

# **DESIGN-BUILD OF A MAJOR TRANSPORTATION PROJECT IN YORK REGION**

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## **Session: Maintenance and Construction: Past-Present-Future**

***Leonard Ng, P. Eng.,***

*Design and Construction Lead, Rapid Transit Liaison, York Region*

***Paul May, P. Eng.,***

*Chief Engineer, York Region Rapid Transit Corporation*

***Mark Popik, M.Eng., P.Eng., AVS***

*Senior Pavement Engineer, Thurber Engineering Ltd.*

### **ABSTRACT**

To help the York Region address their transportation needs for the future, the biggest transportation project in its history has been undertaken to construct rapid bus lanes along four major arterial roadways. Once constructed, the initial dedicated bus lanes for the Viva system will extend about 35 km by 2020. In consideration of the scope of this initiative, the Region understood early in the process that traditional methods for contract delivery would not be adequate for a project of this scope and magnitude, given the pace of delivery. The other consideration was also the complexity of the project, combining road, transit, and Intelligent Transportation System (ITS) elements and making sure they all worked together. With the success of the initial implementation of the Viva project “Quick Start” in 2005, involving bus rapid transit (BRT) in mixed traffic in two major corridors, the Region decided to continue with the design-build process for the following stages of work.

York Region’s vivaNext programme is currently well underway. The programme is funded by the Province of Ontario through Metrolinx. Upon completion, rapid transit infrastructure will be owned by Metrolinx and operated by York Region. YRRTC continued with the design-build process similar to that was carried out in Quick Start. It will expand the dedicated bus lanes along some of the most heavily trafficked roads in the Region. Each contract undertaken as a part of the vivaNext programme had its own unique challenges. With each challenge, York Region has continued to adapt and modify their approach in handling the subsequent contracts. The focus of this paper will be to highlight some of the benefits and lessons learned in managing the design-build contracts.

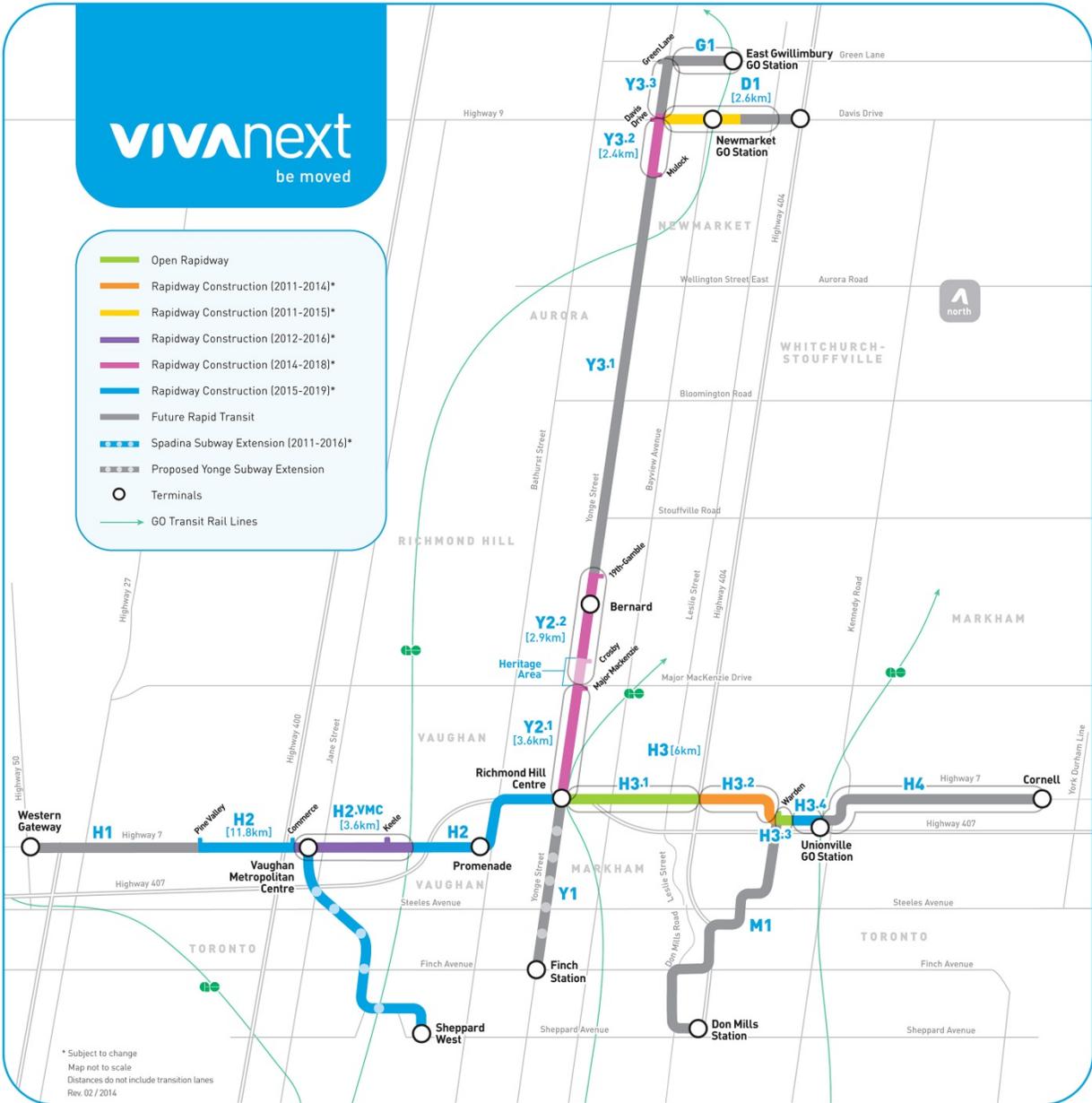


Figure 1 – vivaNext Route Map

## **BACKGROUND**

York Region is located within the Greater Toronto Area (GTA) in Southern Ontario. It is composed of nine area municipalities covering more than 1,700 square kilometres, stretching from the City of Toronto in the south to Lake Simcoe in the north, and bounded by Peel Region in the west and Durham Region in the east. York Region has rapidly grown from a population of 169,000 in 1971 to 1.1 million in 2011, and is expected to reach 1.5 million by 2031.

York's rapid transit concept was the result of the Region's Transportation Master Plan completed in 2002. The study concluded that one of the ways to address the ever increasing traffic congestion in its road system is to encourage greater public transit use. It also identified the top priority was to implement rapid transit services to connect the municipal centres in the urban cores of the Region. The York Rapid Transit Plan was developed to fast track the rapid transit system.

At the outset of this massive undertaking, York Region formed a separate entity, called RapidCo (now known as York Region Rapid Transit Corporation, YRRTC for short). YRRTC is a wholly-owned subsidiary and share capital corporation of The Regional Municipality of York. Its Board of Directors comprises the York Region Chairman & CEO [Chief Executive Officer and Chair of the Board] and four directors who are the Mayors of the Towns of Richmond Hill and Newmarket and Cities of Markham and Vaughan.

YRRTC is responsible for the planning, design and construction of the rapid transit network and related infrastructure; for the pursuit of joint development opportunities; and for the strategic oversight of Viva operations to deliver on the transit priorities set out in the York Region Transportation Master Plan. To achieve this mandate, YRRTC is staffed by a team of experts in capital planning and delivery, design, engineering and project management. They also contract with design-build firms to develop the final design and carry out construction.

Shortly after the release of the Transportation Master Plan, York Region signed a Public-Private Partnership agreement with York Consortium (YC) 2002 to plan the Rapid Transit initiative. YC2002 completed the preliminary engineering design of the funded projects with the expectation of construction being completed before 2020. The engineering and construction partners of YC2002 have followed-through as the Design-Builder of the first project Quick Start and three subsequent projects, Highway 7 in Markham/Richmond Hill (the 'H3' project or Highway 7 East in this paper), Davis Drive in Newmarket (the 'D1' project) and Highway 7 in the Vaughan Metropolitan Centre (the 'H2.VMC' project or Highway 7 West for simplicity). The remaining funded projects will be awarded to Design-Builders through competitive bids based on the preliminary engineering design.

### **Quick Start**

YRRTC developed a short-term and long-term planning and implementation strategy for the Bus Rapid Transit (BRT) system in York Region. In addition, the short term goal was to establish the BRT routes with all of its elements that could be quickly implemented (off-board fare payment, transit signal priority, queue jump lanes where feasible, variable message signs, less

frequent stops). All of these helped to decrease average travel times in the corridor. The first phase of the York Region BRT project “Quick Start” began in 2003 and completed in 2005. The first contract also consisted of the branding of the new “Viva” system, which was to signify the bus rapid transit on the selected corridors. The branding process included new vehicles, a transfer hub in Richmond Hill and more than 90 new stops along Yonge Street and Highway 7 that will become the major routes of the new BRT system.

The Viva buses were operational by the fall of 2005. The new bus system was quickly proven to be successful as ridership surpassed the expectation in the following years. Furthermore, the branding of Viva continued to gain popularity throughout the community.

## **VivaNext**

Riding on the success of Quick Start, YRRTC decided to continue with the next phase of the bus rapid transit, or “vivaNext”, in 2008. It will involve widening of the pavement by an average of 12 metres to accommodate the rapidway, station platform and raised median in the centre of the road. With the funding made available from the Government of Ontario through its crown agency Metrolinx in 2009, the construction of the first project Highway 7 East started in 2010. This project was quickly followed by the expansion on Davis Drive in Newmarket in 2012, and Highway 7 West at Vaughan Metropolitan Centre in 2013. Figure 1 shows the planned routes of the Viva programme. The following phases will be Yonge Street in Richmond Hill (Y2.1 & Y2.2) and Yonge Street in Newmarket, (Y3.2) in 2014; Highway 7 in Vaughan (the remainder of the H2 segments) plus the easterly extension of H3 corridor to Kennedy Road in Markham (H3.4) in 2015 as illustrated in Figure 1. Although the vivaNext programme includes the subway extension into York Region from the City of Toronto, this paper only deals with the bus rapid transit of the programme. The City of Toronto is managing the subway work.

### **VivaNext – The balance of the funded projects**

YRRTC plans to continue on the successes of these initial design-build (D-B) contracts with the construction of the rapidway along Yonge Street, and the remaining segments on Highway 7 corridor, between Pine Valley Drive in the City of Vaughan and Kennedy Road in the City of Markham. With each challenge, York Region continues to adapt and modify its approach in administering the subsequent contracts. The focus of the remainder of this paper will be to outline the design-build process completed to date, and highlight some of the benefits and lessons learned in administering these contracts.

## **EVOLUTION OF DESIGN-BUILD PROCESS FOR VIVANEXT**

### **Quick Start**

As the design and construction of the number of new stops and associated facilities would require large amount of resources and expertise in many specialized fields, York Region decided to issue it as a design-build contract. YRRTC retained an Owner’s Engineer (OE) to assist in administering these contracts and to provide specialized support. The Design-Builder can

coordinate the different elements of the work such as civil, electrical, Intelligent Transportation System(ITS) which would minimize the risks the owner need to take with separate contracts. The Design-Builder can schedule the activities to minimize conflicts between different disciplines as well as compressing the delivery schedule. As a result, the Quick Start programme was completed from a general concept in 2003 to commencement of the Viva service in the fall of 2005. YRRTC would not have been able to achieve this accomplishment through traditional Design-Tender-Build process.

YRRTC initiated the Risk Analysis process in Quick Start to determine the risk allocation. Some of the risks were transferred to the Design-Builder. In the subsequent contracts, the form of the design-build process continued to evolve based on the needs.

### **VivaNext – Phase I - Highway 7 East, Davis Drive and Highway 7 West at Vaughan Metropolitan Centre**

YRRTC also commissioned YC 2002 to fast track the design of a Viva station on Enterprise Boulevard which is part of the Highway 7 East corridor in Markham. This prototype station was put in use in March of 2011. The design team learned valuable lessons in the constructability and practicality of the work which helped the development of the station design as well as minimizing costs and schedule for the rest of the vivaNext project.

Regional staff and the Owner’s Engineer (OE) met with the D-B teams regularly during the design stage to fast track the approval process through continuous dialogues. The same process was carried out for the utility relocation work, as regular meetings were held with the utility companies, and their designers, to ensure the efficiency of the approval process and the coordination of the schedules.

The vivaNext contracts that followed the ‘Quick Start’ programme stressed the importance of accommodating the public in all aspects during design and construction. During construction, the Region compiled a dedicated team to assist in the issuance of lane closure permits and comment on work schedules to minimize traffic disruption. YRRTC also assembled a dedicated community liaison team, who contacted local businesses and residents to ensure they have up-to-date information about the work that was on-going in their area. Continuous updates were also posted and monitored on social media sites such as Twitter, Facebook, and Instagram. The public was encouraged to submit their comments through these sites while the liaison staff worked hard to respond in a timely manner. Variable messaging signs were erected strategically along the work zone to provide drivers with real-time travel time information and the normal, pre-construction travel time – among the first ones to do so in North America.

In addition to the Community liaison team, YRRTC also has a team of staff dedicated to dealing with all of the property acquisitions and the related property work (demolitions, clean-ups, relocations, etc.) The property team would also comment on re-development applications to ensure the other proposed work will fit in with the vivaNext construction.

The D-B team and YRRTC have also kept the local municipalities abreast during the design and construction stages of the project. The local municipalities planned their necessary construction/maintenance work around the Viva project. It has been a collaborative effort to keep up with the winter maintenance. The Region, Design-Builder and the local municipalities were able to respond to public queries and resolved issues in a coordinated and timely manner.

### **VivaNext – Phase 2 - Yonge Street in Richmond Hill and Newmarket**

To introduce more flexibility into the design and construction process, the Region decided to modify the design-build approach to the construction of the rapidway lanes on Yonge Street. YRRTC, Metrolinx, and York Region Engineering staff worked together with the Owner's Engineer to implement the procurement of the Yonge Street project. The procurement team reviewed the previous contracts and other design-build contracts elsewhere before the Pre-qualification process and the subsequent Request for Proposals.

The procurement team prepared the terms of reference for this contract that identified the Region's desired performance requirements. The design-build proponents were given the freedom to submit a bid based on their own recommended design; however, the proposed design must have complied with minimum requirements. The intent was to invite competition and innovation into the design-build process.

### **PREPARATION FOR THE REQUEST FOR PROPOSAL (RFP) – Yonge Street**

One of the lessons learned from the previous contracts was the uncertainty of some elements of the work. YRRTC carried out a number of investigations and studies ahead of the RFP stage to give the proponents a better understanding of the existing conditions. The following are some examples of the investigation work prepared for the proponents:

- A comprehensive detailed Subsurface Utility Engineering (SUE) study was carried out by the procurement team. This would help all parties involved to identify early any conflict between the proposed work and the existing utility installation. Utility relocation can be planned well ahead, but the work must be designed to accommodate the planned utilities. Senior staff of YRRTC met the management of individual utility companies to raise the awareness of the vivaNext project and seek opportunities to further streamline the utility relocation process. Every effort was made to assure mutual interests were considered in the collaboration process.
- The procurement team also conducted a geotechnical study to identify soils and foundation conditions at the planned station platform locations, as well as an environmental investigation to identify any concerns of soil contamination. This additional work allowed the environmental remediation work to be planned more appropriately during the bidding process, and included in the proposed work schedule. The foundation investigation allowed the structural components to be designed and priced more accurately in the proposal stage.
- Additional pavement assessment work was carried out to provide the proponents with as much information as possible on the structural performance of the existing pavement and

underlying subgrade soil conditions. The pavement work completed prior to the release of the RFP included: a preliminary pavement design report; a Ground Penetrating Radar (GPR) survey; Falling Weight Deflectometer (FWD) testing; and a number of pavement cores. Recent photographs of the project corridor were also made available from the Region's Pavement Management System.

- Updated traffic information was collected at each intersection within the project limits, as well as vehicle class distribution of truck traffic.
- A CCTV review was undertaken for the pipe condition of the storm sewers to assess capacity to accommodate the proposed road widening. With this information, the proponents could estimate more accurately for this costly and time consuming work item.
- The OE refined and updated the preliminary design to confirm the property requirements which allowed the Region to start the property acquisition process confidently to give the Design-Builder a head start.

The other applications of lessons learned from the previous contracts were to clarify the objectives of the project and specify the performance expectations.

Taking the pavement design as an example, the pavement specialist of the Owner's Engineer team specified a number of minimum design requirements that needed to be maintained, which were accompanied by performance specifications to monitor the quality of work during construction. In addition to the traditional pavement material and paving specifications used in Ontario (such as asphalt densities, material variability, surface appearance and surface tolerance), performance testing was included that required the use of GPR equipment to measure asphalt thicknesses and FWD testing to ensure that the constructed pavements met the minimum structural strength required in the design. Other performance parameters that were added to the specification included a pavement smoothness requirement and a minimum asphalt density along longitudinal joints. Incentive and disincentive in monetary terms were also developed for a number of the performance specifications that included mat and joint asphalt densities and pavement smoothness. The intent of the performance specifications was to give the proponent certain flexibility in the design of the new pavements while trying to ensure the design and construction will provide a good performing and long lasting pavement structure. As a result, it is anticipated that the bus patrons will enjoy a smooth ride experience on the Viva buses.

Another example of an improvement in the Yonge Street RFP is the management of Utility Relocation work from the lessons learned in the Phase 1 contracts. In the first contract, H3 along Highway 7 East in Richmond Hill and Markham, the Owner retained responsibility for the utility relocation, with input, reviews, design assessment and support by the Design-Builder. However, adequate lead time was not available for the advance work by utilities prior to the roadway, rapidway and boulevard works. This required construction resequencing and other mitigation strategies to accommodate the utility delivery timeframes. For the next project on Davis Drive, the utility coordination work was the responsibility of the Design-Builder, with some up-front utility investigations and coordination work undertaken prior to award. This did help to get work moving more quickly, but again, utility timeframes and delivery rates were difficult to mesh with the Design-Builder's schedule. This led to further enhancement in the utility coordination requirements in the Contract, with better consideration of utility capabilities in the subsequent Contracts. This resulted in a significantly improved result on the third contract, Highway 7 in

Vaughan, with an improved coordination of the Design-Builder's work with the utility work. Even with the improved performance in the third contract, lessons learned could be taken forward to further enhance the utility coordination process.

The utility coordination requirements were further enhanced in the contract on Yonge Street. The enhancements included the requirement to fully schedule the utility work with due consideration for the planned roadway, rapidway and boulevard works. This led to a change in contract completion date to better accommodate the utility relocation works within the Contract. Utility companies were required to set out a utility design delivery process map. This process map was used as the basis for the Design-Builder to work through all aspects of the utility design and permitting timelines. The SUE studies led to an enhanced understanding of the existing utility infrastructure, thereby better informing all bidders of the pre-existing conditions. The Design-Builder was made responsible for all utility coordination, but with more information and knowledge, they were better equipped to take on the risks associated with the utility coordination activity.

The third example of incorporating lessons learned into the Yonge Street contract is the Quality Management Systems (QMS). The initial three design-build contracts of the vivaNext Phase 1 all required the Design-Builder to manage an ISO 9000 compliant Quality System, but the QMS requirements were not detailed in the Contract. Also, the Design Engineer was not tasked with oversight and certification of the work. The certification provided by the Engineer was qualified due to their lack of field presence. Also, the QMS was managed by the Design-Builder's staff. Oversight in the field was performed by the Owner's Engineer. The resulting quality of work was reasonable, but there were a number of issues that arose where production may have trumped quality and the Owner's Engineer staff did not have adequate resources to monitor all aspects of the work. This process offered room for improvement.

The Quality Management Systems were significantly enhanced and the role of an Independent Quality Certifier (IQC) requirement was defined in the Yonge Street RFP. This individual is responsible for developing, managing and auditing the QMS. Quality Assurance and Quality Control is split into two separate activities under the IQC, managed by a separate Quality Control Manager and a Quality Assurance manager. An Engineer with the Lead Design Engineering Team will certify that the work is in accordance with the design and meets the project requirements. The individual and the firm responsible for this certification is responsible for having staff in the field over the duration of the construction to verify that the work is performed adequately and meets the standards and specifications. The field review by the Engineer and the Lead Designer must be performed by qualified and trained individuals, meeting minimum standards set out in the Contract. The requirement of the Lead Designer's Engineer to stamp the "As Built" drawings adds an additional responsibility to manage the content, quality and accuracy of the Issued for Construction drawings. This responsibility will carry through the construction phase to the Red Line and Record Drawings, and to a final stamped, signed certified As-Built drawing prepared by the Engineer. Construction materials testing and the Engineer's inspection activities are governed by the Ontario MTO Construction Administration and Inspection Task Manual. All these activities and quality enhancements are expected to improve the quality processes and to enhance the Design-Builder's QMS.

Another lesson learned is spending more time up-front defining third party work (Regional or local municipal) that may be incorporated in the Viva contracts. The work may include replacement or upgrade of watermain or sewers, and enhanced streetscape features. This should help to reduce the number of changes later on and minimize the impact on the delivery schedule.

We have also benefitted from all of the work on the previous projects to define new standards and specifications for the rapidway/stations, etc. so that there should be fewer post-award changes.

## **CONCLUSION**

The design and construction of the Quick Start contract was deemed a great success by the Region. The Region had the help from the design-build team with their expertise to complete the design and construction of the project in a much shorter time frame than it would have been in a conventional project delivery process.

The subsequent stages of the vivaNext project continued to build on the successes of the Quick Start project. In the development of the most recent RFP, the Region attempted to state clearly the objectives and performance expectations, while providing as much information as practical to clarify the existing conditions to reduce the risks of unforeseen situations. YRRTC expects a fair and equitable outcome of the project for all concerned.

Although the Viva corridors are already heavily travelled, they are expected to become much more vibrant with more and more commercial and high density residential developments. Major work to rehabilitate the infrastructure in the future will not be desirable. Therefore, every effort is taken to construct these works with highest quality during the initial construction. As the Region continues to gain experience in managing the design-build contracts, future projects will continue to evolve to ensure that these contracts are constructed to meet every expectation. In the meantime, the completed work will be closely monitored to ensure proper maintenance will be carried out at the right time. Metrolinx and the Region are committed to ensuring that this infrastructure will remain in top condition to give the transit patrons the convenience and comfort they deserve.