TORONTO TRANSIT COMMISSION
REPORT NO.

MEETING DATE: MAY 11, 2011

SUBJECT: OPPORTUNITIES FOR IMPROVED BUS SERVICE ON FINCH AVENUE

ACTION ITEM

RECOMMENDATIONS:

It is recommended that the Commission:

1) endorse the undertaking of a follow-up more detailed study regarding opportunities for improving bus service on Finch Avenue, which will allow the further development and assessment of the options identified in this report; and

2) forward this report to the City of Toronto and Metrolinx for information.

FUNDING

This report has no effect on the TTC's capital or operating budgets.

BACKGROUND

At its meeting of March 1, 2011, the Commission referred to staff for report, correspondence from Commissioner Crisanti (attached) which discussed his support for, "…the development and implementation of a rapid bus transit service…[to meet]…the needs of commuters along the Finch West corridor."

Subsequently, on March 31, 2011 the Province of Ontario, Mayor Rob Ford, and Metrolinx entered into a Memorandum of Understanding (MOU) under which the City is to provide enhanced bus service within the Finch transit corridor between the Finch West station on the extended University-Spadina subway line and Humber College.

The purpose of this report is to respond to the Commission's request for a report on this subject and to begin to discuss the opportunities for the enhanced bus service referred to in the MOU.

DISCUSSION

The attached discussion paper provides an introductory overview of the types of potential improvements which could be considered for bus service on Finch Avenue West. A broad range of options is described and, through a preliminary evaluation, this long list is narrowed down to a shorter list of alternatives for more detailed development and assessment.

The alternatives discussed in the report include combinations of both infrastructure and operational improvements to enhance the current bus service provided by the TTC in this corridor.

Infrastructure improvement alternatives include:

- construction of a 'busway' or two-lane roadway within the hydro corridor north of Finch Avenue, which would be restricted to bus use only, (as now exists between Dufferin and Keele for the York University express bus service);

- allocation of two centre lanes within Finch Avenue West for exclusive bus use as 'bus rapid transit' (BRT), essentially an alternative to the use of these lanes for the LRT service proposed in the TTC *Transit City* plan;

- dedication of the curb lanes on Finch Avenue West for bus use only; and

- establishing "queue by-pass" lanes, through road widenings at strategic signalized intersections, which would allow buses to move to the head of the line, rather than being delayed while vehicles ahead clear intersections.

Operational improvement alternatives include:

- substituting longer, 18-metre, articulated buses for the TTC's standard 12-metre buses now operated on Finch Avenue, a substitution that would increase both bus carrying capacity and capital costs by about 50 percent;

- relocation of selected existing bus stops to the away (far) side of intersections in order to allow more effective application of the TTC's established and successful transit signal priority technology;

- introduction of "off-board" fare payment (POP) and the installation of ticket vending machines at identified stops in order to eliminate delays at stops associated with the fare collection process itself and to permit faster boarding and alighting by allowing customers to use all doors;

- selective expansion in the use of transit priority signals along the route; and

- a possible reduction in the number of bus stops (i.e. increases in average stop spacing) so as to reduce travel times for most passengers (with a resulting disadvantage to those passengers who would be required to walk longer distances to reach their bus stops).

The attached discussion paper also addresses the possible use of electric trolley buses. Based on a 2009 TTC study, trolley bus technology, even with recent advances in "off-wire" capability, does not appear to be a cost-effective use of funds from the standpoint of capital costs, operating costs, or reductions in greenhouse gas emissions.

The main finding of the discussion paper is that, in order to enhance existing bus service on Finch Avenue West in a perceptible way, at a minimum, the existing bus fleet should be replaced with articulated buses that would increase capacity (and reduce crowding) by about 50 percent and would also improve service reliability. Given the high volume of passengers using the bus services on Finch Avenue, using articulated buses would be consistent with the general transportation principle of using larger capacity vehicles on services that have the highest traffic density.

With the prospect of using such larger articulated buses, three alternatives are identified for more detailed assessment of costs and benefits, namely:

- BRT service in the parallel Finch hydro corridor;
- Creation of an exclusive bus-only centre-lanes BRT facility on Finch Avenue, over some portion of the previously approved LRT route; and
- Development of a comprehensive program for the introduction of queue by-pass lanes at strategic signalized intersections in combination with:
    - relocation of stops to the far side of intersections;
    - more widespread application of transit priority techniques at signalized intersections; and
    - conversion from the present method of fare collection to 'proof-of-payment'.

On the basis of this preliminary overview, it is recommended that the Commission endorse the undertaking of a more detailed study involving the development and assessment of the design and operational combinations suggested above.

The main components of the proposed study would be:

1. Determination of capacity requirements on the basis of both present statistics and refined forecasts tailored to the individual design alternatives;
2. An up-to-date survey of the technical specifications, performance, capital costs, and operating costs for currently available articulated buses;
3. Detailed development of design and operating concept combinations;
4. An assessment of benefits and costs of these alternative combinations; and
5. Development of recommendations for a preferred approach for enhancing bus service on Finch Avenue.

JUSTIFICATION

The attached discussion paper presents a number of options for improving bus service on Finch Avenue West, as requested by the Commission and as contained in the Memorandum of Understanding pertaining to transit improvements in Toronto. These options can be developed and assessed in more detail by staff if the Commission endorses such work to be done.

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April 26, 2011
11-31-RS/80

Attachments: March 1, 2011 correspondence from Commissioner Crisanti
Discussion Paper: Opportunities for Improved Bus Service on Finch Avenue

Opportunities for Improved Bus Service on Finch Avenue
27 April 2011

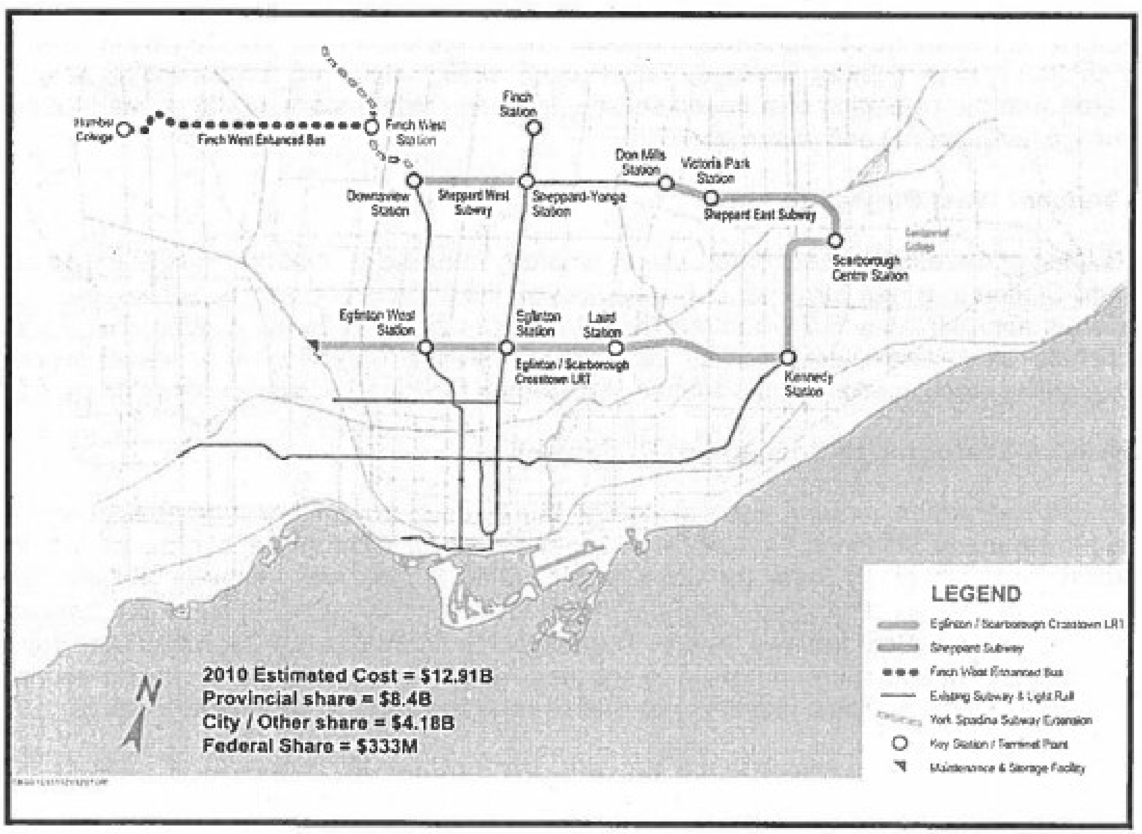
Background
The inclusion of Finch Avenue as one of the higher-priority applications of light rail transit (LRT) service embodied in the TTC's *Transit City* plan raised expectations for greatly improved service in this corridor.

Both the design for the proposed Etobicoke-Finch West LRT and the environmental assessment were completed, on the basis of which, the western segment between Humber College and Keele Street was approved and included in Metrolinx's ten year capital budget in June, 2010.

As a result of the municipal election, however, support for *Transit City* in general and the Etobicoke-Finch West LRT, in particular, has shifted. Recently, the City of Toronto and Metrolinx have entered into a Memorandum of Understanding (MOU) under which, as shown in Figure 1,

- The City assumes responsibility for the delivery of transit projects along Sheppard Avenue,
- Metrolinx agrees to deliver transit projects along Eglinton Avenue and the Scarborough RT, and
- The City is to provide enhanced bus service within the Finch transit corridor between the Finch West station (Keele Street) and Humber College.

Figure 1 – Revised Plan Covered by the MOU between the City of Toronto and Metrolinx



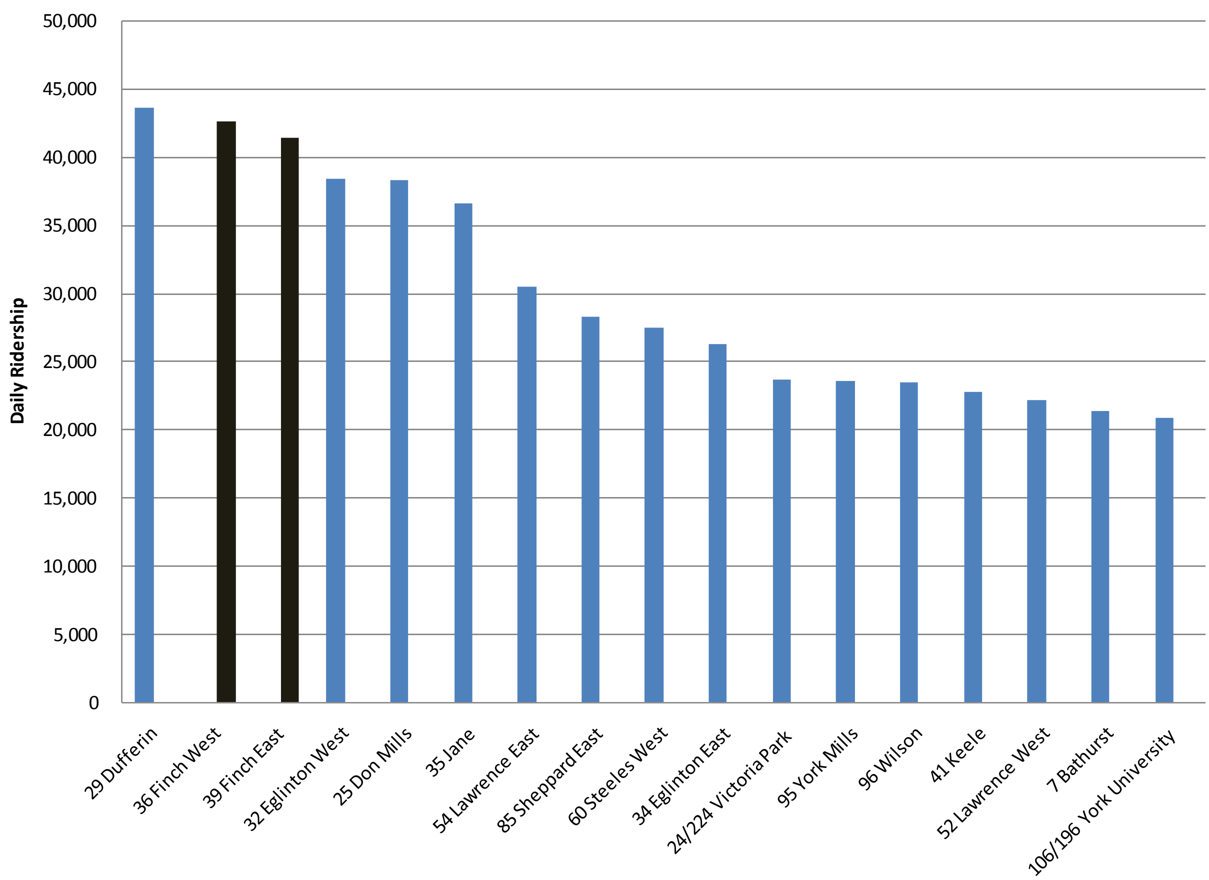
The purpose of this paper is to provide background on potential opportunities for improved bus service within the Finch Avenue transit corridor consistent with the recent MOU. In particular, the overview is intended:

- to describe alternative opportunities for enhanced transit service on Finch Avenue,
- to screen opportunities in order to narrow the range of options for more-detailed review, and
- to identify implications for enhanced bus service on other high-density bus routes within the City.

Current Service and Projected Future Ridership

Figure 2 shows that bus services on Finch Avenue carry among the highest number of passengers of all TTC bus routes in terms of average daily ridership, one of the main reasons that LRT services on Finch Avenue, as well as other high traffic routes, such as Eglinton and Sheppard Avenues, were included in the first phase of *Transit City* implementation.

Figure 2 –TTC Bus Ridership by Route



High levels of bus ridership on Finch Avenue, of course, reflect the network of existing surface and rapid transit services. Once the Spadina subway extension is in service, for example, it is reasonable to expect relative changes in bus ridership in various segments of the Finch West services, notably east and west of the Finch West subway station at Keele Street, as some passengers previously destined to the Yonge subway choose, instead, to transfer to the new subway.

Table 1 provides information related specifically to transit service on Finch Avenue West for two main segments, namely, Humber College to Keele Street and Keele Street to Yonge which, when combined, constitute the original LRT alignment proposed in *Transit City.* Data are shown both for current services and ridership projections included in the *Transit City* environmental assessment for the Finch LRT. As noted above, the 2031 LRT projections show a relatively-higher increase in ridership west of Keele Street than east of Keele Street, largely attributable to the re-orientation of transfers between bus and subway services.

Table 1 – Selected Data for Finch Avenue Transit Service

Segment	**Existing Bus Service**				**2031 Projected LRT**	
	Route Length (km)	Daily Ridership	Maximum Volume (PPHPD)*	Peak Headway (seconds)	Daily Ridership	Maximum Volume (PPHPD)
Humber College to Keele	8.9	22,000	885	160	51,000	3,000
Keele to Yonge	6.3	20,600	1,010	160	37,500	2,200

*Persons per hour per direction

In addition to information on existing ridership and potential demand, trip origins and destinations are also important inputs for purposes of developing and evaluating opportunities for enhanced bus services. Figures 3 and 4 illustrate the pattern of origins and destinations of current users of the Finch bus route during the AM peak period of travel. These data suggest that:

- the vast majority of both trip origins and destinations are within close proximity and walking distance of Finch Avenue, and
- the distribution of destinations within downtown Toronto would be served equally well by the completed Spadina subway extension or the existing Yonge subway.

Design Elements of Opportunities for Enhanced Bus Service

Opportunities for improving bus service in the Finch corridor involve the following four distinct elements:

1. Project scope,
2. Alternative Design Concepts,
3. Operational Improvements, and
4. Bus Technology

Project Scope refers to the extent of the area for which alternatives for enhanced service are to be considered.

Figure 3 –Origins of AM Peak Finch Bus Ridership

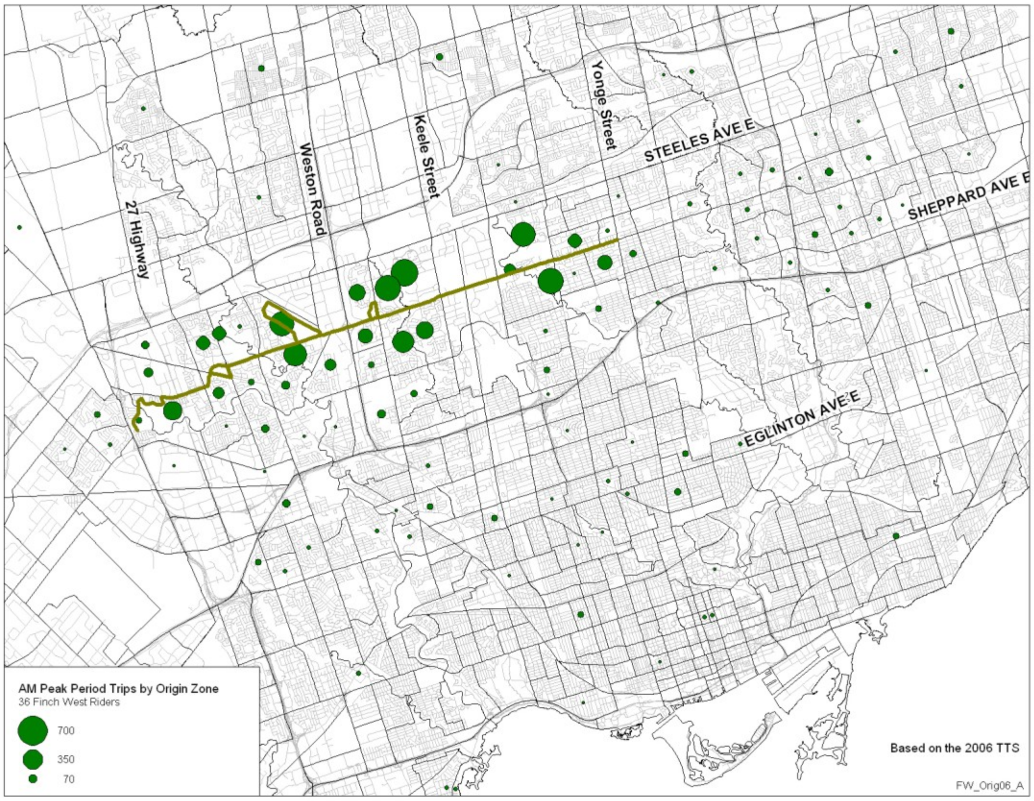
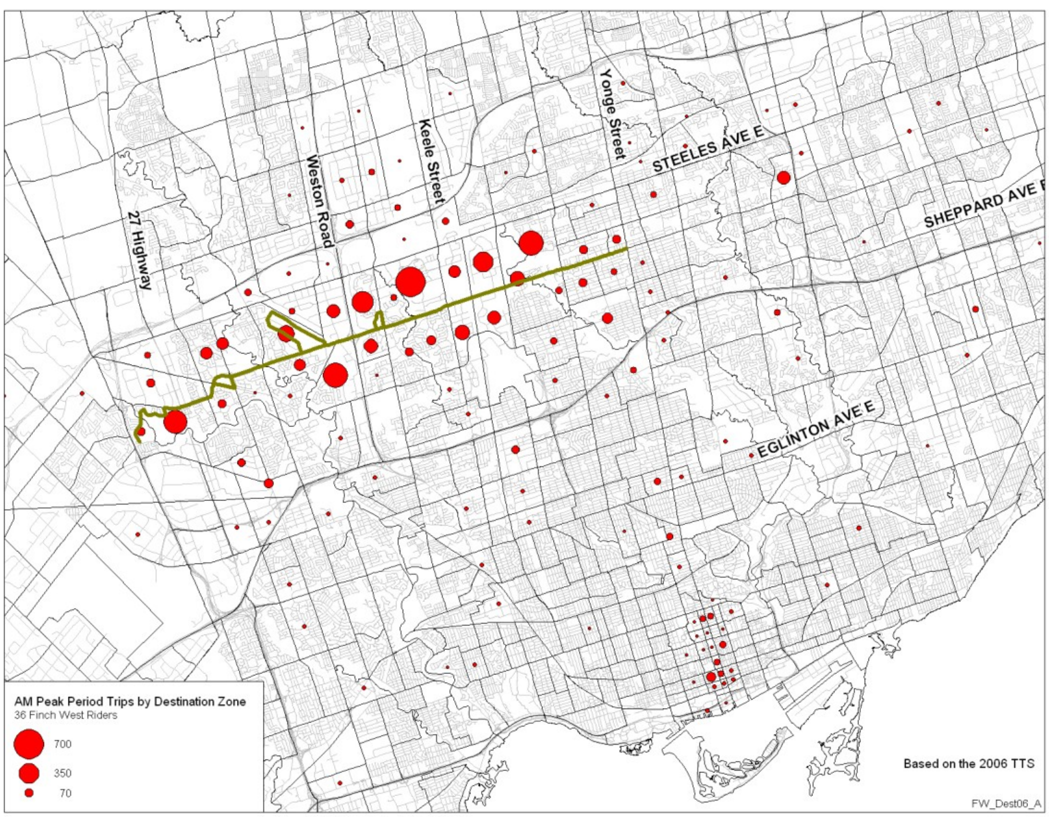


Figure 4 –Destinations of AM Peak Finch Bus Ridership



Alternative Design Concepts involve infrastructure components characterized by varying degrees of capital investment in construction including:

- A dedicated two-lane busway parallel to the Finch corridor within the hydro corridor north of Finch Avenue,
- Exclusive bus lanes in the centre of Finch Avenue for bus rapid transit (BRT), basically in the alignment of the Finch LRT proposed in *Transit City*, with appropriate modifications to design specifications (slightly wider lanes),
- Exclusive curb bus lanes and, possibly, high-occupancy vehicle (HOV) lanes as used elsewhere within the City, (for example, Eglinton Avenue and Dufferin Street),
- Road widening at strategic locations to accommodate bus-only lanes as a means of bypassing queues at busy intersections (known as queue by-passes), and
- relocation of bus stops to the far side of intersections in order to allow more-effective application of the TTC's established and successful transit signal priority technology.

Operational improvements are intended to reduce delays due to traffic congestion and increase average bus speed which, in the process, results in shorter travel times for passengers.

Operational improvements include:

- Conversion of the existing fare collection process to 'off-board' fare collection (proof-of-payment) which reduces stop dwell times and allows all doors to be used for boarding,
- Relocation of stops to the far side of intersections, as noted above, to reduce bus time losses at signalized intersections,
- More widespread application of signal priority for buses to further reduce delay at signalized intersections, and
- Reduction in the number of bus stops to increase average speed and bus productivity (obviously, at the expense of increased walking distances).

Finally, the choice of *bus technology* itself influences the opportunities for enhanced bus service within the Finch transit corridor. The main variables include vehicle size (standard TTC buses versus longer, articulated buses) and propulsion systems (diesel/hybrid buses and electric trolley buses).

Project Scope

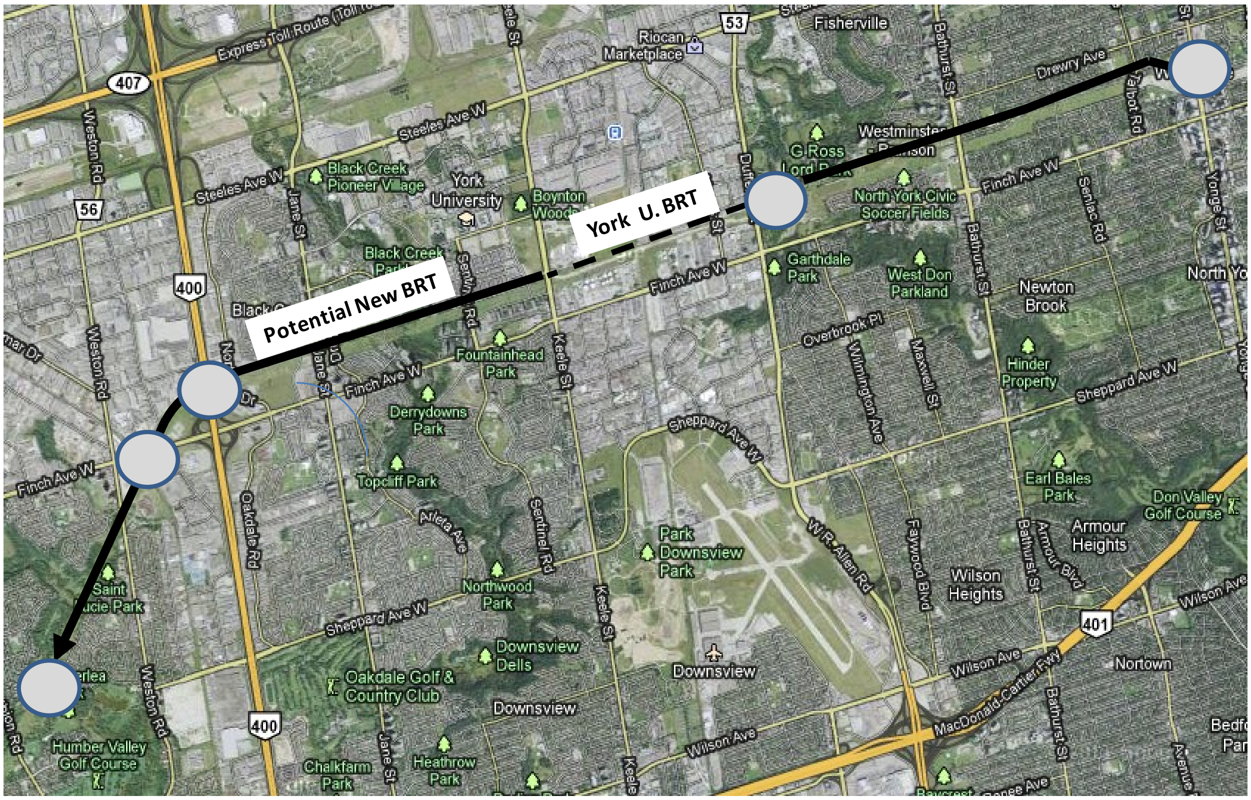
Recognizing that *Transit City* envisaged LRT service along the entire corridor between Humber College and the Yonge Street subway, whereas Metrolinx's 2010 approval for LRT on Finch was limited to the segment west of Keele Street, initially, probably both segments should be considered within the scope of this overview.

Alternative Design Concepts

Dedicated Busway in the Finch Hydro Corridor

Periodically, the prospect of establishing a bus-only road or busway within the Finch hydro corridor, shown in Figure 4, has been considered for various segments of this corridor. In 2006, for example, as part of a broader study of using hydro corridors for transit purposes, the TTC examined the Finch hydro corridor in some detail, noting significant technical constraints in some areas.[1] Although there are several major impediments to establishing a through corridor between the Finch subway station on the Yonge Street subway and Humber College, a 2 km section of such a facility, shown in Figure 5, was constructed as an important component of bus rapid transit (BRT) service between Downsview station on the Spadina subway and York University. One segment of the hydro corridor busway is shown in Figure 6.

Figure 4 –Finch Hydro Corridor Alignment



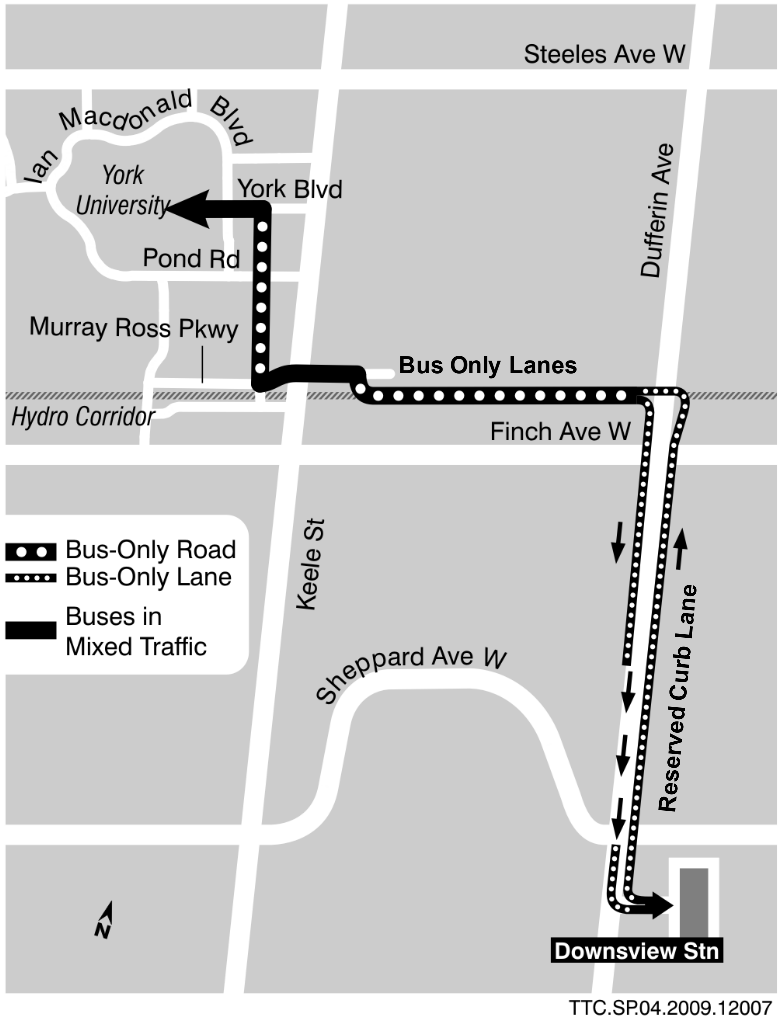
Denotes Major Construction and Design Issues

Use of this corridor for express bus rapid transit has some degree of appeal both from the standpoint of achieving higher average speed than is possible in mixed traffic, reduced signal delay due to relatively few North-South intersections, and connectivity with the Yonge and Spadina subways, as well as the GO Barrie commuter rail route.

From the standpoint of the majority of current users of Finch Avenue bus services, however, the hydro route does not penetrate major transit markets on Finch Avenue itself, and would generally entail considerably longer walking distances. Thus, while such a route might be beneficial from the standpoint of inter-regional transit connectivity, it would likely provide poorer service for most City residents who now use bus service on Finch Avenue.

[1] Hatch Mott MacDonald, *Hydro Corridor Study*, Toronto: Toronto Transit Commission, April 2006.

Figure 5 –York University Reserved Lane/BRT Bus Service



The relatively short 2 km busway for the York University BRT was constructed at relatively modest capital cost of about $3.9 million per km. Because of major construction issues at several locations along the hydro corridor, including Ross Lord Park, the Highway 400 crossing, and access to Humber College, a more-extensive busway is likely to be a very costly venture that would generate considerable community opposition from adjacent residential neighbourhoods to any form of transit service within this corridor.

In the earlier studies, the estimated capital costs for LRT in the hydro corridor were very high, although much of the cost premium was associated with providing electrification systems for LRT. As a BRT, the capital investment should be significantly lower. In fact, the 2006 TTC study estimated average capital costs of about $22.5 million per km in 2006 dollars, or about $27 million in current dollars.

On balance, an initiative to provide BRT service throughout the entirety of the hydro corridor west of Yonge Street would undoubtedly involve an undertaking similar in length and process (including environmental assessment) to any of the proposed *Transit City* LRT routes.

Figure 6 –Existing Busway in the Hydro Corridor

Nevertheless, in a more-detailed study of the Finch corridor, it would be useful to examine the realistic potential for using this corridor to provide truly express bus service between western areas of the City and subway stations at Keele and, possibly, Yonge streets.

Exclusive Centre-of-the-Street Bus Lanes

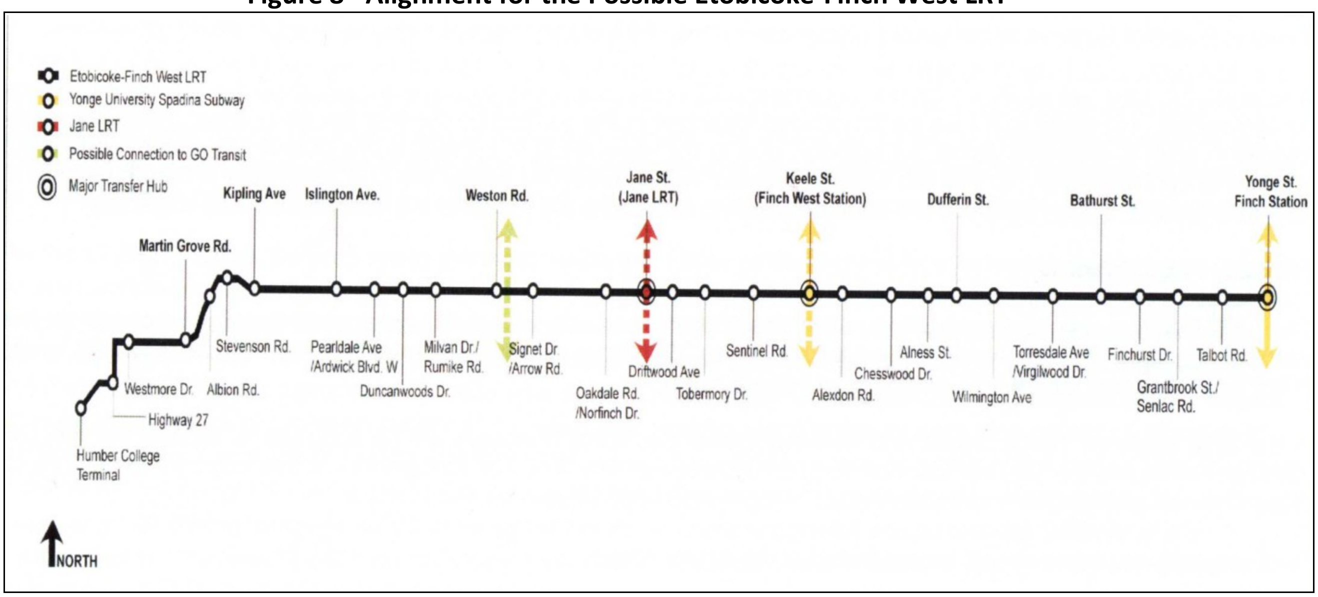
In this concept, LRT vehicles within the right-of-way of the previously-studied Finch LRT would be replaced by buses in a facility that resembles the now removed BRT service in Richmond (Metro Vancouver), shown in Figure 7. Relative to the proposed LRT service, ultimate transit capacity is reduced by substituting single buses for LRT vehicles capable of multiple unit operation. However, considerable reductions in total capital costs are possible due to the elimination of track structure, overhead electrification, and substations, as well as less-stringent requirements for vehicle storage and maintenance facilities.

The route for a possible Finch LRT, extracted from the environmental assessment, is shown in Figure 8. For BRT in more or less the same corridor, the reduction in capital investment would be significant due to the elimination of track structures, overhead electrification, power conversion substations, specialized yard and maintenance facilities, and the light rail vehicles themselves which, per unit of capacity, are considerably more costly than bus technology.

Some of the savings in capital costs would be offset by the need for a new bus garage and maintenance facilities. In addition, the original LRT design, premised on rail vehicles operating on a fixed-rail alignment, would be too narrow for safe, two-way bus operation, resulting in modest additional capital cost.

Figure 7 –Metro Vancouver BRT Service, 2001-2006

Figure 8 –Alignment for the Possible Etobicoke-Finch West LRT

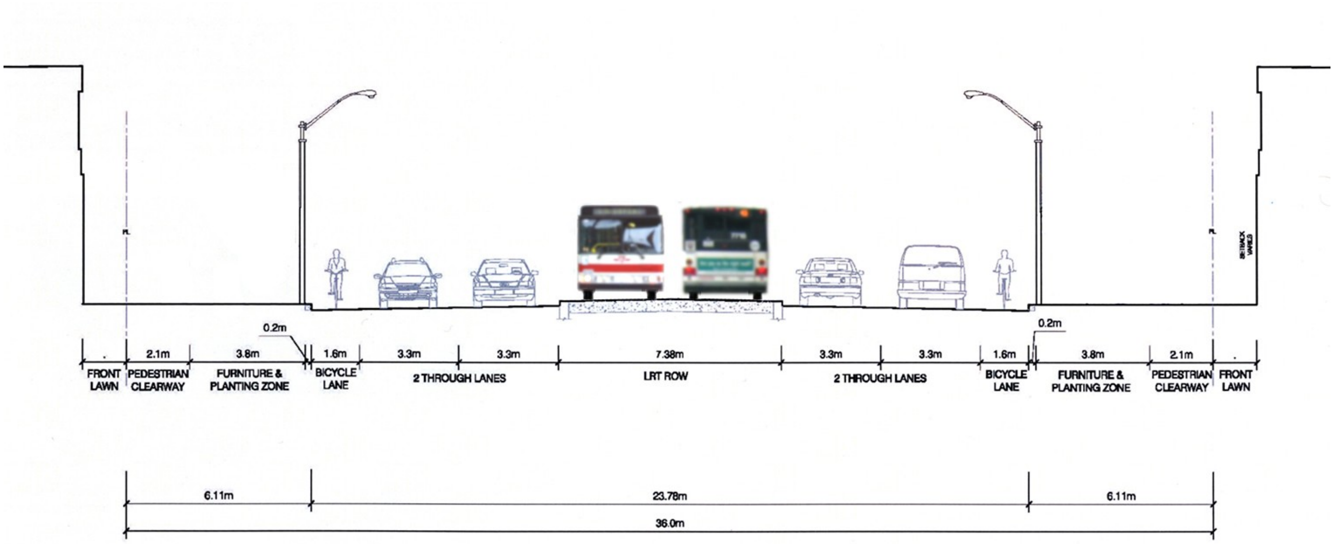


By substituting BRT for LRT within this proposed LRT alignment, some adjustments could be made that are less dependent on connections to storage and maintenance facilities. The western segment, for example, could be shortened to operate between Martin Grove Road or Kipling Avenue and Keele. Between Humber College and the terminal of a centre lane BRT on Finch Avenue, current bus services could continue to be operated on the existing route. In addition, the centre lane BRT could be extended east to Yonge Street as per the LRT proposal treated in the environmental assessment.

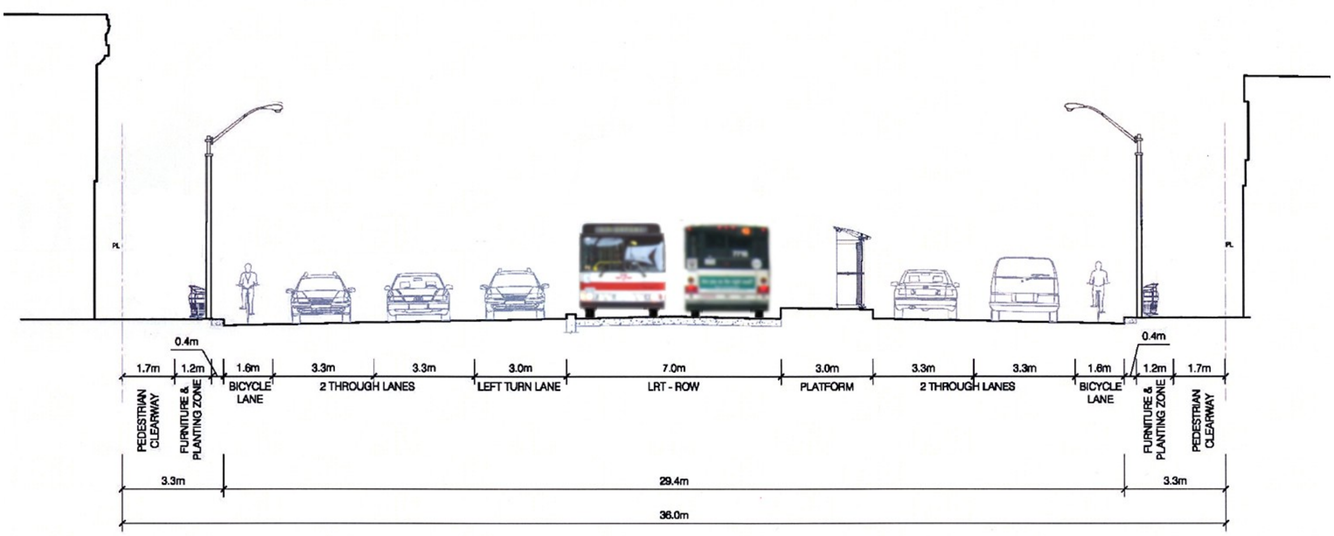
Setting aside potential savings in capital investment, the provision of BRT service in exclusive centre lanes, of course, raises the same issues associated with removing two automobile traffic lanes and using them, instead, for LRT service. Nevertheless, a high quality bus service could be provided in terms of increased average speed, service reliability, and capacity with, as in the case of the proposed LRT service illustrated in Figure 9, no loss in existing road capacity for non-transit vehicles through road widening. (There would be some reduction in access to local properties due to mid-block turn prohibitions.)

Existing traffic lanes would be maintained and, p*rovided appropriate design clearances for buses are maintained*, this design concept provides flexibility to convert BRT service to LRT at some point in the future with little or no loss in 'sunk' capital investment.

Figure 9 –Typical BRT Finch Avenue Cross Sections
Mid-Block



Far-Side Stop



Curb Lanes Reserved for Buses

Some roads on which existing TTC bus services operate have the curb lanes reserved for buses, although, in some cases, special accommodations are made for taxis (as on Bay Street) and high-occupancy automobiles (as on Eglinton Avenue East and Dufferin Street).

There are certain advantages with respect to average bus speeds and service reliability. The main disadvantages concern effectiveness of enforcement (and associated costs), as well as the frequency of right-turning automobiles using these lanes.

Historically, enforcement of reserved transit lanes (both for buses and streetcars) has been perceived as a major barrier to effective implementation. In other constituencies, however, such as central London, reasonable levels of effective enforcement have been achieved (at significant expense) through the use of cameras at fixed locations. Vehicle mounted cameras, activated by bus drivers, could also serve as a deterrent for illegal use of reserved lanes assuming, of course, that appropriate changes to the Highway Traffic Act were to be implemented.

However, designating curb lanes for transit use only (and possibly for HOV, as well) does reduce road capacity for other vehicles and is likely to generate the same reaction as that for reserving lanes in the centre of streets for LRT.

Queue By-Pass Lanes at Intersections

Queue by-pass lanes essentially allow buses to move to the 'head of the line' when traffic is queued at signalized intersections.

As shown in Figure 10, for example, the bus waiting for the intersection to clear incurs delay while waiting in the queue itself and would, in many cases, experience additional delay if the queuing time results in missing the next signal green phase. Providing a 'queue by-pass lane", illustrated in Figure 11, allows the same bus to by-pass the traffic ahead and, possibly, miss at least one red light.

Such by-passes could be provided at strategic signalized intersections where bus service now experiences significant delay. As noted below, the effectiveness of queue by-pass lanes would be enhanced by the relocation of bus stops to the far side of signalized intersections.

Queue by-pass lanes basically perform the same function as reserved curb lanes without removing an existing traffic lane for use by automobiles. In fact, a continuous exclusive curb lane is likely to be only marginally beneficial in reducing bus delays when compared to sufficiently long by-pass lanes, recognizing that road widening is required for these by-pass lanes. By-pass lanes would involve some of the same enforcement issues as reserved curb lanes, but at a scale that can likely be managed more easily.

Operational Improvements

Off-board Fare Collection

Conversion of existing methods of fare collection to 'off-board' or 'proof of payment' fare collection reduces stop dwell times, thereby increasing average bus speed and vehicle productivity in two ways. First, the time required to collect fares is eliminated and second, because all doors can be used for passenger boarding and alighting, the total stop dwell time is further reduced.

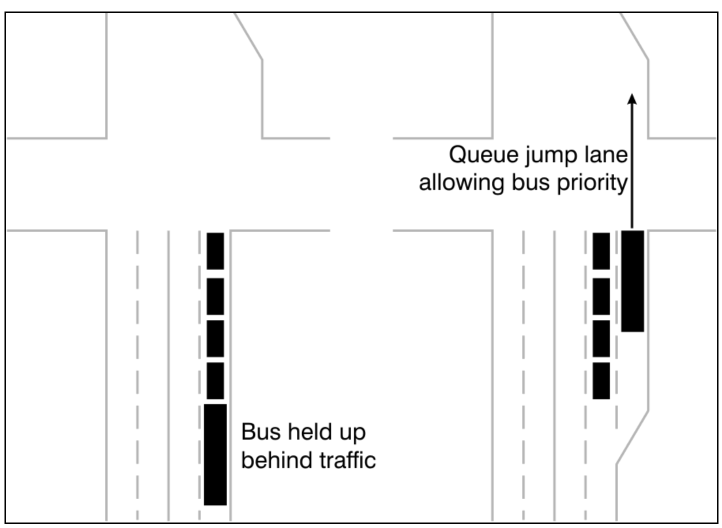
An average reduction of say 10 seconds per stop, cumulatively, would reduce travel time by about 10 minutes. Ticket vending machines would be needed at present stop locations if no fare collection takes place on-board. There would also be additional operating costs for fare inspectors and enforcement.

Bus Stop Relocation

Relocation of bus stops to the far-side of signalized intersections essentially eliminates delays associated with vehicles 'missing' the green phase of signals while passengers board and alight, and which forces buses to wait during the subsequent red phase.

Figure 10 – Bus Delay Due to Queuing at Signalized Intersections

Figure 11 – Queue By-Pass Lanes

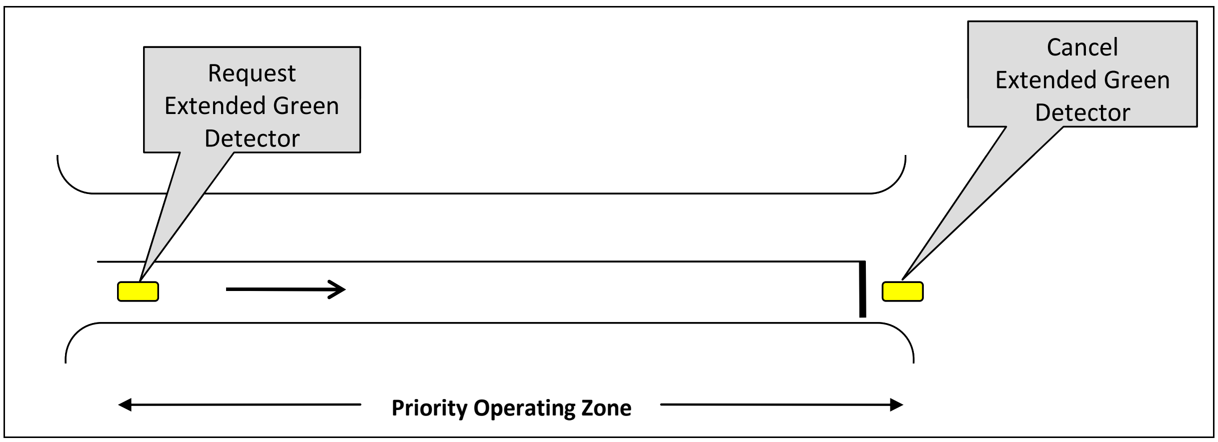


Transit Signal Priority

Within limits, transit signal priority reduces the time buses spend waiting to receive a green signal. Under this concept, the green time available for a bus to traverse the signalized intersection is extended when information on an approaching bus is transmitted to the signal control system by means of detection devices located ahead of the signal, as shown in Figure 12. Similarly, a second detector is used to end the transit priority green phase.

Limits on the advantages of transit signal priority are dictated by the frequency of bus service in the opposite direction, by cross street bus service using the same signalized intersection, as well as by the amount of additional green time that traffic authorities are prepared to give to transit.

Figure 12 – Transit Priority Signals



Increased Stop Spacing

All transit service involves tradeoffs between stop spacing and passenger convenience. Reduction in the number of bus stops (that is, increased stop spacing) increases average speed but also reduces passenger convenience by increasing the distances people must walk to reach their closest stop.

Current bus service on Finch Avenue, between the Humber College neighbourhood and Keele Street, with typical stop spacing of 250 to 300 m, involves 30 intermediate stops. By contrast, the previously approved LRT project involved 19 stops, or an average spacing that ranges between 600 and 800 m, resulting in an average speed of about 22 kmh. Over the entire route to the Yonge subway, the original LRT proposal replaced 57 bus stops with 29 LRT stops. Striking a compromise between the proposed LRT service and existing service, increases in average speed can be achieved, recognizing that, with longer stop spacing, station dwell times at the remaining stops for boarding and alighting would be slightly longer.

Bus Technology

Vehicle technology involves both size and method of propulsion. As with almost any form of transportation, probably the most important vehicle specification relates to size and capacity. As a common rule, larger vehicles are justified as traffic volume increases.

The current Finch Avenue bus route is served by a fleet of standard 12 metre rigid diesel or hybrid buses that have a planned peak period capacity of 48 passengers, equipped with operator-activated folding ramps to assist passengers with physical impairments. Longer, 18 metre articulated buses are also available from manufacturers involving comparable increases in both carrying capacity and vehicle costs. As compared to unit costs of $550,000 per 12 metre standard bus, for example, articulated bus costs are of the order of $850,000 or even more. With larger buses, of course, productivity increases simply because the operating costs of one driver are spread over a larger number of passengers.

For the high volumes of ridership on the Finch West bus services, labour productivity and level of service (in terms of crowding and capacity) could be improved by the substitution of articulated buses for the existing fleet, even without any of the other enhancements treated above. Replacing the existing 12 metre buses with larger articulated buses would also mean the current fleet could be deployed elsewhere within the TTC system.

The second major variable related to bus technology concerns the propulsion system. Here, electric trolley buses can be considered as an alternative to current diesel and hybrid propulsion systems that now dominate the TTC's vehicle fleet.

Concerns about global warming have stimulated renewed interest in electric trolley buses. Decisions to re-introduce or modernize this form of transit service have been taken in a number of U.S. and Canadian cities, including Vancouver, as an important means of achieving more-sustainable transportation.

Trolley buses are quieter and environmentally-friendlier than fossil-fuel vehicles. At street level, greenhouse gas (GHG) emissions are essentially zero. (Overall, emission benefits depend upon how electrical energy is produced at source.) Trolley buses are also capable of higher acceleration, particularly on grades.

The main disadvantages of trolley bus service concern capital costs and service flexibility. Significant capital investment is required for electrification, namely, substations required to convert high voltage alternating current to low voltage direct current, as well as overhead wires and structural supports. The purchase price of vehicles is also higher than for comparable size conventional buses (but economic service lives are also generally higher).

Trolley buses have less flexibility to circumvent blockages, such as accidents, and less ability for one bus to pass another that is 'out of service'. Trolley buses are also more problematic with respect to extending routes into new transit service areas over the short term. However, limited off-wire capability (using battery power or small diesel engines) does facilitate overcoming this inflexibility by making it possible for trolley buses to operate over variable distances without being connected to the overhead power supply.

An earlier TTC report reviewed opportunities for re-introducing trolley buses and compared diesel, hybrid, and trolley bus costs for a candidate network of new services.[2] For this hypothetical network, both costs and emissions were compared.

[2] Toronto Transit Commission, *A Review of Trolley Bus Potential*, January, 2009.

The 2009 preliminary study concluded that:

1. Overall, the unit costs of service delivery are much higher than for either diesel or hybrid buses. Even if diesel fuel costs were to double, the incremental cost estimates of converting the sample network to trolley bus operation still remain very high.
2. The main cost disadvantages of trolley buses derive from the need for investment in electrification infrastructure (sub-stations and power transmission structures) inasmuch as the annual cost of electrification accounts for more than two-thirds of the total cost differential when compared to diesel bus operation.
3. Trolley buses consume less energy and produce lower emissions than either diesel or hybrid buses and are more attractive from the standpoint of air quality, noise, acceleration (notably in heavy traffic), and opportunities provided by central power generation to negotiate steeper grades.
4. Trolley buses provide less flexibility to both alter and extend routes to serve entirely new areas, although, with the availability of new buses with greater off-wire capability, this disadvantage can be reduced.
5. The implied value per tonne of GHG emissions ($1,840) achieved through the operation of trolley buses is considerably higher than values currently assumed for GHG reductions (about $40 per tonne). Even a doubling of traffic intensity still results in an implied value per tonne of about $985.
6. For the large differences in capital investment and total annual costs, the high implied cost per tonne for reducing GHG emissions raises an issue of the relative efficiency of reducing GHG emissions from transit by other means including:

    - achieving the anticipated performance benefits of hybrid buses,
    - the emergence of more cost-effective fuel cell buses,
    - development, within the foreseeable future, of all electric buses, possibly as a by-product of initiatives driven by restructuring of the automotive industry with respect to electric automobiles, and
    - expansion of bus routes to serve new markets.

7. In Toronto, the high cost of trolley bus service derives primarily from the fact that entirely new infrastructure is required for electrification as opposed to situations (as in Vancouver) in which there is an existing electrification network in need of refurbishment.

Thus, although it is difficult to justify the large capital investment in electrification required for new trolley bus service from the standpoint of the TTC's finances alone, such investment may be reviewed by City Council as a separate initiative for achieving its GHG emissions reduction goals.

Preliminary Assessment
In order to screen the range of design and performance alternatives into a manageable number for more-detailed review and analysis, six measures have been selected for purposes of comparison, namely:

1. Technical feasibility,
2. Capital investment,
3. Time for implementation,

4. Community acceptance,
5. Performance, and
6. Effects on street capacity.

A summary assessment is provided in Table 3 for the various design elements treated previously for the western segment of the Finch corridor originally approved by Metrolinx.

This preliminary assessment suggests that, if enhanced bus service is to be provided in the Finch Avenue corridor as an alternative to the benefits anticipated from the Finch LRT project, at a minimum, the existing bus fleet should be replaced with articulated buses that increase capacity (and reduce crowding) by about 50 percent. A fewer number of larger buses also improves service reliability.

Despite the fact that dedication of curb lanes for exclusive use of buses has a certain degree of intrinsic appeal, there are few advantages relative to the construction of queue by-pass lanes at strategically selected signalized intersections. For these reasons, based on the use of larger articulated buses in each case, three alternatives are recommended for more-detailed assessment of costs and benefits, namely:

- BRT service in the parallel Finch hydro corridor,
- Redesign of the previously approved LRT project as BRT within exclusive centre lanes over some portion of the previously-approved LRT route, and
- Development of a comprehensive program for the introduction of queue by-pass lanes at strategic intersections in combination with:
    - relocation of stops to the far side of intersections,
    - more widespread application of transit priority techniques at most signalized intersections, and
    - conversion from the present method of fare collection to 'proof-of-payment'.

Although the pattern of AM peak trip origins and destinations for the present service suggest that new service in the Finch hydro corridor is not well positioned with respect to present demand, there are potential inter-regional considerations that favour undertaking at least a preliminary analysis of the feasibility of providing through BRT service between western areas of the City and the Spadina and Yonge subway extensions. This task would essentially involve revisiting the alignment and cost estimates included in the previous analysis of constructing an LRT facility in the hydro corridor.

In addition, although constructing new transit facilities in exclusive centre lanes appears inconsistent with current Council priorities, possible variations in the extent of the previously-approved LRT lanes and consideration of BRT as a possible pre-LRT service at some point in the future, while maintaining existing road capacity, deserves a closer look in terms of both costs and improvements in the level of service that can be achieved.

Next Steps
A process for undertaking a more detailed assessment of the design options recommended for further study is shown in Figure 13.

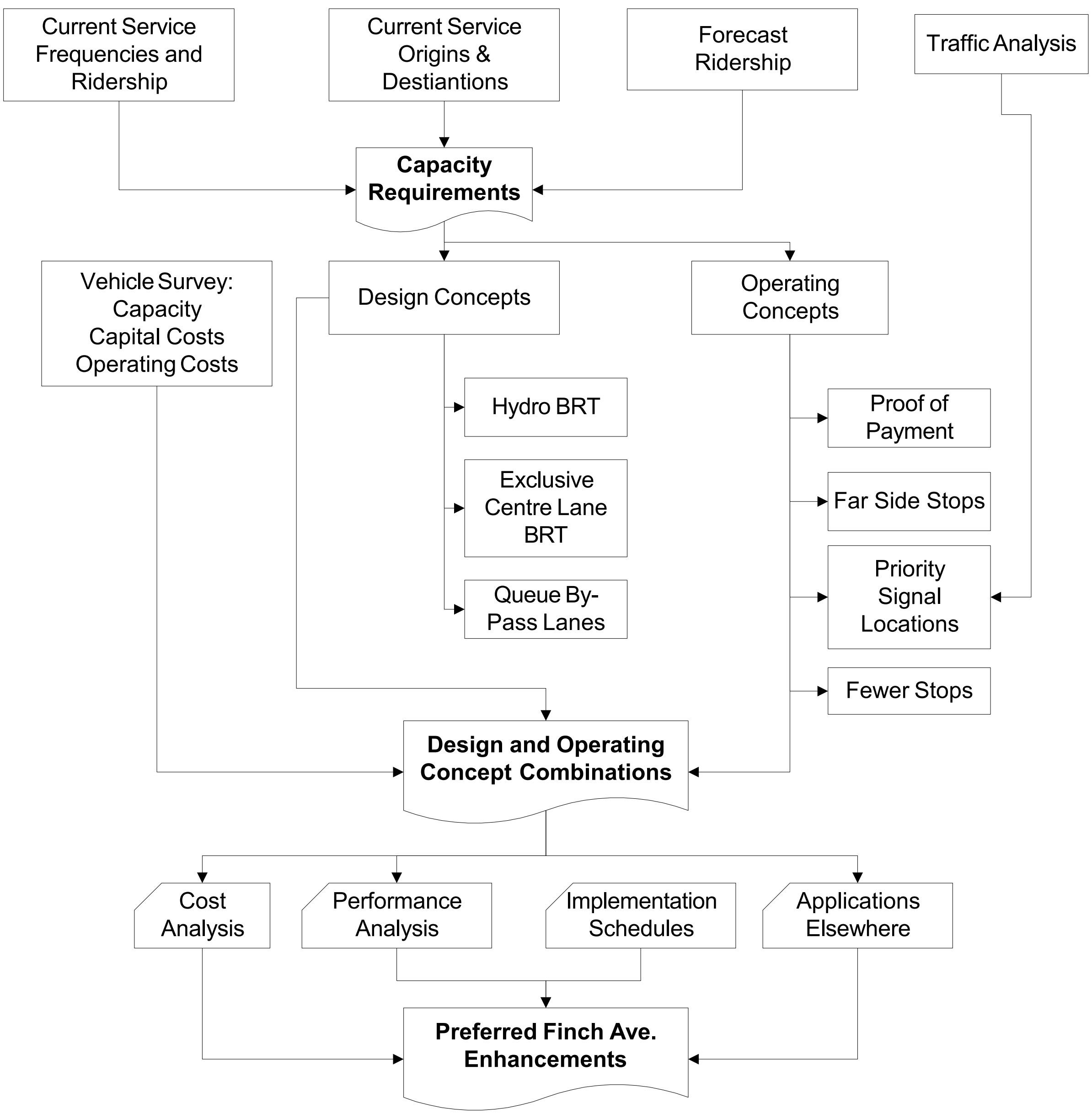
Table 3 – Preliminary Assessment of Alternatives for Enhanced Bus Service Between Humber College and Keele Street

Elements	Existing		Hydro Corridor	Reserved Centre Street Bus Lanes	Reserved Curb Bus Lanes	Queue By-passes
	12 metre Bus	Articulated Bus				
Scope	Humberwood to Finch W Station		Islington to Finch W Station via hydro corridor	Woodbine Downs Blvd. to Finch W Station	Humberwood to Finch W Station	
Articulated Bus	X	√	√	√	√	√
Far Side Stops	X	X		√	√	√
Signal Priority	X	X	√	√	√	√
Construction Length (km)	12.6	12.6		17		
Intermediate stops	Could be reduced		na	22	Could be reduced	
Average Speed (kmh)	20	20	30 to 35	25	Higher than existing	
Capacity (pphpd)	1100	1700	2700	2300	2100	2100
Capital Cost ($1000s)			Very high but unknown	Very high but unknown	None except for signs	Modest for road widening
Technical ease of implementation	No change	No change	Major technical & design issues EA and Hydro approvals	Minor design and route changes	Removes one continuous traffic lane	Road widening at select locations
Implementation time	none	Procurement	long	3 to 4 years	none	1 to 2 year
Remove traffic lanes	X	X	X	√	√	X
Road widening	X	X	X	to maintain existing capacity	X	@ select locations
Ease of City and other approvals	na	Good	Poor	Better than LRT	Poor	Medium
Access to Finch W subway station	No change		New access & station design	No change		
Summary Benefits: Short term Speed Increased capacity Labour Productivity	 X X X X	 √ X 50% √	 X for some users for some users √ (limited)	 X √ √ √	 √ modest 50-60% √	 √ modest 50-60% √
Summary Disadvantages	No benefits	New vehicles	Major new undertaking	Objections similar to LRT	Reduced road capacity	Selective, minor road widening
Retain for detailed review?	X	√	√	√	X	√

The main tasks reflected in this study approach include:

1. Determination of capacity requirements on the basis of both present statistics and refined forecasts tailored to the individual design alternatives,
2. An up-to-date survey of the technical specifications, performance, capital costs, and operating costs for currently available articulated buses,
3. Detailed development of design and operating concept combinations,
4. An assessment of benefits and costs of these alternative combinations, and
5. Final recommendations with respect to the preferred approach for enhancing bus service on Finch Avenue.

Figure 13 – Proposed Study Approach



TORONTO

Councillor Vincent Crisanti
Ward 1 - Etobicoke North

Karen Stintz
Chair, Toronto Transit Commission
100 Queen Street West, Suite B32
Toronto ON M5H 2N2

C-5

March 1, 2011

Dear Chair Stintz,

Reliable and efficient public transportation is a hallmark of great cities around the world. Residents in Toronto's north-west corner are presently served by transportation that is neither reliable nor efficient. The system serving Wards 1, 7 and 8 produces commute times that are unacceptably long and fall below our city's standard of excellence.

The result is that workers, students and families spend more time on the bus and less time at their jobs, in school or at home. The acute limitations facing our public transportation model do little to encourage residential and economic development in Toronto's outer suburbs. This is unfortunate.

The previous mayor and council approved a light rail-based public transportation plan that would have increased capacity and reduced travel times along the Finch West corridor, but at a cost unacceptable relative to its long-term benefits.

I was heartened when Torontonians last October overwhelmingly agreed with a vision for public transportation brought forth by Rob Ford. Mayor Ford recognizes the need for underground public transit, and the opportunities it creates, both in terms of generating revenues through development charges but also in long-term, multi-generational City building.

My vision for North Etobicoke extends far beyond my term of office. It is a vision that leverages North Etobicoke's strategic assets – its proximity to major arteries and an international airport, its strong industrial base and its vibrant culture – to lay the long-term foundations for a growing and thriving community. My vision is to connect North Etobicoke to the rest of the City of Toronto through efficient, reliable and world-class public transportation in the form of a subway.

I trust this vision will be formalized by the TTC when it releases its new transportation plan consistent with Mayor Ford's platform in the coming weeks.

In the interim, the development and implementation of a rapid bus transit service is essential in meeting the needs of commuters along the Finch West corridor. I look forward to working with my colleagues on the TTC Board and with TTC Staff to set this plan in motion.

Respectfully yours,

Vincent Crisanti
Councillor, Ward 1 – Etobicoke North

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