design philosophy, and is expected to be within the \$3 billion envelope.

***Municipal and agency stakeholders were briefed on the findings presented to the Board in May***

- The briefing was well attended with representatives from Vaughan, Richmond Hill, Markham, Toronto, various emergency services, Metrolinx, ORC and various utilities.

***Next Steps***

- With authorization from the Board, the Draft Final Report will be circulated to the various municipal and agency stakeholders for review and comment.
- The comments received on the Draft Final Report will be addressed and the report finalized and brought to the Board in late 2011 for final approval and authority to release.
- The Draft Final Report is being reviewed by TTC and City of Toronto staff who will also provide comment.
- The Final Report is expected to be presented to the TTC Commission in late 2011.

**Conclusion**

- The comments received on the Draft Final Report will be addressed and a Finalized report will be brought to the Board in late 2011 for final approval and authority to release.

For more information on this report, please contact, Paul May, Chief Engineer, York Region Rapid Transit Corporation at 905-886-6767, Ext. 1030.

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Mary-Frances Turner  
President

August 29, 2011

Attachment: YORK-#3522126-V1-Conceptual Design Report Working Draft Executive Summary

YORK-#3479546-v6-RT\_\_3\_\_Yonge\_Subway\_Extension\_Conceptual\_Design\_Draft\_Report



# **Yonge Subway Extension Conceptual Design Services Conceptual Design Report**

**Contract Y85-9**

**Executive Summary**

**DRAFT**

**AUGUST 2011**



A member of  **MMM GROUP**



**Hatch Mott  
MacDonald**

## INTRODUCTION

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***The Yonge Subway Extension (YSE) Transit Project Assessment Process (TPAP) was approved by the Province in April 2009***

On June 15, 2007, the Province of Ontario announced \$17.5 billion in funding for transit project for the Greater Toronto Area and Hamilton. Named “MoveOntario 2020”, the provincial transit plan includes funding for an extension of the Yonge Subway from its current terminus at Finch Station in the City of Toronto to Highway 7 (Richmond Hill Centre) in the Town of Richmond Hill.

On June 21, 2007, York Region Council authorized commencement of a Functional Planning Study in coordination with the TTC and the City of Toronto for the timely extension of the subway.

On October 3, 2008, following completion of the Functional Planning Study, York Region initiated the TPAP for the YSE project (the Transit Project). At the end of October, 2008, the TTC and the City of Toronto became co-proponents of the Transit Project. Final approval of the YSE TPAP submission was received from the Ontario Minister of the Environment on April 7, 2009.

***Metrolinx completed the initial Benefits Case Analysis (BCA) for the YSE based on the findings of the TPAP in July 2009***

The Metrolinx Board received the July 2009 BCA and directed staff to undertake additional analysis related to the YSE project. The additional analysis was to examine the following areas:

1. Possible adjustments in timing or phasing of the subway extension.
2. Review of the need for some stations in order to reduce capital costs.
3. Consideration of the parallel GO Richmond Hill rail corridor to off-load some of the demand on Yonge Street.
4. The costs impacts of the various options on the subway yards strategy, Yonge/Bloor subway station improvements, and a future Downtown Relief Line to bypass the Yonge/Bloor congestion “pinch point” (Metrolinx Board report – July 23, 2009).

Additional conceptual design work and network planning was required in order to address issues that might arise out of Metrolinx’ analysis.

***Work was initiated on the YSE Conceptual Design Study to maintain a state of readiness and to address outstanding issues from the initial Metrolinx BCA***

In October 2009, the Regional Municipality of York and the City of Toronto authorized York Region Rapid Transit Corporation (YRRTC) and the Toronto Transit Commission (TTC) to proceed with the Conceptual Design Study for the Yonge Subway Extension. The Joint Venture of McCormick Rankin Corporation and Hatch Mott MacDonald was retained by the TTC and YRRTC to carry out the work. The purpose of the study is to undertake the additional analysis resulting from the July 2009 Metrolinx BCA, including an update of the projected ridership and estimated capital costs. The

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Conceptual Design Study also continues to advance the design of the YSE project to maintain a state of readiness for implementation.

## GENERAL DESCRIPTION

***The YSE project is 7.42km in length and it is primarily underground with the exception of the crossing of the East Don River***

The YSE project is 7.42km in length with 1.61km in the City of Toronto (south of Steeles Avenue) and 5.81km in York Region (north of Steeles Avenue). The project comprises a total of 5.08km of twin-bored tunnel, five stations, two major bus terminals, two bus loops, five substations, eight emergency exit buildings (EEBs), one bridge, six cross passages, 513m of twin or triple box structure and an 831m below grade triple track train storage facility north of the Richmond Hill Centre Station. There are three sections of special trackwork: the extension of the Finch Tail Tracks, the crossover south of Steeles Station, and the crossover south of Richmond Hill Station.

The alignment is underground for its entire length with the exception of the crossing of the East Don River where the subway emerges from the tunnels and crosses through the river valley via a two-level bridge – with auto traffic on the upper level and subway on the lower level. The subway level of the bridge will be enclosed to maintain the integrity of the tunnel ventilation system and to mitigate against noise transfer to the surrounding community.

Between Finch Station and Langstaff Station, the alignment runs north below Yonge Street. North of Langstaff Station, two reverse curves are provided to divert the subway from Yonge Street to the preferred location for Richmond Hill Centre Station. Slight modifications have been made to these curves since the TPAP to allow the Langstaff Station to shift as far north as possible to best serve the Langstaff Gateway development.

The operational design basis is for every other Yonge Subway train to continue north from Finch Station to Richmond Hill Centre Station with an average headway of 3.5 minutes (210 seconds) during the peak hour and assuming Automatic Train Operation (ATO). As passenger volumes increase, the design protects for the ability to operate every train to RHC.

## STATION DESIGN PHILOSOPHY

***The station design philosophy is to provide high quality architecture, urban design, streetscape, and landscape architecture with:***

- potential for increased Transit Oriented Development (TOD), with entrances that can be incorporated into future development as economically as possible
- Sustainable above and below grade facilities which minimize negative impact on the environment
- Clearly identifiable entrance facilities that allow daylight to penetrate to lower levels where economically feasible
- Urban gateways at Steeles Avenue and at Langstaff Gateway/Richmond Hill Centre

- Circulation routes to vehicle boarding points that are convenient, intuitive, straight forward, well signed, comfortable, and well lit
- Obvious and convenient intermodal transfers.
- Train and bus platform areas that offer an attractive environment, visual diversions to help pass the time, such as public art, architectural design, televised media, advertising etc.
- Emergency egress routes which are clear, convenient, and safe
- A barrier-free accessible entrance

## PASSENGER DEMAND

### ***Projected ridership at Richmond Hill Centre Station increased 25 percent relative to the TPAP***

The projected transit ridership – developed during the TPAP – was updated during the Conceptual Design Study to reflect revised 2031 land use projections from York Region and the City of Toronto. Results suggest that more people (about a 25% increase) will board the subway at Richmond Hill Centre Station during the morning peak hour in 2031 than previously projected during the TPAP. The resultant increase reflects the implications of new secondary plans and development applications received since the completion of the TPAP in 2009. Based on current analysis, it is projected that ridership volume in the Yonge corridor will warrant a subway within the next 10 years (i.e. before the year 2021). The minimum ridership required to warrant a subway is approximately 10,000 passengers during the peak hour. Within the next 10 years, over 12,000 peak hour passengers are expected to board or depart at RHC station alone. By 2031, ridership at RHC is expected to increase to 14,000 peak hour passengers. The ridership volumes along the line are expected to reach 165,000 daily riders by 2031.

## CUMMER STATION

### ***The conceptual layout for Cummer Station remains largely the same relative to the TPAP***

The length of the station box has been increased by about 20m as a result of conflict with an underground storm sewer. This conflict necessitates a modification of the station's ventilation configuration which resulted in a lengthening of the station box.

Analysis carried out during the Conceptual Design Study has shown that an electrical substation, providing traction power to the subway, will be required at Cummer Station. The substation will be located above the Main Entrance building in the northeast corner of the Yonge Street/Cummer Avenue intersection.

## STEELES STATION

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***Steeles Station still includes an underground bus terminal but the design has evolved to connect all four quadrants of the Yonge/Steeles intersection with a public concourse***

The total number of bus bays at the station has been reduced from 25 to 16 bays by relocating some of the YRT routes from Steeles Station to Clark Station. As a result, there is no longer a need to provide a portal on Yonge Street for YRT buses to access the underground bus terminal from the north. A new concourse level, connecting all four quadrants of the Yonge/Steeles intersection, has been added to the previous two-level concept developed during the TPAP. The new concourse will be situated one level underground and directly above the underground bus terminal. The design recognizes the constraint posed by the York-Durham Sewage System infrastructure located within the Steeles Avenue right-of-way.

The design team has met with the land owner of Centerpoint Mall in the City of Toronto to discuss opportunities for a relocated bus terminal from under Steeles Avenue to the surface in the southwest quadrant of the Yonge/Steeles intersection. This could be explored further as part of the next stage of design.

## CLARK STATION

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***The conceptual layout for Clark Station has evolved to include a bus loop which is incorporated as part of the already planned combined entrance and electrical substation building***

To improve passenger connections to the subway, a small bus loop with three bus bays has been incorporated as part of the main entrance building and electrical substation which were identified in the TPAP. The bus loop allows YRT customers to access the subway sooner, rather than travelling further south in mixed traffic on Yonge Street to Steeles Station as was proposed in the TPAP. The proposed bus loop at Clark Station reduces the number of bus bays required at Steeles Station and eliminates the need for a portal on Yonge Street for YRT buses to access the underground bus terminal at Steeles Station.

## EAST DON RIVER BRIDGE

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***The East Don River (EDR) Bridge has been advanced to better understand the engineering constraints and opportunities***

A number of structurally and operationally acceptable options were developed during the Conceptual Design Study to inform decisions with respect to capital cost estimates. The design options considered a number of engineering issues including; issues associated with the railway enclosure, the transparency of the structure, the height of the road, the central span of the valley, constructability, capital and operational costs, etc. The long list of options was narrowed down

to two options which will frame discussions during the next stage of design for the incorporation of heritage aspects. Based on geotechnical concerns associated with the tunnelling option, the EDR bridge is required regardless of whether Royal Orchard Station is included as part of the project.

## ROYAL ORCHARD STATION

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***Based on limited redevelopment opportunities and low ridership projections, it is recommended that Royal Orchard Station be removed from the YSE project***

Future redevelopment potential in the area of the proposed station is limited as a result of its location within the Vaughan Thornhill Heritage Conservation District. The limited redevelopment and land growth opportunities result in the projected subway ridership volume being too low to justify the expense of building and operating a subway station. The projected 2031 morning peak hour ridership at the station is 350 passengers, which is approximately two-thirds the current ridership of Bessarion Station on the Sheppard Subway, which is the lowest existing volume subway station operated by the TTC. Therefore, based on constrained redevelopment opportunities and low ridership projection, it is recommended that Royal Orchard Station not be included as part of the subway extension.

Nevertheless, based on the distance between Clark and Langstaff stations, an electrical substation and emergency exit building will still be required in the vicinity of the Royal Orchard Station location. Without a station, there are more options to locate these facilities so as to minimize impacts on existing and future land uses in the area.

## LANGSTAFF STATION

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***The design has progressed for the alignment of the Langstaff and Richmond Hill Centre stations***

As a result of further work carried out on the overall alignment, the platforms at Richmond Hill Centre and Langstaff Stations can shift up to 35 metres closer together. The shift requires deviations from the minimum TTC standards, which will require design variance approvals from the TTC. A shift of the Langstaff Station platform to the north will provide a shorter connection to the planned entrance building in the southeast quadrant of the Langstaff/Yonge intersection which will serve the future Langstaff Gateway development.

The design of the commuter parking lot has been advanced in order to provide new stormwater management ponds required as part of the stormwater management strategy for the site. Layout of the parking lot, noise attenuation measures, as well as sustainable design features will be determined as part of the next stage of design.

## RICHMOND HILL CENTRE STATION

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***Several design options for the bus terminal at Richmond Hill Centre (RHC) have been explored***

One option is a single level 25-bay bus terminal connects the underground subway station to Langstaff GO Station via the existing pedestrian bridge. The design also protects for a future passenger connection to the 407 Transitway. The subway station, including the bus terminal, has been designed to be fully integrated into future development and the future road network planned by the Town of Richmond Hill, but can be constructed independently in case the timings of YSE implementation and area development do not coincide.

However, given the complexity and importance of the relationship between TOD and transit facilities within the area, it is recognized that more design and planning work is required for the bus terminal and associated surface facilities at Richmond Hill Centre Station. The conceptual design of the single level terminal has been used for cost estimation purposes only.

***Design principles for the RHC bus terminal have been established***

The key principles for the Richmond Hill Centre bus terminal design are to:

- Provide a high quality, efficient passenger connection between the various modes of transit included within the anchor hub
- Provide good access to facilitate surface transit operations
- Maximize the use of lands that are already encumbered for development purposes
- Facilitate opportunities for integration with future TOD
- Allow for construction and operation independent of the status of surrounding development

Additional work is required to design the bus terminal in conjunction with TOD, to connect the fixed rapid transit elements. This work will be developed through the next stage of design in consultation with all key stakeholders.

## TRAIN STORAGE FACILITY

***A preferred option for the required storage facility to accommodate 14 subway trains north of Richmond Hill Centre Station has been identified***

The need for this facility was identified in the TTC Subway Rail Yard Needs Study (SRYNS), which was endorsed by the YRRTC Board in May of 2010. Options which can accommodate 14 train sets were developed, reviewed, and analysed. Considerations were given to not preclude a future extension of the Yonge Subway north from Richmond Hill Centre. Three short-listed options were evaluated in terms of; a future 16th Avenue station location, property and building impacts, constructability, future extension, capital and operating costs, noise and vibration, operational issues etc. The preferred option for the train storage facility is a 831m long triple-track structure along the west side of the CN rail corridor, under the 15m wide Town of Richmond Hill property planned for future transit use. The train storage facility will require parking, a staff building, and an elevator.

## CONSTRUCTION METHODS

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### ***Tunnelling and cut-and-cover construction methods will be used on the YSE project***

The majority of the project will be twin tunnels which will be constructed by using tunnelling construction methods. Stations, special trackwork, and emergency exit buildings will be constructed by cut-and-cover methods. Because the majority of the YSE stations, special track work, and EEBs are located within the Yonge Street right-of-way, cut-and-cover construction for these facilities will therefore require a series of measures to initially divert traffic and utilities to permit installation of the selected excavation support system.

## CAPITAL COST ESTIMATE

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### ***The conceptual design study finding confirms the capital cost estimate of the YSE project is in the order of \$3 billion, in 2011 dollars***

Based on the costing work, the early stage of design (approximately 3 to 5 percent), and the magnitude of contingency being carried, the capital cost estimate for the YSE project is estimated to be in the order of \$3 billion in 2011 dollars. This estimate reflects inflation since 2008, input from geotechnical infield investigation, evolution of the design, as well as lessons learned from the Toronto-York Spadina Subway Extension (TYSSE). The annual impact of inflation on this project is approximately \$110 million based on an assumed 4% inflation rate per year.

## FUTURE WORK AND NEXT STEPS

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### ***Upon completion of the Conceptual Design Study, several issues will need to be addressed to keep the project moving forward to the next stage of design:***

- Complete a TPAP for the extension of the project to include the underground train storage facility north of Richmond Hill Centre Station;
- Continue work with the Town of Richmond Hill, Town of Markham, the 407 ETR, Metrolinx, and area land owners on integration of a bus terminal with area development to connect the rapid transit infrastructure located within the Richmond Hill Centre Station and the Richmond Hill Centre / Langstaff Mobility Hub;
- Undertake a property protection study to address any property required for the YSE that is not already protected under the approved TPAP.
- Undertake the development of a preliminary engineering work program for the YSE.