Project Description

2 PROJECT DESCRIPTION

This chapter documents the extensive preliminary planning activities undertaken prior to the commencement of this Transit Project Assessment Process. Preliminary planning activities included:

- Consideration of the significant amount of previous analysis, key decisions and policy directions that influence the planning of this assignment (see Chapter 1)
- An assessment of issues and opportunities created once the decision had been made to use Light Rail Vehicles on the Scarborough RT
- An identification of environmental factors and technical considerations (see Chapter 3 for details) that influences the form and location of the proposed transit infrastructure
- A detailed analysis of major functional design alternatives using a traceable, reproducible decision making process
- Extensive consultation with property owners, key government stakeholders and aboriginal communities (see Chapter 7 for details) and all decisions made through the preliminary planning process
- Consideration for the impact on the transit project associated with funding constraints identified in late 2009 that influenced the type and location of infrastructure needs

This chapter is divided into four major sections. The first section establishes the overall goals and objectives based on the analysis to date and policies in place at the municipal and provincial levels. The second section is the evaluation of major functional design alternatives. Specifically, this section describes the alternatives that were analyzed in finalizing the defined transit project. They are broken down into the following sections:

1) Alternative Designs considered for Kennedy Station
2) Design Development for Conversion of Existing Line and Stations
3) SRT Extension – Network Alternatives Considered
4) SRT Extension – Alternative Alignments

The third section, SRT Extension – Network Alternatives Considered, includes the refinements to the evaluation options which include:

1) Refinements to the southern portion of the extension
2) Refinements to the alignment of the northern portion of the extension
3) Sheppard Bus Terminal location
4) Maintenance and Storage Requirements for the SRT, including the need for a non-revenue service connection in the short term and the long term maintenance and storage needs

The fourth section, SRT Extension – Alternative Alignments, describes the project and the associated features including:

1) Runningway
2) Stations
3) Ancillary Facilities
4) Roadway Modifications
5) Construction Methods

2.1 PROJECT OBJECTIVES

The Scarborough Rapid Transit (SRT) is a significant part of the Toronto Transit Commission's rapid transit infrastructure that already supports many local and provincial objectives. The objectives of this project stem from the results of the previous reports as summarized above. The objectives can be further refined based on the three specific project elements, namely Kennedy Station, the Conversion and the Extension.

2.1.1 Kennedy Station Objectives

Kennedy Station will be modified to accommodate new LRT vehicles, reduce passenger walking distance between the SRT and subway level / platform and accommodate the future Eglinton Crosstown and Scarborough-Malvern LRT lines, while continuing to provide for bus and subway connections, passenger pick up, pedestrian access, GO Transit access, and parking facilities.

2.1.2 Conversion (North of Kennedy to McCowan Station) Objectives

The objective of the conversion from north of Kennedy Station to McCowan Station is to modify the existing SRT line to accommodate the new LRT vehicles. The recommended LRT vehicles have differing characteristics from the current Mark I vehicles. The existing line, from Kennedy Station to McCowan Station, must be modified to accommodate these characteristics. Specifically:

- New trains will operate with 3-car consist (approximately 96 metres long) - existing trains are 51 metres long;
- The new vehicles have lower floor heights; and
- Traction power - replace 3rd rail with overhead catenary – increasing overhead clearance requirements.

In order to minimize impacts to the environment and reduce costs, the changes to the existing SRT should maximize the use of existing infrastructure within the existing corridor.

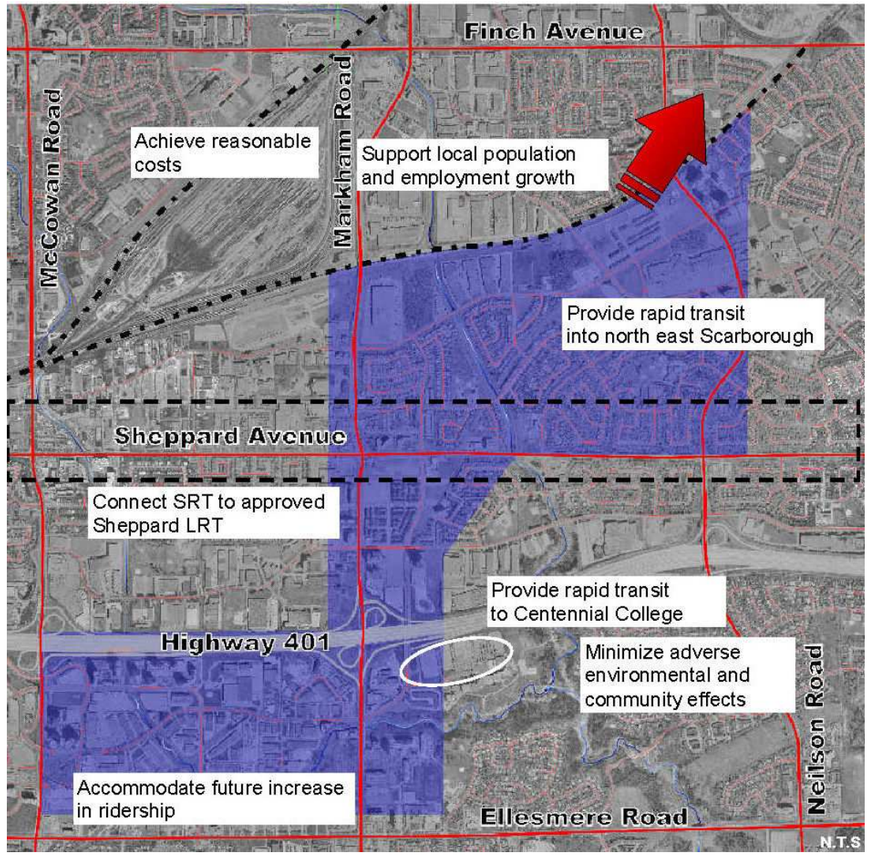
2.1.3 SRT Extension

Based on Provincial and local policies and the transit demand summarized in Chapter 1, the TTC and the City of Toronto developed the following project objectives that form the basis of all planning undertaken as part of this study. As illustrated in Exhibit 2-1:

1. ***Minimize adverse environmental effects*** – the assessment of alternatives must consider all elements of the environment including the natural, archaeological, heritage, cultural and socio-economic features. This is consistent with the Province's objectives as captured in the EA Act.

2. ***Support population and employment growth*** – in keeping with City and Provincial policies, solutions that provide high quality transit into areas of existing and expanding concentrated development while reducing the overall dependency on private automobiles, lead to sustainable development. Northeast Scarborough and Markham have experienced rapid commercial and residential growth, and this growth has generated an increase in commuter traffic through and within the area. The City of Toronto has recognized the growing problem of traffic congestion in major urban areas such as northeast Scarborough and the resulting economic, social and environmental costs. Fast, high quality, reliable transit service can counter this trend.
3. ***Improve rapid transit service to the northeast Scarborough area*** - The main objective of this study is to determine the best option for providing transit service to the Malvern community (see Exhibit 2-1) and to introduce transportation system improvements in the northeast sector of the City.
4. ***Connect SRT to proposed Sheppard East LRT*** – A part of the Transit City plan is to provide interconnecting transit for the public. A connection between Scarborough Rapid Transit and Sheppard East LRT will provide the necessary link and transfer opportunity for passengers.
5. ***Improve rapid transit service to Centennial College*** – the large number of students and staff at the community college represents a major source of potential riders.
6. ***Accommodate existing ridership and future increases in demand*** – the existing SRT already accommodates some of the highest ridership on TTC's current system (outside of the subway). With continued growth in Scarborough and increased transit demands, the ridership volumes from Kennedy Station to the proposed end of line will increase. The SRT extension must be designed to meet both short and long term demands.
7. ***Achieve reasonable capital and operating costs*** – As it is the TTC's objective to provide high quality transit service throughout the City of Toronto, the SRT solution must be a cost effective use of public funds.

Exhibit 2-1: Project Objectives for the SRT extension



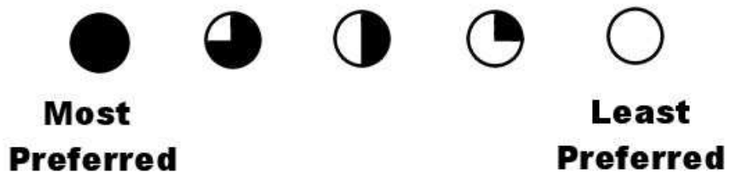
2.2 Evaluation of Major Functional Alternatives as part of Preliminary Planning Activities

Prior to the commencement of this Transit Project Assessment process, an extensive amount of preliminary planning was undertaken. The following describes the work undertaken prior to the Notice of Study Commencement.

2.2.1 Evaluation Scoring Systems

As a method of depicting the most preferred to the least preferred option, a series of pies were used to within the analysis and evaluation table. Exhibit 2-2 shows the options that are available within the analysis and evaluation tables. The most preferred option would be depicted by a filled pie or black circle. The second choice ¾ black, third choice ½ black and so on.

Exhibit 2-2: Evaluation Scoring System



2.2.2 Alternative Designs Considered for Kennedy Station

2.2.2.1 Background

The need for changes at Kennedy Station was triggered by a need to replace the aging SRT vehicles. The new vehicles are physically larger and require modifications to the existing station and running structure. In addition, to accommodate current and future ridership on the SRT, the trains will operate more frequently and in longer consists, resulting in a need for longer platforms. The existing single track platform at Kennedy Station cannot accommodate these changes, creating an opportunity to reduce the existing multi-level transfer between the SRT and subway platforms.

In addition to the changes required for the SRT, the Transit City Program was introduced which included the Eglinton Crosstown (EC LRT) and the Scarborough Malvern (SM LRT) lines, both intended to operate into Kennedy Station.

Based on these requirements, a large number of conceptual design alternatives were generated to accommodate the SRT, ECLRT and SMLRT, in Kennedy Station (see Appendix A-1 for details).

2.2.2.2 Alternative Designs Considered

The Kennedy Station design alternatives were complicated because they had to connect three new RT/LRT lines into an existing station that already had bus, subway and GO Transit facilities, in addition to on-site parking, pedestrian access etc. Concepts were identified that included a range of above-grade, at-grade and below-grade connections for SRT, ECLRT and SMLRT at Kennedy Station. The design and evaluation process also had to consider a number of technical factors and criteria including:

- Passenger Circulation (level changes and walking distance between transit routes and modes)
- Impact on Station Access (Convenience and Travel Time)
  - o Bus Operations
  - o Pedestrian Pick up and Drop Off (PPUDO)
  - o Taxis
  - o Walk-ins
  - o TTC Parking
  - o GO Transit
- Impact on Vehicular Traffic (Congestion and Delays)
- Weather
- Minimizing adverse environmental and community effects (property acquisition/easements and future development)
- Constructability

The evaluation of design alternatives for elevated, at-grade and below-grade scenarios is summarized below. Details are provided in Appendix A-1.

2.2.2.3 Evaluation Criteria

The existing conditions at Kennedy Station, as defined by environmental specialists during the EA, are described in Chapter 3. Because the existing Kennedy Station is located in a highly urbanized area, surrounded by busy streets and commercial land uses with very little natural or cultural environment, some criteria were not considered relevant to the selection of a preferred plan.

2.2.2.4 Analysis of Alternative Designs

Elevated

Generally speaking, the elevated alternative was constrained by the GO Transit corridor and the existing bridge on Eglinton Avenue. Vertical connections to the subway were also poor, requiring passengers to travel three levels between platforms. The above grade alternative was also visually intrusive and therefore was not carried forward for further consideration.

At Grade

The at-grade alternative was better for pedestrian connections, but introduced major challenges for both train and vehicular traffic in and around Kennedy Station. Ultimately, the train delays and traffic impacts of providing at-grade connections to the proposed ECLRT vehicles, as well as delays to general vehicular traffic on Eglinton Avenue, were deemed unacceptable, primarily due to traffic signal timing requirements. Some alternatives would also have affected Transway Crescent resulting in traffic re-routing, which was deemed unacceptable. At-grade alternatives were therefore not carried forward for further consideration.

Exhibit 2-3: Elevated Kennedy Station Option – Alternative C3

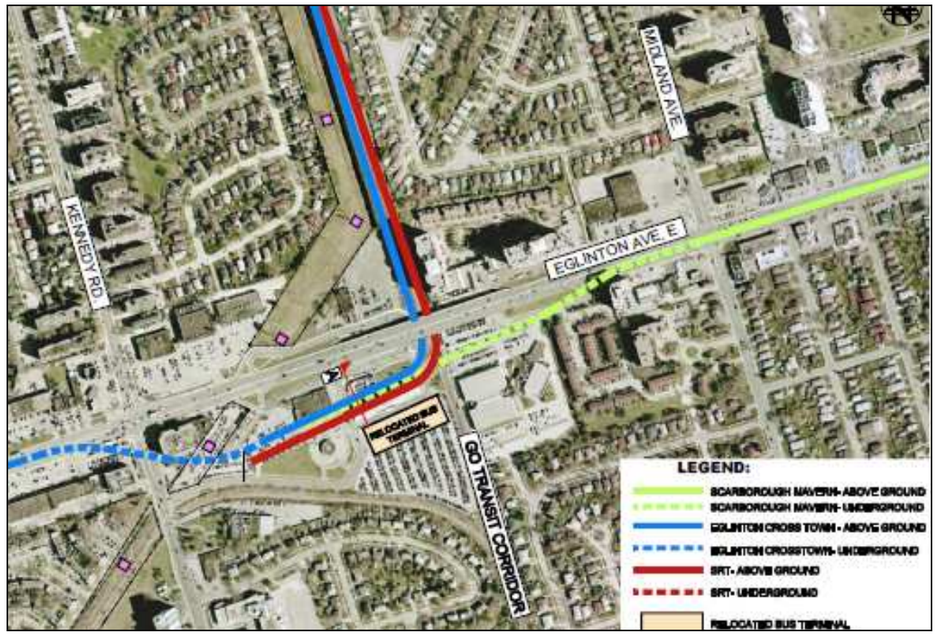
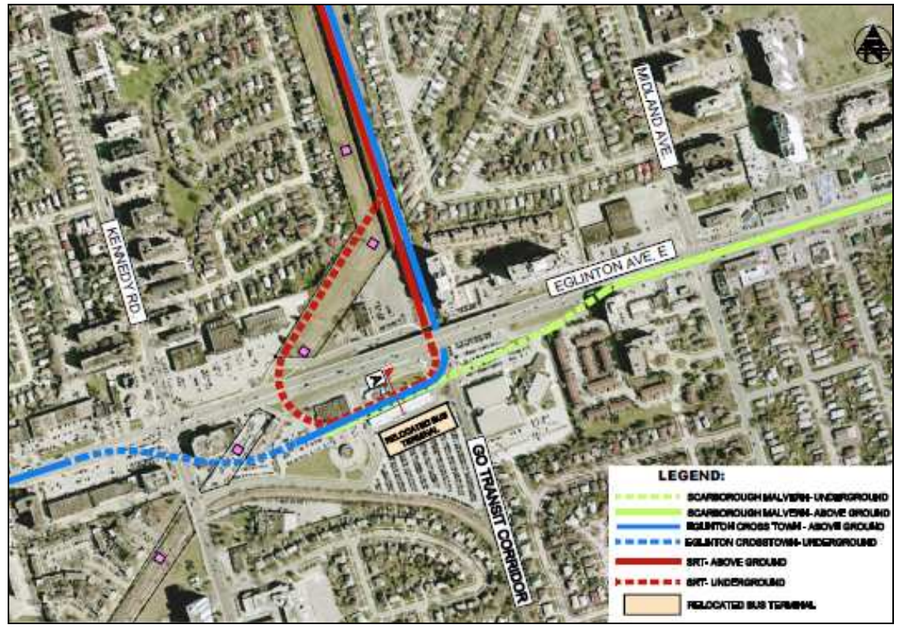


Exhibit 2-4: At Grade Kennedy Station Option – Alternative D2



Below Grade

Ultimately, it became apparent that a below-grade alternative was preferred because it maximizes convenience for passengers, minimizes delays to transit vehicles and other traffic and leaves no permanent visual impact on the surrounding community. It is, however, the most costly alternative.

Exhibit 2-5: Below-grade Kennedy Station Option – Alternative A1

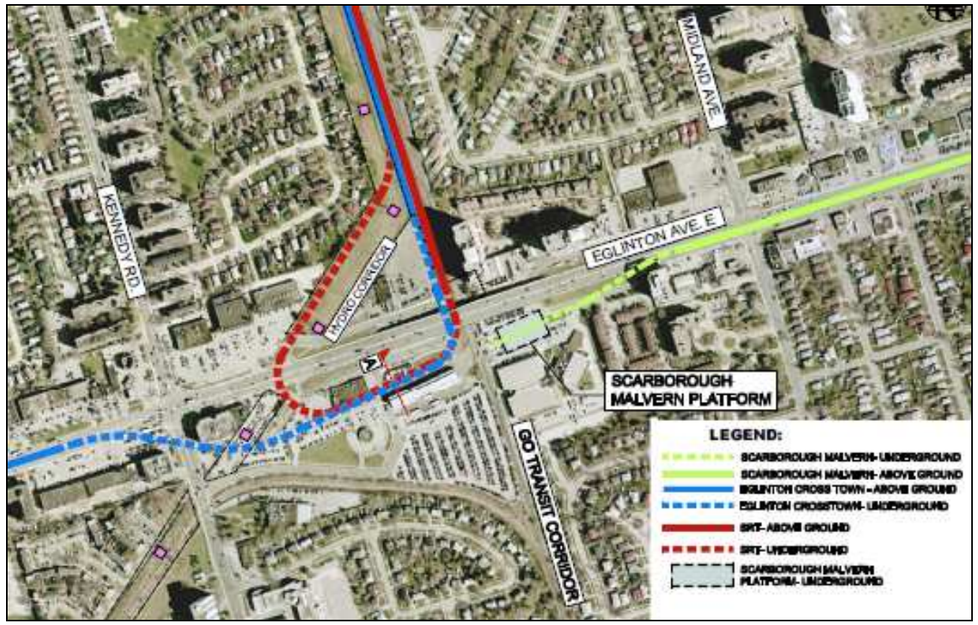


Table 2-1 summarizes the evaluation of design alternatives for Kennedy Station. The evaluation criteria used for Kennedy Station focused on the criteria that are relevant to the existing conditions at the site. Although the natural and cultural environments are important to the EA process, there are no significant features at Kennedy Station (or at the connections to the station) and therefore all alternatives have similar (very minimal) impacts to these criteria.

Relevant environmental criteria include land use (including proximity to residences and commercial businesses), property impacts and potential visual impacts. Other important evaluation criteria included are related to transit service, traffic impacts and cost.

Table 2-1: Evaluation of short-listed design alternatives for Kennedy Station

Kennedy Station Evaluation of Design Alternatives			
	Elevated	At Grade	Below Grade
Transit Service	◑	◕	●
Environmental	◑	◕	●
Traffic	◕	◑	●
Construction Cost	◕	●	◑
OVERALL SUMMARY	◑	◕	●
			RECOMMENDED

A summary of rationale for the rankings in Table 2-1 is as follows:

Transit Service – the below grade alternative is “most preferred” because it enables LRT to run on its own schedule and frequency, with no interruptions from vehicular traffic or other delays. The elevated alternative is “least preferred” because it increases the vertical distance for pedestrians between connections. The at-grade alternative is subject to delay caused by on-street traffic conditions and therefore also not preferred.

Environmental – the below grade alternative is “most preferred” because it minimizes impacts to existing land uses, reduces property impacts and minimizes potential noise impacts to adjacent residences and businesses. In addition, there are no visual, or aesthetic impacts with the below grade alternative. The elevated alternative is “least preferred” because of the visual impacts and potential impacts to adjacent properties and land uses as well as potential increase in noise. The at-grade alternative is also not preferred because it has property impacts that result in removal of businesses and noise impacts to adjacent residences.

Traffic – the below grade alternative is “most preferred” because it does not impact vehicular traffic on Eglinton Avenue or at the intersection with Kennedy Road. The at-grade alternative is “least preferred” and not supported by the City, because it results in poor level of service on Eglinton Avenue and at the intersection with Kennedy Road. The elevated alternative has fewer impacts to traffic.

Construction cost – the below grade alternative is most expensive and therefore ranked as “least preferred” in comparison with other alternatives in this criteria. The at-grade alternative has the lowest cost and is therefore ranked more favourably.

Overall Summary – the below grade is overall “most preferred” because it provides the best transit service, has the least environmental impact and minimizes impact to traffic, although it is the most costly alternatives.

In summary, the recommended alternative involves the SRT connection underground at the mezzanine level of the current subway station and the Eglinton Crosstown and Scarborough-Malvern LRT lines underground at the subway level. This option provides the best combination of efficient passenger transfer between lines and connections to the surface bus terminal and pedestrian access to future developments in the area.

2.2.2.5 Consultation

Throughout the analysis of alternatives and the selection of the preferred, the project team consulted with key stakeholders including Toronto Transportation, Hydro One Networks Inc., Metrolinx and Canada Post. As part of the preliminary planning activities, the recommended design was presented to the public on March 8th and 11th, 2010. Of the public that attended on those two days, 75% expressed support for the design. Reasons provided included:

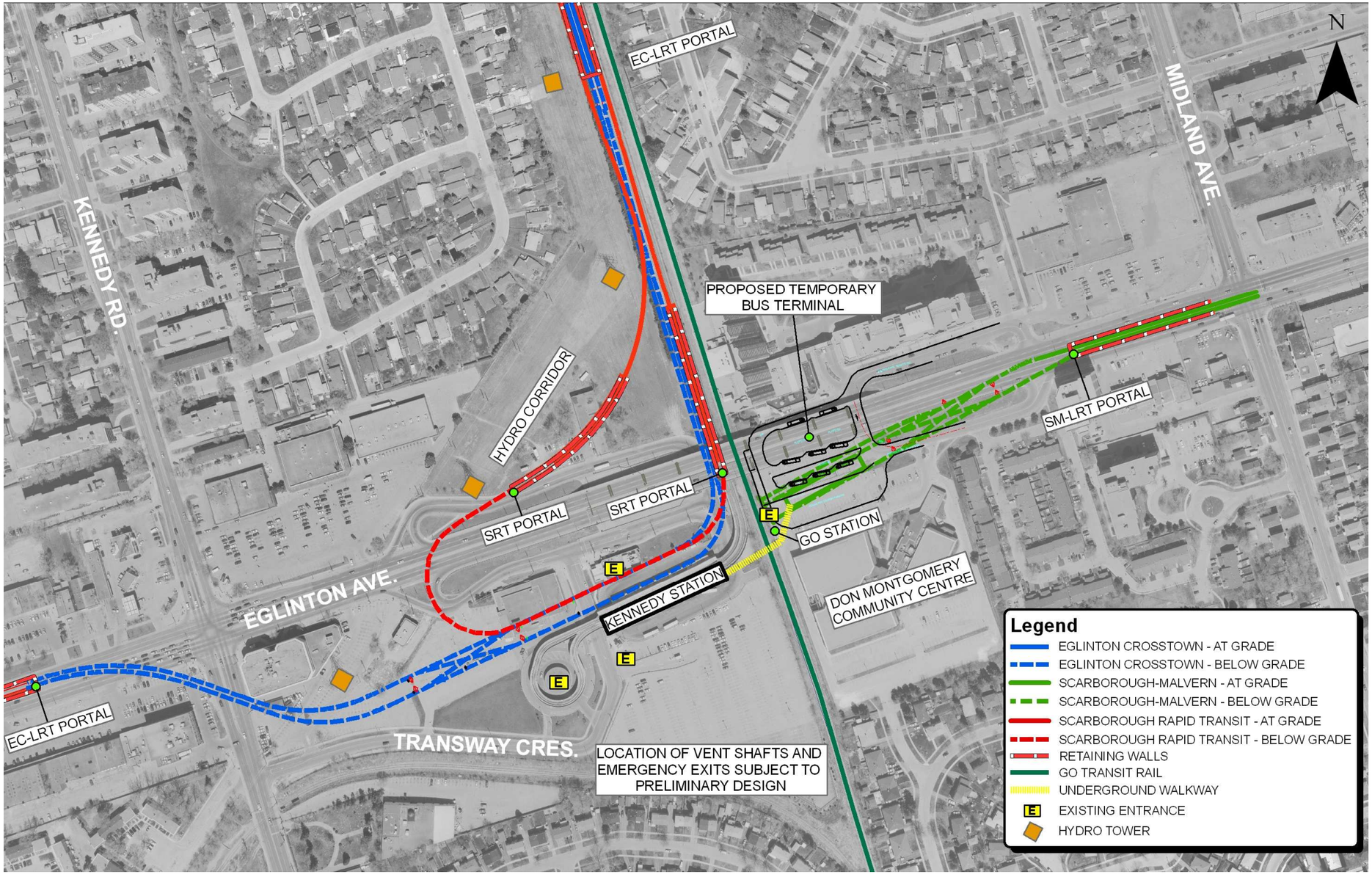
- minimum walking distance for transfers between lines
- opportunity to integrate station into community

The major concern related to the impacts to properties.

2.2.2.6 Area Context

During early consultation in support of this Transit Project Assessment, it was determined that the location of the SRT running structure in the hydro corridor could be modified to be south of the hydro corridor (see Exhibit 2-6: Modified track alignment at Kennedy). This modification reduces impacts to utilities and increases the separation between transit operations and the stable residential neighbourhood to the north.

Exhibit 2-6: Modified track alignment at Kennedy



2.2.3 Design Development for Conversion of Existing Line and Stations

Building on the recommendation from the 2006 Strategic Plan, TTC undertook an engineering assessment in order to quantify the changes necessary on the existing line, from north of Kennedy to McCowan Station.

As the light rail transit vehicle has differing characteristics from the current Mark I vehicle, significant modifications to both the running structure and stations were addressed by this project, including: extending the existing passenger platform lengths; increasing the clearance height inside the station; reinforcing the superstructure of the existing stations and substantive modifications to the elevated running structure between stations to accommodate increased loading requirements; and revising underpass structures to accommodate the larger dynamic envelope. In addition to the conversion modifications, renovations will include alterations to address barrier free deficiencies cited in the June 2006 report at Lawrence East, Ellesmere, Midland, and McCowan Stations (Scarborough Centre Station and Kennedy Station are already equipped with elevators).

As the final design criteria of a specific vehicle have not yet been determined, this TPA has proceeded with preliminary engineering based on a "worst case" analysis of key structural and architectural points. Based upon the longest of several proposed vehicle configurations, the resulting platform design length has been determined to be between 96m and 101m. The structural analysis and reinforcement recommendations to support the increased loads are based upon the model creating the worst case structural load combinations, both static and dynamic. Overhead clearance in the stations is based upon the vehicle requiring the most operating clearance inside the station combined with the new catenary power system requirements. In all cases the top-of-rail height to platform height has been determined to be 0.35m, necessitating a revision to the existing 0.75m configuration. All proposed design vehicles require additional structural support for both the station structures and the guideways to resist the increased design loads generated by the new vehicles.

Lawrence East Station

At present, the tracks immediately to the north and south of the existing Lawrence East station are curved. Tracks within a station must be straight so that the gap between the floor of the vehicle and the edge of the platform can be kept at an absolute minimum. The lengthening of the platform requires a straightening of the tracks and a shifting of the curves and track alignment in order to tie back into the existing alignment. Constraints in the immediate area include a townhouse condominium complex to the southwest of the station and the GO Stouffville Line immediately to the east of the station. Recognizing these constraints, the following three options for the extension of Lawrence East Station were considered.

Extending at both ends – Recommended option

The first option is to increase the length of the existing platform by placing additional structure and platform on both the north and south sides of the existing station, adding a total of 40 meters. This option balances the impact that the addition would have on the south side (for the town homes) against the conflict with the existing GO corridor running on the east side parallel to the SRT tracks.

Extending only to the South – Not Carried Forward

The second option is to increase the length of the existing platform by placing the entire addition on the south side of the station. This option has significantly more impact on the townhouses. This option was not carried forward.

Extending only to the North – Not Carried Forward

The station cannot be extended by placing the entire addition on the north side of the station. The result would be infringement to the GO transit line which would affect its service. This option was not carried forward.

2.2.4 SRT Extension - Network Alternatives Considered

2.2.4.1 Background

The purpose of this preliminary planning stage was to continue to refine the work initiated as part of the 2006 Strategic Planning study. Specifically, this alternative solutions phase was undertaken to determine the best option for providing high order transit service to the Malvern Community.

2.2.4.2 Alternative Designs Considered

Exhibit 2-7 to Exhibit 2-10 illustrate the four network alternatives analyzed for this project. They are briefly described as:

- Option 1: A continuation of the fully exclusive right of way from its current terminus at McCowan Station to Malvern. New stations, conceptually located within the blue zones would include Centennial College, the Sheppard Avenue area and at Malvern Town Centre. A possible transfer connection would be available at Sheppard Avenue with the proposed Sheppard East LRT line. With this alternative, there are different corridors available to run the SRT into the Malvern area, hence the large yellow band. This option would provide transferless service from Malvern to Kennedy Station. During later stages of the analysis, a fourth station was considered at Bellamy Road.
- Option 2: This option closely resembles the original 1994 EA approach by extending the fully exclusive right of way to Markham Road / Sheppard Avenue and having the Sheppard East LRT provide service to Malvern Town Centre. In addition to the existing SRT stations, this network alternative would provide two stations, one at Centennial College and the other at Markham Road and Sheppard Avenue where the fully exclusive right of way would terminate. The proposed Sheppard East LRT line would include a branch at Neilson Road that would run north to the Malvern Town Centre. This option would require some passengers from Malvern to transfer between SRT and LRT at Markham and Sheppard. This option also has the potential for a Bellamy Road Station.
- Option 3: This alternative suggests extending the fully exclusive right of way to Centennial College only, with a separate LRT line running from Scarborough Town Centre to Malvern Town Centre. This alternative provides the shortest extension of the existing line with an additional station at Centennial College and a possible Bellamy Station. The LRT would run from the Scarborough Town Centre north on McCowan Road to Sheppard Avenue East. At this intersection the LRT would join with the proposed Sheppard East LRT east to Neilson

Road, where the LRT would branch north on Neilson Road to Malvern Town Centre while the proposed Sheppard East LRT would continue east on Sheppard Avenue. Transit stops would be provided along the LRT spaced at roughly 400m intervals. This option requires transit passengers from Malvern to transfer at Scarborough City Centre Station if they are destined to the Bloor Danforth Subway, but provides direct service to Centennial College for SRT riders.

- Option 4: The fourth alternative is similar to Option 3 and consists of a separate LRT line from Malvern to Scarborough Town Centre with the SRT passing through Scarborough Town Centre as it does today, terminating at McCowan Station. The new LRT line would run along Progress Avenue to Sheppard Avenue, merge with the proposed Sheppard East Avenue LRT until it branches off north on Neilson Road to Malvern Town Centre. Transit stops would be provided along the LRT, spaced roughly 400m apart.

Exhibit 2-7: Network Option 1 - Extension of SRT to Malvern

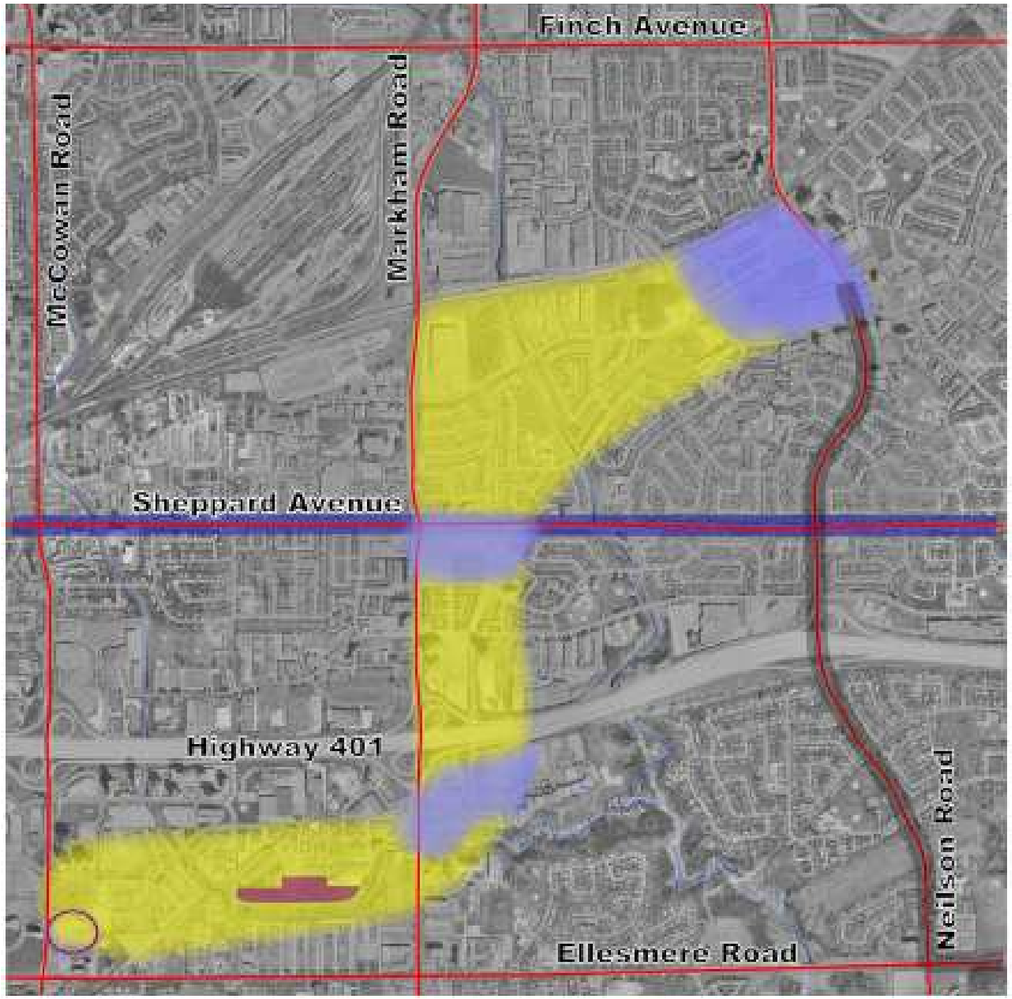


Exhibit 2-8: Network Option 2 - Extension of SRT to Sheppard and LRT to Malvern

Exhibit 2-9: Network Option 3 - Extension of SRT to Centennial College and LRT to Malvern

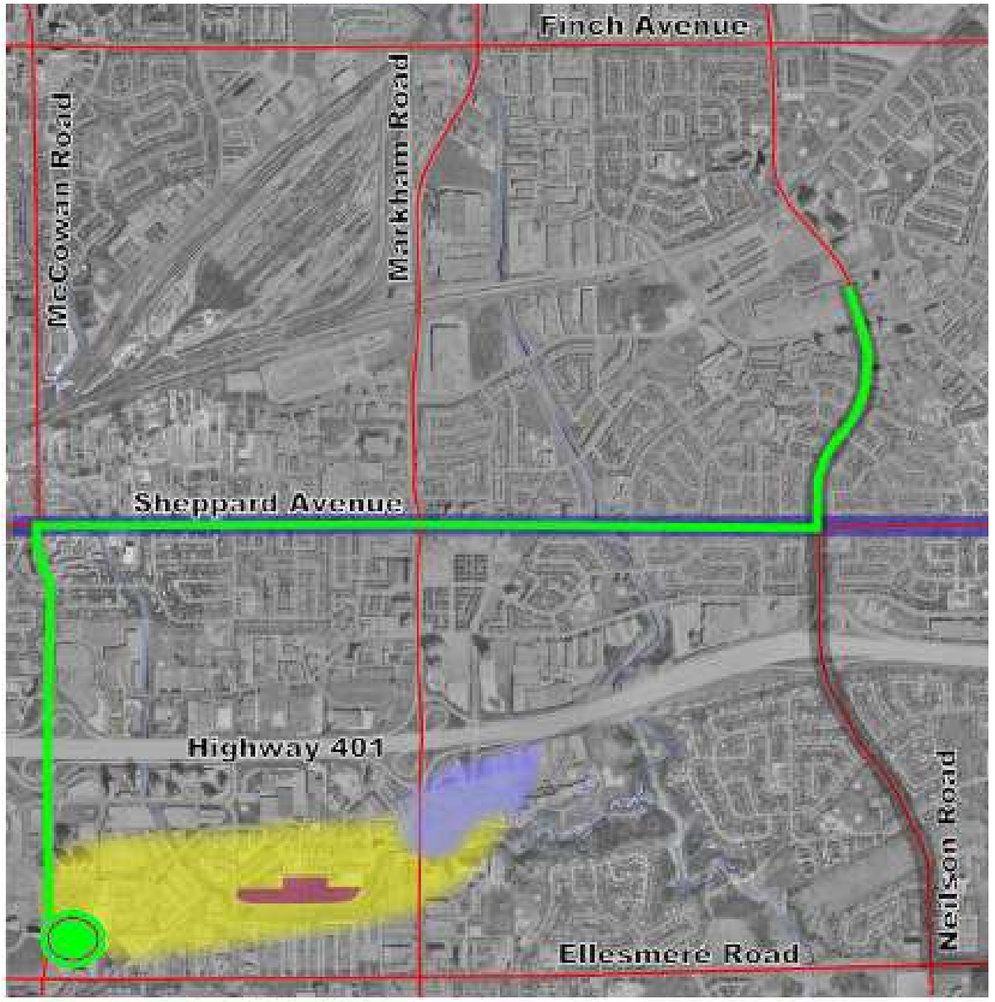
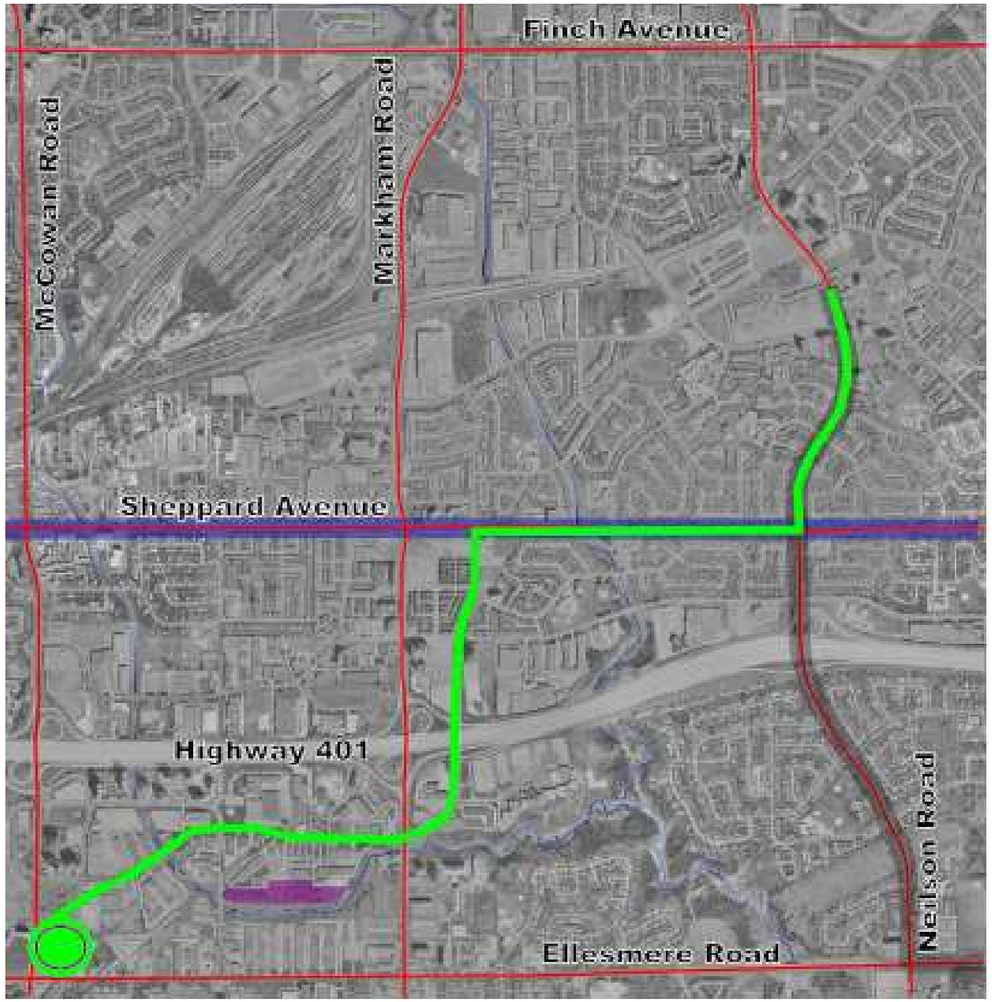


Exhibit 2-10: Network Option 4 – New LRT to Malvern from McCowan Station and no SRT extension



2.2.4.3 Evaluation Criteria

Each of the four alternatives were assessed on their ability to address the project objectives, namely:

1. Achieve reasonable capital costs and operating costs
2. Minimize adverse environmental effects
3. Support local population and employment growth
4. Provide rapid transit into northeast Scarborough
5. Connect SRT to proposed Sheppard East LRT
6. Provide rapid transit into Centennial College
7. Accommodate future increase in ridership capacity

2.2.4.4 Analysis of Alternative Designs

Since all four options can satisfy the project objectives, the selection of a preferred network was determined based on which satisfies the majority of the objectives to the greatest degree.

Table 2-2 summarizes the analysis of the four alternatives. Some alternatives have greater benefits or fewer adverse effects. Based on the detailed analysis contained in Appendix A-2, Network Option 1, an extension of transit in an exclusive right of way to Malvern is preferred because it:

- Best supports population and employment growth by providing the most reliable transit service to Malvern.
- Provides a fast and high quality, no transfer service for passengers traveling between Malvern and Kennedy Station and all points in between.
- Improves transit service to Centennial College.
- Accommodates future increases in ridership demand associated with growth in the study area and allows for a future extension to the northeast to connect with other proposed transit services.

Table 2-2: Analysis of SRT Extension Network Alternatives

Objectives	Option 1	Option 2	Option 3	Option 4
A) Minimize Adverse Environmental Effects	◕	●	●	●
B) Support Population and Employment Growth	●	◕	◕	◑
C) Improve rapid transit service to North East Scarborough	●	◕	◑	◑
D) Connect SRT to Proposed Sheppard LRT	●	●	◕	◕
E) Improve Rapid Transit service to Centennial College	●	●	●	◕
F) Accommodate Future Increase in Ridership Demand	●	◕	◕	◕
G) Achieve Reasonable Costs	◑	◕	◕	●
Overall	**Recommended**	**Not recommended for further study**		

2.2.4.5 Consultation

As part of the preliminary planning, the recommendation to proceed with Network Option 1 was discussed with key stakeholders. At the first round of public consultation on April 15, 2008, the public was given the opportunity to comment on the preferred network option. Of the written comments received, the community agreed with Option 1 as the preferred because:

- "Potential for future expansion North or East later"
- "No Transfers: more transfers = less people who use it"
- "Most of the ridership comes from this area already"
- "It would be the fastest"
- "Markham & Sheppard will be heavily developed and therefore will required a technology that will carry people from Markham"
- "Other options involve too many transfers"

Some concerns expressed regarding network Option 1:

- Noise and vibration impacts
- Visual / Privacy impacts

2.2.4.6 SRT / LRT Hybrid Option

With the current Mark I vehicles and their third rail power configuration, the SRT must operate in an exclusive right of way given the anticipated headway required to meet the current and future ridership levels. However, with the conversion to LRT vehicles and their overhead catenary power system, an opportunity for a hybrid solution which combines fully exclusive and semi-exclusive right of way operations in one transferless system was considered worthy of supplemental investigation.

This investigation included analyzing the required track configuration for an LRT line and associated challenges with horizontal and vertical alignments and operational issues. Areas of focus included the feasibility of operating on Progress Avenue including the bridge at Highway 401 and interlining with the Sheppard East LRT. The cost estimates and risks were also outlined, as were the recommendations regarding the feasibility of the use of LRT technology on the SRT line and SRT extension.

Five different aspects of a hybrid exclusive/semi-exclusive LRT alignment were studied (additional documentation is contained in Appendix A-3):

- Short-turn operations at Scarborough Centre Station or McCowan Station to account for the differences in the projected ridership numbers east and west of Scarborough Centre Station;
- The running structure required on Progress Ave between McCowan and Centennial Station;
- Operational conditions associated with interlining the SRT with the Sheppard East LRT;
- Alternatives for a terminal station at Malvern Town Centre;
- Cost evaluation for the implementation of this project.

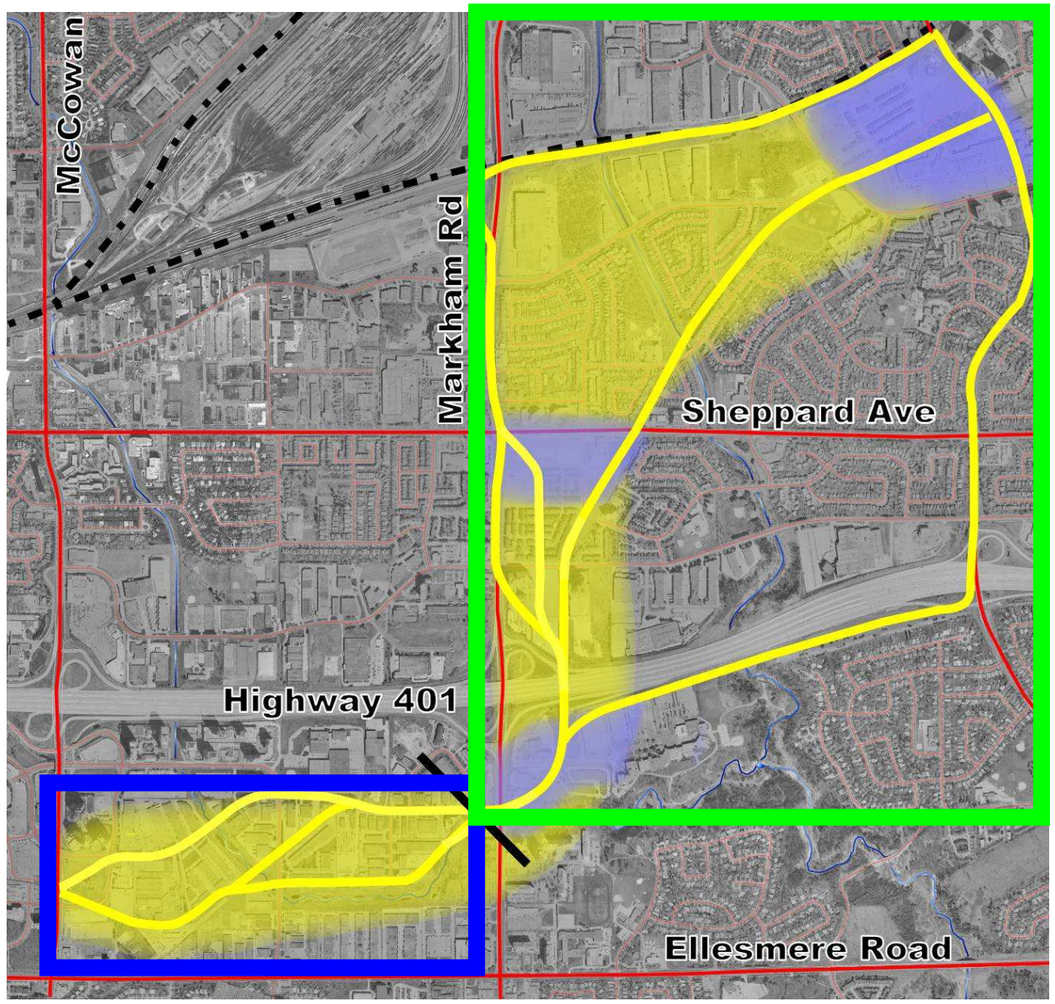
It was expected that on-street facilities would be significantly less expensive to build than fully grade-separated ones. However, due to the physical terrain of the corridor, and the capacity requirements of the existing line and the extension, the cost savings were small compared to the detrimental effect a partially-exclusive option would have on transit service capacity and reliability. As such, a fully grade-separated facility is recommended.

2.2.5 SRT Extension – Alternative Alignments

From the network analysis, the preferred Option (#1) is represented by a large band which defines the possible area within which a specific alignment is possible. Within the selected network option, there are a number of corridors that have a high potential of being utilized as an exclusive right of way for the Scarborough Rapid Transit extension.

Recognizing that all alternatives share common points, including the existing end of line (around McCowan Station), Progress Avenue at Centennial College and Malvern terminus, the study area was divided into north and south segments to facilitate the detailed evaluation of each (see Exhibit 2-11). A detailed discussion and evaluation of each corridor can be found in Appendix A-4.

Exhibit 2-11: Alternative Alignments Considered for Preferred Network Plan



2.2.6 South Alignments

2.2.6.1 Alternatives Considered

Exhibit 2-12 to Exhibit 2-15 illustrate the south segment alignment options analyzed for this project. They are briefly described as:

- South Alignment 1 is the option that continues along Progress Avenue from a new McCowan Station. The concept utilizes Progress Avenue to the greatest extent possible and continues until Markham Road. This option provides a station at the Bellamy and Progress intersection.
- South Alignment 2 continues along the existing corridor from the current yard and connects into Progress Avenue next to the animal shelter. The alignment then follows Progress Avenue until Markham Road. The current McCowan Station will be followed by a new station on Bellamy Road approximately 200m south of Progress Avenue.
- Modified South Alignment 2 still utilizes the current McCowan Station and provides a Bellamy Station approximately 200m south of Progress but follows the north limit of the proposed yard (hatched area on all exhibits) instead of Progress.
- South Alignment 3 closely resembles the original 1992 EA approach in which the alignment travels from McCowan Station. along the existing corridor on a new alignment through the existing yard, thereafter running along the north side of Highland Creek. This option provides a Bellamy Station that is approximately 350m south of Progress Ave.

Exhibit 2-12: South Alignment 1

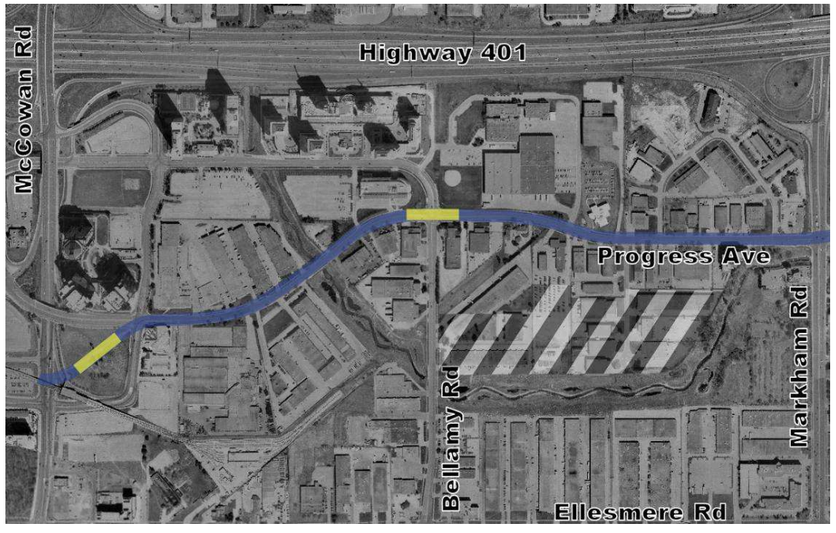


Exhibit 2-13: South Alignment 2

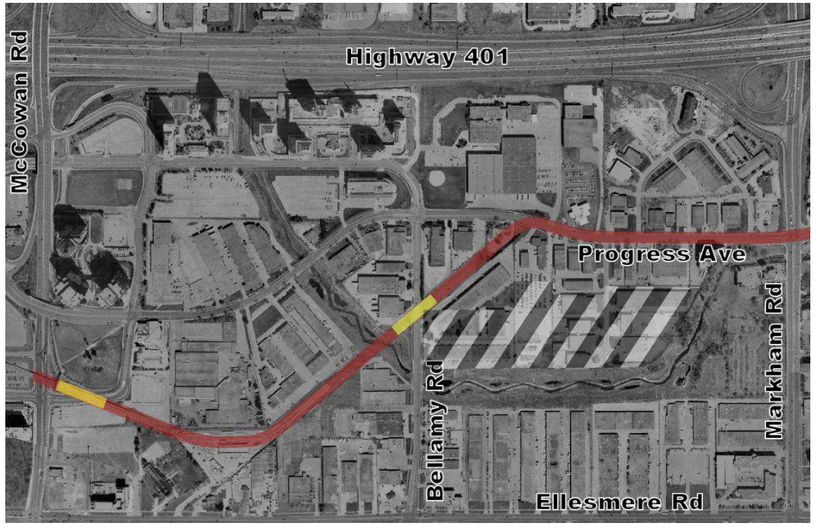


Exhibit 2-14: Modified South Alignment 2

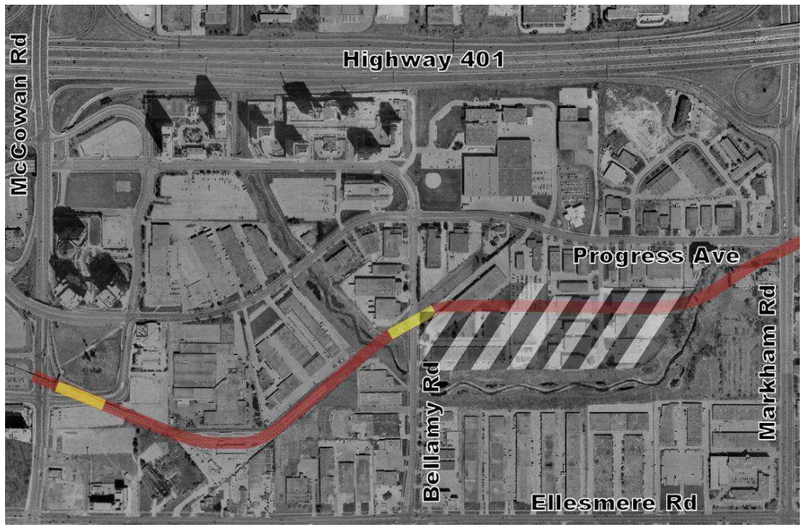


Exhibit 2-15: South Alignment 3

2.2.6.2 Evaluation Criteria

Each of the above south alternatives was assessed on its ability to address the project objectives, namely:

1. Provide rapid transit service to northeast Scarborough
2. Support population and employment growth
3. Accommodate future increase in ridership
4. Minimize adverse environmental and community effects
5. Connect SRT to proposed Sheppard East LRT
6. Provide rapid transit service to Centennial College
7. Achieve reasonable costs

2.2.6.3 Analysis of Alternative Designs

The following conclusions can be drawn after assessing each alternative with respect to the above seven objectives:

- The proposed Bellamy Station and relocated McCowan Station of alignment S1 provides shortest walking distance to existing higher density development in the area. Alignments S2 and S2 Modified can provide most of these benefits. Alignment S3 provides the least coverage.
- The proposed Bellamy Station location and the relocated McCowan Station required for alignment S1 provide the best overall coverage within the Scarborough City Centre

Secondary Plan area, thereby providing the greatest support for City planning objectives and transit oriented development opportunities. Alignments S2 and S2 Modified can provide most of these benefits. Alignment S3 provides the least support of the alternatives being considered.

- S2 Modified is the most preferred alignment as it has the lowest impacts to the businesses along Progress Avenue and modest adverse effects to the natural environment. Alignment S3 has the potential to greatly affect Highland Creek: however, these impacts can be mitigated. Impacts to businesses along Progress associated with S1 cannot be readily mitigated, therefore alignment S1 is least preferred.
- Alignment S1 is the most costly due to the reconstruction of McCowan Station, Progress Avenue and associated property acquisitions. It is therefore the least preferred from a cost perspective. Options S2 Modified and S3 have similar construction costs.

Table 2-3 summarizes the analysis of the south alignments considered.

Table 2-3: South Segment Alignment Analysis

SRT Extension - Alignment Analysis					
Objectives	**South Option 1**	**South Option 2**	**South Option 2 Modified**	**South Option 3**	**Comments**
A) Provide rapid transit service to north east Scarborough	●	◕	◕	◑	The proposed Bellamy station and relocated McCowan Station of alignment S1 provides shortest walking distance to existing higher density development in the area. S2 and S2 (modified) options can provide most of these benefits. S3 provides the least coverage.
B) Support population and employment growth	●	◕	◕	◑	The proposed Bellamy station and relocated McCowan Station of alignment S1 provides the best overall coverage within the Scarborough City Centre Secondary Plan area, thereby provide the greatest support for City planning objectives and transit oriented development opportunities. S2 and S2 (modified) options can provide most of these benefits. S3 provides the least support of the alternative being considered.
C) Accommodate future increase in ridership	–	–	–	–	No difference - not decision relevant
D) Minimize adverse environmental and community effects	◔	◕	●	◑	S2 modified is the most preferred as it has the lowest impacts to the businesses along Progress Avenue and modest adverse effects to the natural environment. Although S3 has the potential to impact the Highland Creek, these impacts can be mitigated whereas the impacts to businesses along Progress (associated with S1) cannot be readily mitigated and therefore S1 is least preferred.
E) Connect SRT to proposed Sheppard LRT	–	–	–	–	No difference - not decision relevant
F) Provide rapid transit service to Centennial College	–	–	–	–	No difference - not decision relevant
G) Achieve reasonable cost	◑	◕	●	●	S1 represents the highest cost due to the reconstruction of McCowan Station, Progress Avenue and associated property acquisition in support of this alignment and therefore is least preferred. Options S2 modified and S3 have similar construction costs.
Summary (Rank)	**2**	**3**	**1**	**4**	S2 modified provides reasonable transit service to existing and future potential higher density population and employment areas at a reasonable cost and low impacts to the environment and therefore it is most preferred. Although S1 provides the best transit service to the immediate area, this option adversely affects the existing business community and costs significantly more to implement and therefore it is the second choice.
			Recommended		

Based on the analysis presented here and in Appendix A-4, Modified South Alignment 2 was preferred because it:

- Provides the lowest impacts to the socio-economic environment
- Provides the lowest impacts to the natural environment
- Provides good coverage within the Scarborough City Centre Secondary Plan area, thereby providing support for City planning objectives and transit oriented development opportunities.
- Has the overall lowest cost

2.2.6.4 Consultation

Input and guidance on the analysis of the south alignment alternatives was sought through extensive consultation with directly affected stakeholders. This included public input during three separate rounds of open houses: PIC #2 – June 4th and June 5th, 2008 and PIC #3 – June 2nd, 2009.

2.2.7 North Segment of Extension Alignment

2.2.7.1 Alternatives Considered

Exhibits 2-16 to Exhibits 2-19 illustrate the north segment alignments analyzed for this project. They are briefly described as:

- North Alignment 1 is a continuation of the original 1994 EA with an extension of the fully exclusive right of way along Markham Road and the CP corridor. This alignment passes through Parkborough Boulevard and approaches the Markham Road / Sheppard Avenue East intersection in a north-west direction before merging with Markham Road. The alignment then travels north and merges into the south side of the CP corridor before turning south onto Tapscott Road to reach Malvern Town Centre along McLevin Avenue. The Sheppard East Station would be at the intersection of Sheppard Avenue East and Markham Road.
- North Alignment 2 is similar to that of North Alignment 1 except that this alignment merges with Markham Road immediately after Highway 401 instead of Sheppard Avenue. In this scenario, the alignment then continues along Markham Road before merging into the south side of the CP corridor and finally turning south onto Tapscott Road to reach McLevin Avenue and Malvern Town Centre.
- North Alignment 3 utilizes the abandoned rail corridor to make a direct connection to Malvern Town Centre via McLevin Avenue. The proposed Sheppard East Station would be within the abandoned rail corridor crossing at Sheppard Avenue next to the Chinese Cultural Centre.
- North Alignment 4 was created in response to public input. North of Centennial College, the alignment turns east onto the south side of Highway 401, utilizing the spaces between the college and the highway right of way before turning north onto Neilson Road. Centennial College station would be located within the campus while the Sheppard East Station would be located at the intersection of Neilson Road and Sheppard Avenue.

Exhibit 2-16: North Alignment 1

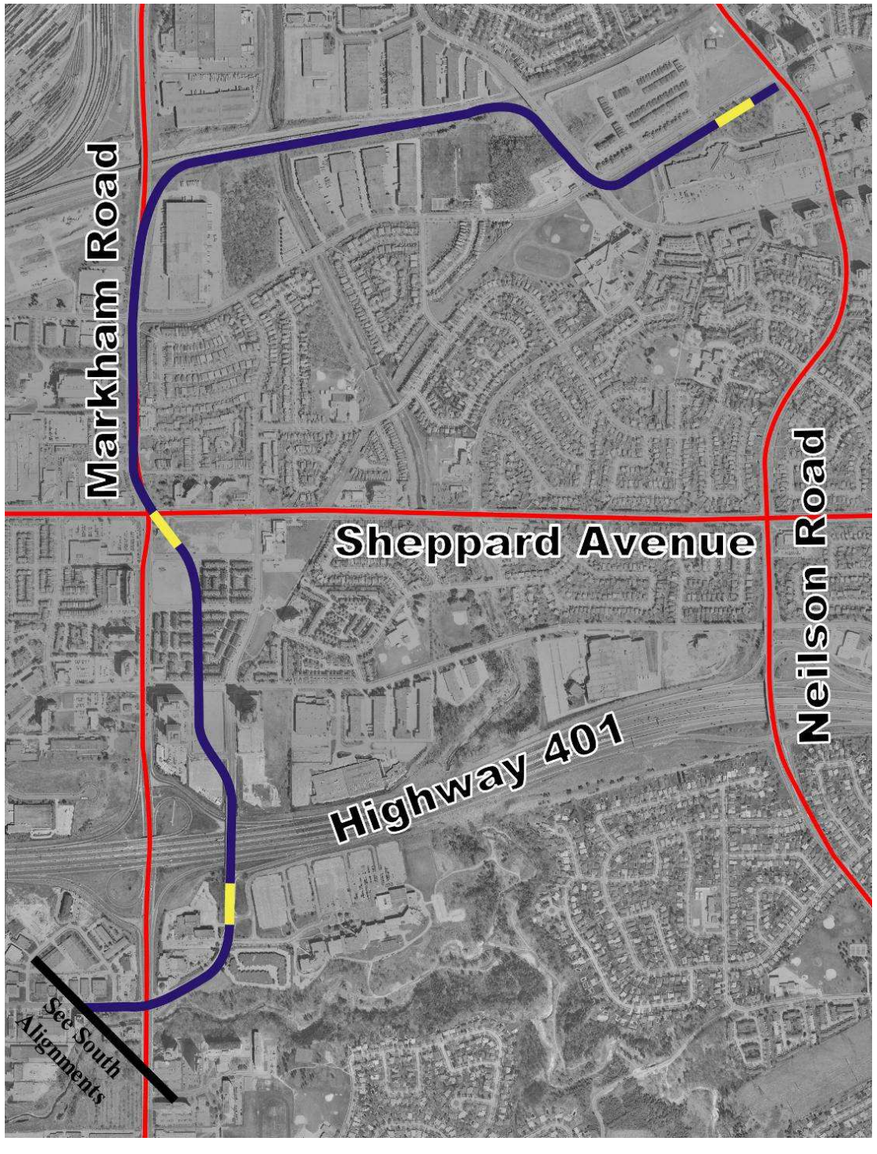


Exhibit 2-17: North Alignment 2

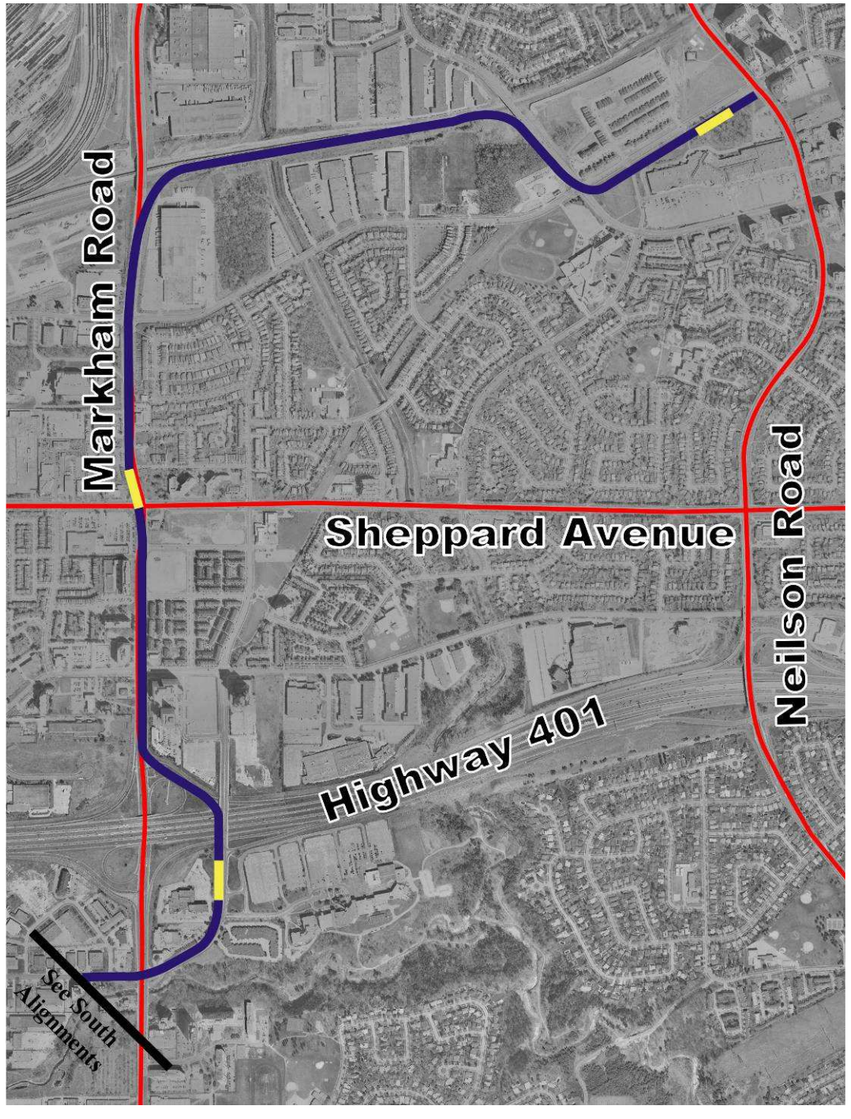


Exhibit 2-18: North Alignment 3

Exhibit 2-19: North Alignment 4

2.2.7.2 Crossing of Highway 401

Subsequent to the completion of the 1994 EA, a new road bridge (Progress Avenue) was constructed over Highway 401. The 2006 SRT Strategic Plan identified the use of this existing bridge as a possible means to cross the 401 with the SRT.

Results of structural analysis undertaken in support of this study indicate that negative bending moments at piers due to LRT live load are larger than negative bending moments due to CHBDC vehicular live load. Additional dead loads and longitudinal loads associated with LRT track structure were not included, which would only worsen the overstressing of the structure. Significant structural modifications would be required to the extent that the bridge may require complete reconstruction.

With this in mind, it is proposed that it would be more cost effective to build a new structure for the SRT along side of the existing structure of the Progress Road Bridge.

2.2.7.3 Evaluation Criteria

Each of the above north alternatives was assessed on their ability to address the project objectives, namely:

1. Provide rapid transit service to north east Scarborough
2. Support population and employment growth
3. Accommodate future increase in ridership
4. Minimize adverse environmental and community effects
5. Connect SRT to proposed Sheppard East LRT
6. Provide rapid transit service to Centennial College
7. Achieve reasonable costs

2.2.7.4 Analysis of Alternative Alignments

The following conclusions can be drawn after assessing each alternative with respect to the above seven objectives:

- N3 provides reasonable service to the existing high density areas of Markham and Sheppard and the fastest service to the high density areas within Malvern and therefore is the most preferred. N1 and N2 provide slightly better service to the Markham / Sheppard Area but much slower service to Malvern.
- Although N1 and N2 are most consistent with current transportation planning policy, N1, N2 and N3 support more mixed use and apartment neighbourhoods as contained in the City's Official Plan. N4 is situated in existing transportation corridors and is surrounded by stable (low density) neighbourhoods with limited Official Plan support for more transit oriented development.
- From an environmental perspective, N3 is the most preferred because most of its impacts can be mitigated by underground construction. N1 and N3 have greater impacts on the residential community. N4 is least preferred as it has the most significant impact on the natural environment and some community impacts along Neilson Road.
- Although N4 provides a station closer to the main area of campus, all options provide significantly improved transit service to Centennial College.
- N3 will result in the lowest operating costs, and it is the simplest to construct and thus is most preferred. N2 (and N1) would have the highest operating costs and would be the most complex to construct. Therefore, it is least preferred.

Table 2-4 summarizes the analysis of the north alignments considered.