TORONTO TRANSIT COMMISSION – 101
A GUIDE FOR DECISION MAKERS

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Contents

1. PURPOSE

Toronto's transit riders love to complain about the Toronto Transit Commission, almost as much as they do the weather, or how the Leafs are playing. They do this because they have such high expectations for this publicly owned transit system that plays such an important role in their daily routines.

As the second largest transit agency in Canada and the United States, second only to New York's MTA, and ranking in the top tiers on ridership in North America, the TTC truly carries heavy aspirational freight. Besides riders' anticipation that vehicles come often and proceed smoothly and quickly to one's destination, transit now has an expanded city-building mandate. There is a growing understanding that when public transit is given priority over other mobility options on our roads, the urban space we share is safer, more cohesive, pleasanter, and more prosperous.

But the objective conditions are fraught. The TTC has the distinction of receiving one of the lowest per ride transit subsidy of any transit agency among developed OECD countries. It almost doesn't matter that the Commission runs one of the most cost-efficient systems of any among developed countries in terms of price per passenger, or per passenger kilometre. While this is laudable in and of itself, it quickly becomes the challenge. It mostly means that the service or quality of facilities is less than Torontonians hope for. That gap between high expectations and deliverable items is the stuff of some of the major public conflicts over transit planning and funding today.

Gone are the days when public transit was seen as a last resort service for those who had no choice but to ride it. Now we recognize it as a quality of life engine, fostering local economies, bettering the environment, and serving as an insurance policy on streets being people-friendly, dynamic, and well planned.

With liveability of cities now an important economic development tool, having good transit is also important to attracting good paying jobs in the new knowledge economy. Transit is key to scoring well in the international rankings of cities that Toronto routinely scores in the top spots and that are important to decisions made by companies around where they locate.

Indeed with Toronto's bid for Amazon's new HQ, the connection between transit and building a strong economy is clear to all – witness the way the City offered our transit network as part of its power pitch to a company looking for a sophisticated city to do business in. In discussions with the trucking and manufacturing sectors, the relationship arises again – transit's ability to replace a

percentage of road-clogging car traffic is a gift to industries relying on moving inputs to goods, and final products to and from markets.

While this understanding may have been long present in downtown areas, the suburbs have now clued in with a vengeance, and there is increasing pressure from areas outside the core for quality transit and all the spin-offs that work so well in the city centre.

Transit as a First Choice

The key to making the TTC a truly attractive choice – one that trumps reliance on the congestion-creating private car – starts, of course, with ensuring sufficient and reliable service, a reality that often tests budgets at both municipal and provincial levels. Hopping a vehicle that's come on schedule, and didn't require a long wait may be the essence of successful transit, but it's not the whole story. Boarding a TTC vehicle should be a user-friendly experience, the ride has to be comfortable, and the system has to contain a network of high quality public spaces that are well maintained and that people really want to be in. The entire transit operation, in short, has to signal respect for those who use its services.

Ensuring our public transit becomes all that we want it to be is dependent on a myriad of decisions, most of them in the political realm. While in theory City Council does not directly control the budget or operations of the TTC, as its largest funder and the entity that names that Board, it has a lot of say over how the system is run. Council exercises this control by approving the list of projects in the capital budget and doing line-by-line reviews of the budgets that leads to de facto control of the TTC and means that the TTC essentially operates as a committee of Council.

Which brings us to the purpose of this guide. This overview of the TTC's workings, its history, the issues it confronts, and key discussions around options for improvement, is offered as a reference how-to for decisions-makers.

The hope is those in decision making roles will keep faith with Toronto's hundreds of thousands of transit riders and formulate policies that serve their interests, and that of the economic region as a whole. After all, making life easier for transit users is just another way of helping make the City a more hospitable place for everyone, not to mention a hive of creativity, enterprise and initiative.

There are different ways to improve transit and indeed it is the role of our elected and appointed officials to debate the options, but hopefully these will be

thoughtful, fact-based and shed light on the challenges of building a 21st century transit system.

TTC Structure

The TTC was established by Provincial Statute in 1920 after residents approved a referendum to create the TTC and the City of Toronto Act of 2006 outlines its interaction with the City of Toronto as municipal corporation and commission.

The current board is made up of citizens and elected officials, with the Chair being named by Council usually on the recommendation of the Mayor and the Vice-Chair being elected by the Board.

The Board is responsible for hiring the Chief Operating Officer, who is currently Rick Leary and the CEO is responsible for all other staff.

The Board is responsible for setting corporate governance including direction, policy and objectives and approving large contracts and purchases, while the CEO and the senior management team is responsible for day-to-day operations and providing technical and management expertise.

Current TTC Board

- Chair – Councillor Jaye Robinson
- Vice-Chair – Alan Heisey, Q.C. (Citizen)
- Councillor Brad Bradford
- Councillor Shelley Carroll
- Joanne De Laurentiis (Citizen)
- Councillor Jim Karygiannis
- Councillor Jennifer McKelvie
- Ron Lalonde (Citizen)
- Councillor Denzil Minnan-Wong
- Julie Osborne (Citizen)

2. AUTHOR

Adam Giambrone was a member of City Council and the TTC Board from 2003 to 2010, serving as Board Vice-Chair from 2005-2006 and Chair from 2006 to 2010. He has an MBA from the University of Toronto and an EMBA focusing on Transportation Operations from the University of St. Gallen.

Adam Giambrone, MBA

After leaving office, he served as the Director of Studies in Planning and Innovation at Montreal's Regional Transit Authority, and then worked for the cities of Milwaukee and Savannah overseeing streetcar construction and, overall System Planning including buses.

He served as the Director of Streetcars and LRT/Transit Capital Projects with the City of New York between 2016 and 2018 where he reported through the Mayor's Office, and worked on a series of projects focusing on transit expansion across the five boroughs.

Adam is currently the General Manager of SAPTCO (Saudi Arabian Public Transit Company) and responsible for overseeing their multi-billion dollar transit capital expansion plan including the creation of three new metro systems, new urban bus networks in all the large cities and a high-speed intercity train network.

He continues to spend to spend time in Toronto every month to stay connected with family and friends

INTRODUCTION 3.0

Toronto is a growing, vibrant city that attracts thousands of people each year – many that will board TTC subways, buses and streetcars for the first time when

they arrive. Since 2010, TTC ridership has grown from 477 million rides per year to an expected 539 million in 2018, and with steady growth (and the opening of the Eglinton LRT), could well reach 570 to 590 million riders by the end of the next City Council term.

The City has one of the highest transit ridership rates per capita in North America -– around 200 annually, slightly less than Montreal or New York, but more than double cities like Vancouver, Boston and Chicago. And locally, Toronto is obviously the big hitter, as most of the municipalities around Toronto have around 40 rides (linked trips) per capita at best.

Transit in Toronto is better, believe it or not, to anything that exists in most North American cities, but service budgets haven't kept up with demand, and there are simply not enough buses and streetcars on the road. This has resulted in a disappointing decrease in ridership growth, from 2% to 3% per year, to under 1% or just under 5 million new trips per year over the last few years, despite the fact that recent transit pilot projects and service additions suggest that there is a lot of latent pent-up demand. Still, to keep this flat ridership growth in perspective, many US transit agencies have seen ridership numbers actually fall in most of the last five years, from 5% to 10%.

Toronto - Far Ahead

Transit expansion is happening in Toronto, albeit slower than desired, and with occasional sidesteps. Even with the addition of the projected new subways and LRTs lines, it is expected that over 60% of TTC riders will still rely on a bus or streetcar route to reach rapid transit lines well into the future, which is why bus and streetcar service expansion should continue to be a key focus.

As noted earlier, the TTC is a very efficient transit operator per rider, or per kilometre, and ranks in the top three in the OECD in this regard (as it does in NOVA's, a bench-marking academic organization focused on transit run out of the University College London: https://cometandnova.org), but this efficiency comes, we can all attest, at the cost of more crowded vehicles and less kilometres of rapid transit available to riders.

Of course, this efficiency has been born out of necessity, given government decisions, with Toronto transit riders covering around 70% (and for many years, more than 70%) of the cost of operating transit – 20% to 30% higher than in other large North American cities with multi-modal systems, meaning a mix of subways, bus and commuter rail, etc.

Things weren't always so difficult. Until 1972, the TTC had an operating surplus, and before 1950 could even cover most of its capital investments through fares, even building the first part of the Yonge subway with banked fare money. Nowadays the subsidy of the TTC represents around 7-8% of the City's entire operating budget.

Once the costs of servicing debt for capital budgets are factored in the TTC can be said to be the largest single expenditure by the City, even larger than the Toronto Police Service. The police have a large operating budget, but small capital budget, whereas both of the TTC's budgets are large. In fact, the TTC's capital budget consumes around 50% of the City's entire annual capital budget and is impossible for a large portion of its accumulated debt.

Financial Summary for the Last 10 Years

As long-time transit observer and commentator (www.stevemunro.ca), Steve Munro, concluded the following after examining the stats for the last ten-year period,

- Operating expenses in this period rose by 52% while revenues increased by only 45%.
    - On a per trip basis, operating expenses rose 29.8%, while revenue increased only 23.3%.

        With expenses outpacing revenue, the overall subsidy grew by 47.7% per trip and 72% overall. This was due to inflation and the addition of new service to meet ridership. If these trends continue, the TTC budget as a percent of the total City budget will expand and put pressure on the City's attempt to control total budget expenditure growth.

- The above is true despite the fact that fares went up 29.9%, compared to general inflation (which increased 19.36%).

- Over this same ten years, ridership went up by 17%, and service (hours of service) overall went up by an average of 20.5%, though more so on the bus network (28.8%) than on the subway (11.4%) or streetcar (11.0%) networks. These increases were made possible with the larger bus and subway fleets – up 24.7% and 23.9% respectively.

Conclusion:

In conclusion, transit costs grow faster than inflation, but the TTC has done a good job of controlling costs. While fares have risen faster than inflation, they have not been enough to cover shortfalls and so there has been a large growth in the total subsidy amount, although per ride subsidies have stay within a +/- 10% range. While service has grown with ridership, it has struggled to keep pace and the system has relied on using more bus service to manage ridership growth.

Big Shifts to Come

And there are major issues ahead. Transit is facing forces that will alter traditional ways that services are planned and operated. The next few decades will require the TTC to adapt to challenges as diverse as cost-effective electric buses, driverless transit vehicles, ride hailing and micro-mobility, and operating budgets that grow faster than inflation or property tax revenues. Likewise, ongoing maintenance and renewal of over $30 billion (replacement value) in infrastructure and assets (i.e. State-of-Good-Repair) necessitates demanding greater investment to ensure system safety and efficiency, and sustain ongoing customer loyalty.

TTC also has to adjust to the ridership impact of cyclical economic growth, as well as economic and demographic changes such as the rising urban population, aging population, the 24 hour city, telework, and political changes that will affect its role as an Agency of the City of Toronto.

To Upload the TTC or Keep it in Municipal Hands

The public discussion started by the Province about the upload (transferring responsibility to the Province) or partial upload is a distraction that sidesteps important discussions about how to improve transit and substitutes a discussion about governance structures that will do little to improve transit.

Uploading responsibility for local transit service will have little effect on efficiency on one of the top 3 most efficient systems in the OECD. Handing political responsibility to a legislature where only 1 out of 5 of the seats are from Toronto could lead to long term decline of the system which would not receive as much attention at the provincial level as it does at the local level.

What uploading the TTC to the province really does is to take advantage of a financial environment that makes more capital funding available for service expansion (by purchasing more vehicles and extending train lines) and significant replacements of TTC capital assets (replacing vehicles and other infrastructure at the end-of-life). Simply put, the provincial government is able to borrow more money than the City of Toronto, with far fewer restrictions on how much.

What uploading does not do is to provide more operating funding or resolve the service challenges that the TTC faces. It does not improve service planning and accountability, or ensure that the needs of the TTC (which carries 85% of public transport users in the Greater Toronto and Hamilton Area) would receive full attention and support from the provincial government.

The best example is New York's New York City Transit (NYCT) in which the assets are still theoretically owned by the City, but in practice are controlled by the State through the Metropolitan Transportation Authority (MTA).

Right now, New Yorkers are paying the price of handing over the City's transit authority to the state in the mid-20th century when the City faced bankruptcy. Similar to Toronto, elected State representatives from New York City make up a minority of the State legislature and upstate legislators have refused to allocate sufficient resources. This has led to what has become a $68 billion state-of-good-repair backlog (compared to TTC's $3 billion) causing the deterioration of service, with only 70% on-time performance by some of the City's subways and a state of emergency declared after a series of accidents and crashes caused by faulty equipment that has led to declining ridership.

Uploading the TTC to the province would also require a full analysis and accounting of TTC infrastructure, assets and liabilities, and significant effort to determine if and how the City of Toronto would be compensated by the province, as well as how staff would migrate, how salaries would be paid. Addressing these and many other behind-the-scenes factors would cost time and money and, as stated earlier, are a distraction from the important and necessary service improvements that could help sustain and increase TTC ridership.

These complications may be why the province has chosen a phased approach to uploading the TTC. Bill 107 (passed by the Ontario legislature on June 4, 2019) amended the Metrolinx Act, 2006 to include the ability for the Province to prescribe a rapid transit project as the sole responsibility of Metrolinx. The project would become part of Metrolinx's regional transit system. The Province would also have the authority to transfer assets, liabilities, rights and obligations related to the project from the City of Toronto to Metrolinx, through an Order in Council.

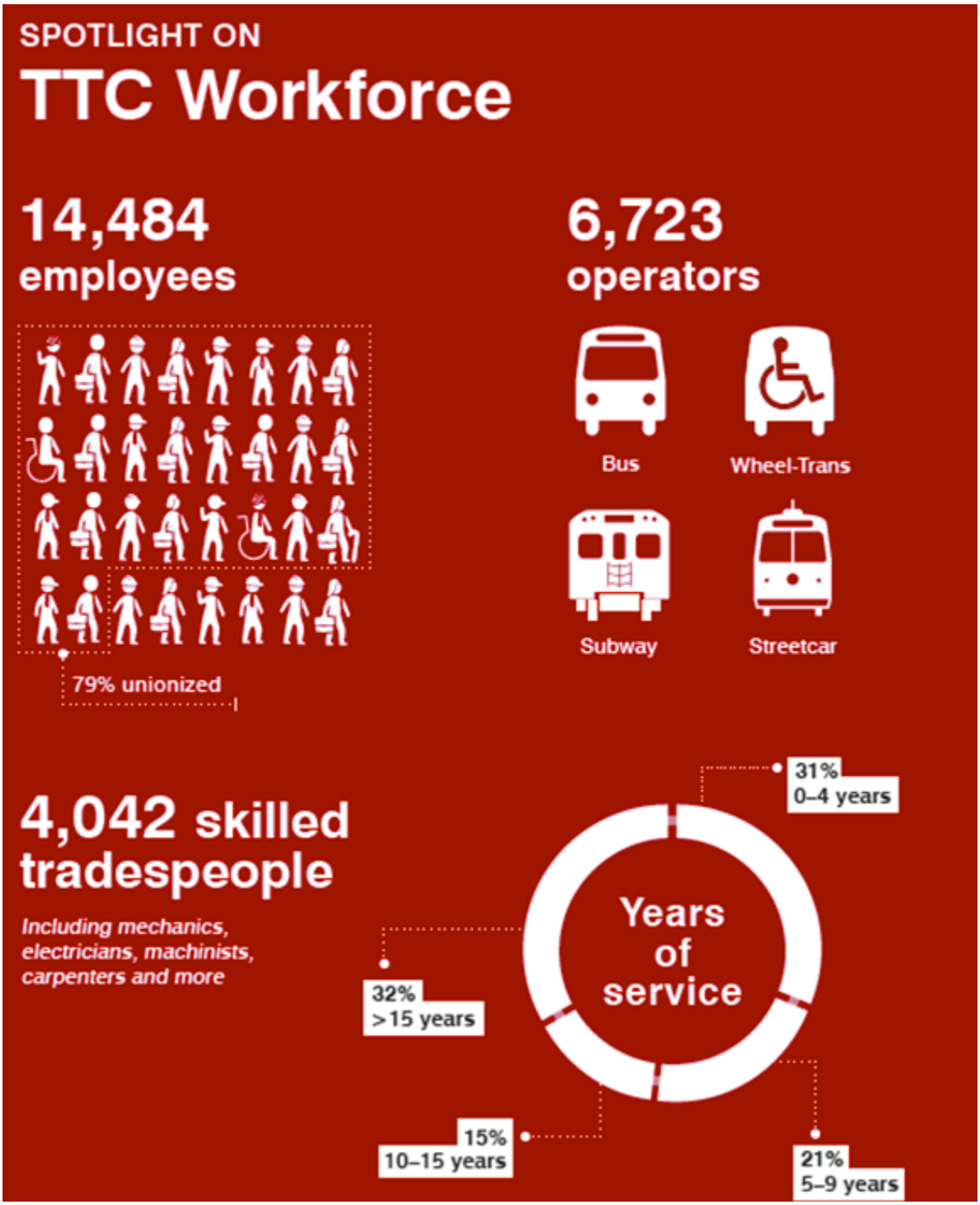
TTC as a Local Service

Urban transit service belongs at the local level where local politicians can be held accountable directly for service quality and funding decisions with funding support from those orders of government with more taxing authority including the provincial and federal governments which together collect around 95% of all taxes, versus the 5% collected by municipalities.

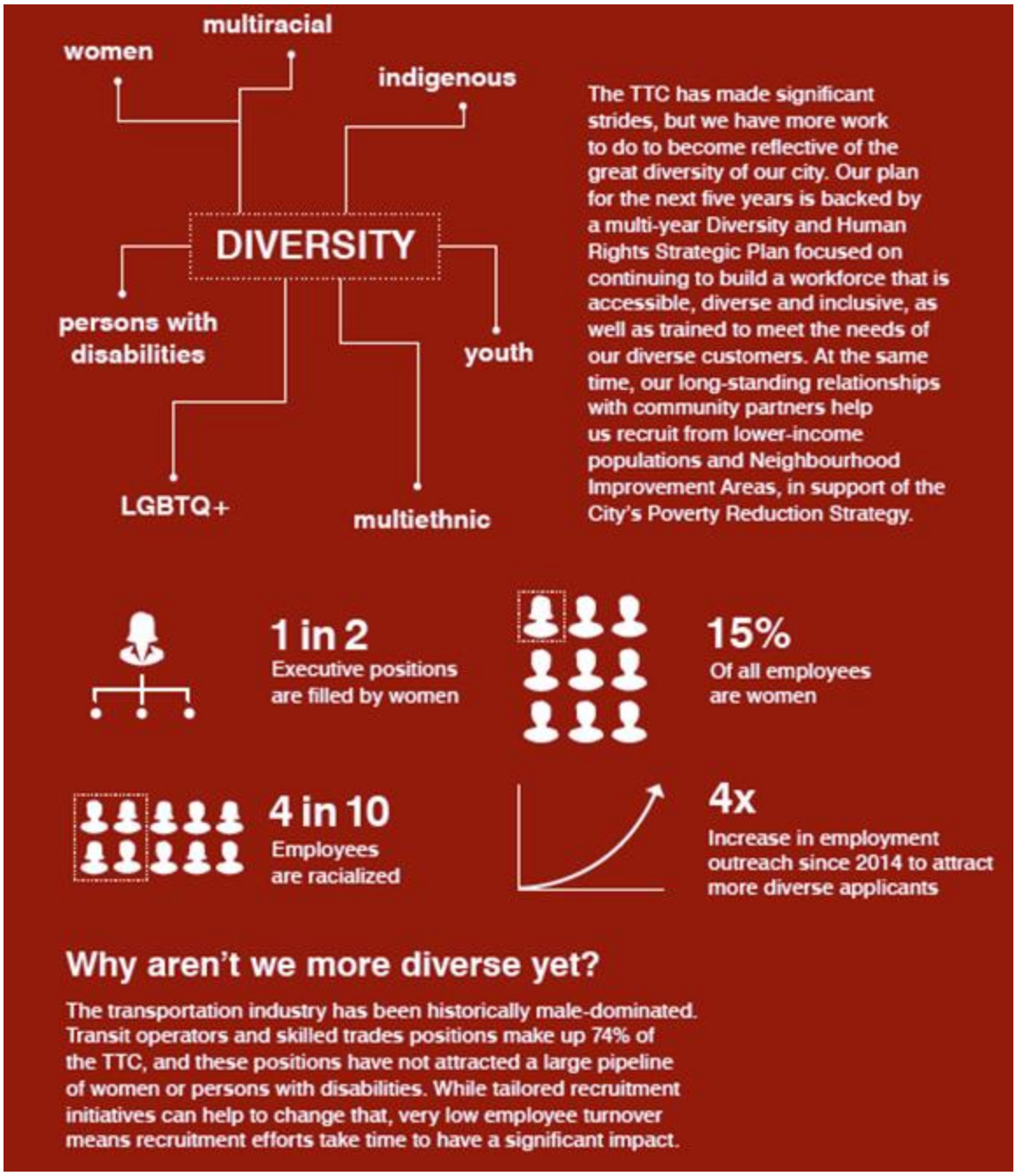
Despite the challenges ahead, expansion must continue, but only with projects that clearly and effectively serve large numbers of new or existing riders. Building expensive subways in areas lacking density high enough to generate ridership is a poor use of precious resources that will mean less money available to improve transit elsewhere, and overall fewer riders benefiting from transit investments.

Table 1: TTC Statistics (source: TTC)

Facilities	Number
Number of Subway Kilometers	**76.9km**
Subway Stations	**75**
Bus and Streetcar Stops	**10,000+**
Bus Garages	**7**
Main Subway/SRT Maintenance Facilities and major overhaul facilities	**4**
Vehicles	**Number (2018)**
Bus	**1,906**
Streetcars	**260**
Subway cars	**800**
Employees	**Number (2018)**
Operating	**12,670**
Wheel-Trans	**620**
Capital	**2,515**
Total	**15,805**
Ridership	**2018**
Daily Ridership	**2.76 million**
Bus Ridership	**1,425 million**
Streetcar	**271,000**
Subway	**1.01 million**
Paratransit Ridership	**4.3 million**
Total Ridership (linked trips)	**540 million**
Total Ridership (unlinked trips)	**875 million**



Breakdown of TTC Employees in 2017 (Source: TTC)



TTC Workforce Analysis, 2017 (Source: TTC)

4. BRIEF HISTORY OF THE TTC

The Toronto Transit Commission (initially called the Toronto Transportation Commission) was founded in 1921 when the City floated a bond to buy out the private street railways that ran streetcar service. It was a decision motivated by the poor quality of service, lack free transfers between lines run by different companies and the need to expand service. The Commission, while owned by the City of Toronto, is a distinct entity, thus allowing it to maintain some independence, and lessening political pressures on transit planning. Its current board is a mixture of citizens and City Councillors.

Vacation Air (Source: Web).

In the past the TTC has run an intercity and commuter bus company (Gray Coach Lines), which is why it still owns the bus Terminal at Bay and Dundas. It also once did consulting around the world with a TTC owned consulting firm and even briefly owned an airline through its Gray Coach subsidiary that was called Vacation Air.

In the 1920's the Commission replaced the old streetcars and introduced buses to serve new routes. In the 1930's (with delivery continuing into the 1940's and 1950's) the TTC started to add a large fleet of Presidents' Conference Committee (PCC) streetcars, classic Art Deco looking cars that would serve riders until the last ones were retired in the 1990's. In addition, during the 1950's the TTC bought many PCCs from cities across North

TTC bus (source: TTC)

PCC Streetcar (source: TTC)

TTC Bus (Source, TTC)

America that were phasing out streetcars as a low-cost solution to increase the streetcar fleet.

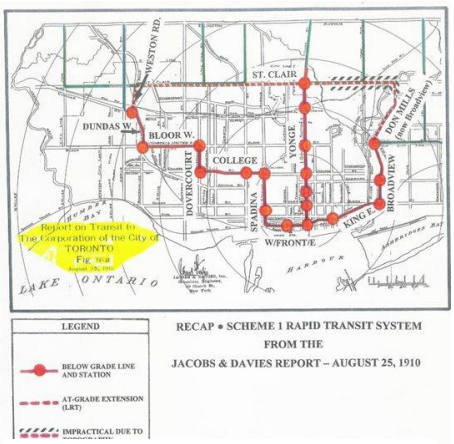
The 1940's brought rising issues of congestion to the forefront and the Commission started planning for a subway along Queen, and one up Yonge Street, since the roads were too crowded for efficient high-volume streetcar service.

The quote below could almost have been written today and not over 70 years ago.

> ***The present congestion of traffic on Toronto streets threatens the very economic life of our City. Its welfare varies with the ease and efficiency with which people and goods can move throughout the city. The Commission does not propose to stand idly by and allow this deterioration of its services and of the city itself to take place. There must be a gradual separation of public and private vehicles, both of which are now trying to operate on the narrow streets originally designed for horse-drawn traffic.***
>
> ***POLICY STATEMENT "RAPID TRANSIT FOR TORONTO"***
> ***Toronto Transportation Commission (TTC), 1945***

Subways for Toronto

Subways had been talked about in Toronto since 1910, and a referendum approved proceeding with design of a subway, only later to be repudiated by citizens in a second referendum after the costs were made clear.



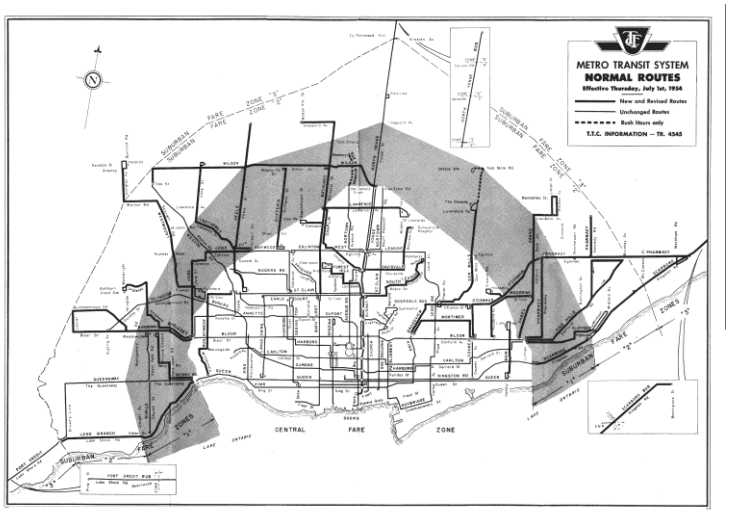
Proposed rapid transit, network, 1910. (Source: Toronto Archives)

During World War II, the TTC was unable to invest in much new service or many new vehicles due to war rationing, but with industrial employment rising to support the war effort, the TTC recorded large surpluses from increased ridership.

But the rise in transit ridership rates co-existed with burgeoning automobile traffic, meaning it was becoming progressively more difficult to provide good quality streetcar service.

Surpluses Paid for Subway

The Commission used the profits from the war to pay for the construction of the Yonge Subway from Union to Eglinton, perhaps the last subway in North America to be built without government subsidies. It also hired its first female employees, to help drive Commission vehicles due to the labour shortages at the time.



TTC Route Map from mid-1954, months after the Yonge subway opened. (Source: TTC)

Restructuring

In 1962 TTC handed over operations of the ferry system (which it had run since 1927) and all 8 boats to the Parks Department of Metropolitan Toronto.

Ferries formerly owned and operated by the TTC are now owned and operated by the City of Toronto (source: TTC)

Toronto Transportation Commission Ferry, 1928 (source: TTC)

The End of Profitability

Even after many private transit operations went bankrupt and were acquired by government entities, the TTC remained profitable (on operations), until the early 1970's following a period in the 1960's when by direction of the Metropolitan

TTC Marketing Poster (source, TTC)

Toronto government, the TTC was forced to expand service to the inner suburbs to go along with the creation of the Bloor-Danforth subway. This also marked the end of the "zone" fare system (Toronto had had a mostly two-fare zone system as few routes continued into the then Zone Three), in which most routes outside of what was then the former City of Toronto were charged higher fares.

Bloor Chosen over Queen for New East/West Subway

As the city boomed in the post war period, rapid transit expansion was again on the agenda.

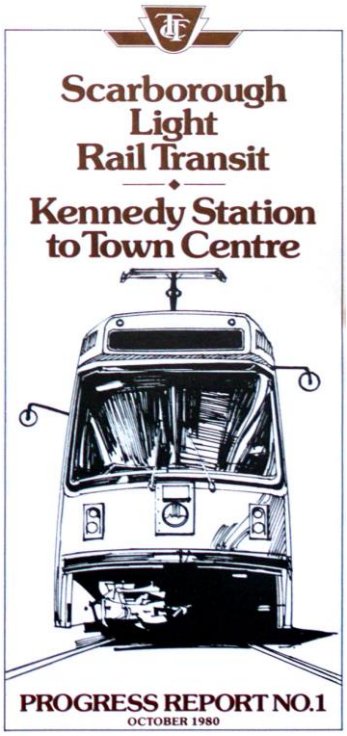
Ultimately the Metro level of government (which had been given responsibility for TTC oversight after its creation in 1954) decided that a Bloor subway was more important for the Metro Region than one on Queen, and work began on the Bloor Danforth Line in the 1950's. It was completed and started operation in the mid-1960's.
Through the 1960's and 1970's, the Bloor-Danforth and Yonge line were expanded. With the cancellation of the Allen Expressway towards downtown in the early 1970's, the Conservative government decided to expand the Spadina – University Subway north of Bloor, deemed again a higher priority than the Queen subway.

Today, we might be appreciative that the Queen subway was not built, as it was to have been constructed as an "open cut" (similar to the section of subway just north of Yonge/Bloor) on the north side of Queen Street. It is unnerving to think this would have resulted in the bulldozing of much of the currently vibrant West Queen West neighbourhood.

An artist rendering showing the tunnel portal on the proposed Queen line, west of University Ave. The Canada Life building is in the background. (Source: Toronto Archives)

It was also at this time that a funding formula was established by Premier Davis' Conservative government – one that was to survive for three decades and through governments of all three major parties. It saw riders paying around 68% of the cost of operating service, with the TTC's operating deficit (around 32% of its budget) split between the Province and the City (or at the time Metro), and the Province covering 75% of the capital budget of "approved work", as well as the full cost of Wheel-Trans, a service founded in 1975.

Up until the late 1950's, the Province had only thrown in some small grants, but it's fair to say it didn't get into direct transit project funding until the Bloor-Danforth subway line was extended towards Scarborough and Etobicoke with the extensions opening in 1968. In the mid-70's, the Province helped fund the extension of the Yonge line into North York and it was at this point that the Commission and City began to lose direct control of large-scale transit planning, and Provincial money began to determine whether new lines went forward and where they would be built.



Scarborough LRT brochure. (Source: TTC)

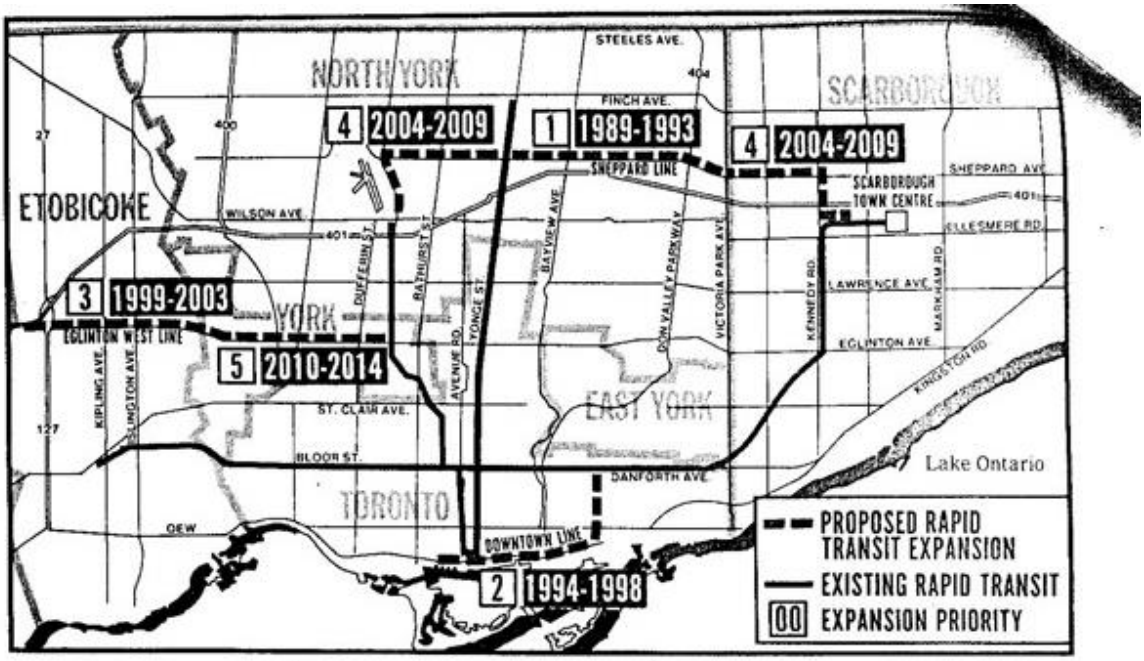
Rapid Transit For Scarborough

After the 1985 opening of the Scarborough Rapid Transit line using SkyTrain technology, the TTC's rapid expansion slowed. The Scarborough RT was originally planned as a surface running Light Rail Transit in a dedicated right-of-way, completely separated from other traffic except at intersections. However the Province had a Crown Corporation (UTDC – Urban Transit Development Corporation) that needed a test line for made-in-Ontario technology it wanted to market. Unfortunately, the early SkyTrain technology became a very expensive per kilometre solution and as a result was orphaned. The line was not extended to Malvern Town Centre as planned, and an Etobicoke RT which would have connected Kipling Station to Pearson Airport was never built.

Had the original streetcar in a fully separated Right-of-Way/LRT been the chosen technology for the SRT, extensions north and east in Scarborough would have likely occurred as the costs would have been substantially lower and easier to implement.

The 1990's

The late 1980's, and early 1990's brought other plans to expand rapid transit into the public discussion. The Peterson Liberals (albeit just months before an election) promoted one plan (Network 2011) that was adopted (with alterations) by the new NDP government, elected shortly after. Four years later construction started on the first (Eglinton) of many planned subway lines, but with a change of government in 1995, subway construction on Eglinton stopped and a hole dug to begin tunnelling was filled in, perhaps a metaphor for things to come.



"NETWORK 2011" RAPID TRANSIT STRATEGY FOR METRO TORONTO

1) Sheppard Avenue subway-- first phase.
2) Downtown Rapid Transit Line.
3) Eglinton West busway.
4) East and West Extensions to Sheppard Avenue subway.
5) Upgrading of Eglinton West busway to light or heavy rail.

One of the proposals that were made for rapid transit Network 2011. (Source: Toronto Archives)

A subsequent shrewd manoeuvre led by Mayor Mel Lastman, succeeded in securing funding for the 5.5km Sheppard subway instead of the Eglinton line, although there was ultimately only money enough for five stations. It opened in 2002.

Beyond the Sheppard subway construction, the later 1990's also saw renewed discussion around expansion of the Spadina Subway (although in the short term,

only the addition of just over a kilometre of tunnel to the new Downsview station that opened in 1996 was added) and the construction of the new Harbourfront (1990) and Spadina (1997) dedicated streetcar lines were completed.

During the late 1990's the Davis/Peterson/Rae formula to cover half of the operating subsidy was cancelled, and for a time the TTC received no provincial subsidies for operating or capital. This caused service to be drastically cut and fares increased several times, even twice (two 25 cent increases) in 1996. Starting in 1991 and continuing into the mid-1990's, ridership dropped dramatically. For much of the 1990's, transit suffered from an economic downturn, major cuts to service, and large fare increases that drove away around 20% of riders.

Since then, improvements to service, strong economic growth, increasing population and more density have resulted in ridership recovering in a big way. Between the late 1990s and today, ridership increased by over 150 million rides, from less than 400 million to close to 540 million.

A Move to a "State-of-Good Repair" Mentality

In a moment that significantly shifted TTC priorities for years to come, a train on the Yonge Line bypassed a red signal near Russell Hill, in 1995, and ploughed into a train with passengers on it. Three people died and 30 were injured. It was determined that the accident was caused by leaks in the tunnel leading to water shorting out the signal system so frequently that operators began to ignore red signals from the error-prone signal system, clearly indicating a lack of a good training regime in addition to State-of-Good-Repair issues.

In the aftermath of the tragedy, the TTC hired David Gunn from New York to change the operations philosophy and enact an aggressive State-of-Good-Repair program. Expansion plans were cancelled and replaced by a fierce mandate to put the TTC's facilities and system in good working order.

This urgent priority plus the elimination of provincial funding made the commission a very lean operation. At one time, finances were so tight that riders actually covered 82% of TTC operations, a ratio closer to highly limited commuter services (like GO Transit) rather than a full-service multi-modal transit network. Today the figure is closer to 68%-70%, far higher, as has been noted, than exists in most large cities in North America where the average is around 50%. Older vehicles, customer crowding and less service soon became the norm.

The New Millennium

The new millennium dawned with a push by riders and City politicians for the TTC to again focus on improving service. In 2002, the Ridership Growth Plan considered how the TTC could practically improve and add service without the large capital expense of new lines. Throughout the first decade of the 21st century, starting with the Ridership Growth Strategy, new service was aggressively added, with the TTC hiring some 500 new additional operators in 2008 alone, in order to increase service.

In 2006 the TTC launched Transit City, a proposed network of 120km and seven lines that included the Jane LRT, Don Mills LRT, Waterfront West, Eglinton Crosstown (Pearson Airport to Kennedy), Sheppard LRT, Finch West LRT (Yonge to Humber College) and Scarborough-Malvern (Eglinton to Morningside to Sheppard), A subsequent decision was made to rethink rebuilding the SRT with existing technology and instead focus on the conversion of the Scarborough Rapid Transit (SRT) line to LRT operations, and its extension to Malvern.

The Spadina Subway Extension northward from Downsview started serious design in 2006 and a Busway was opened in 2009 to serve York University until the new subway opened. Also in 2009, the St. Clair streetcar dedicated right-of-way was completed, 204 new streetcars were ordered. The rebuild of the streetcar track network was completed and much of Queens Quay West was redesigned to create a “complete street” with a wide promenade on the south beside the harbour. Over this time the size of the TTC bus fleet grew by hundreds, all equipped with new features like air conditioning, cameras, bus racks, “Next Vehicle” information systems and almost all with modern low-floor accessibility.

In the second decade of the 21st century, the only new line to open has been the 8.6km Spadina Subway Extension (with six new stations) in December of 2017. The decade has also seen extensive construction on the Eglinton LRT, slated to be open in 2021, along with ongoing debate about the Scarborough LRT (versus and Scarborough Subway Extension) and Relief Line, as well as delays to the Finch West LRT. Construction on the Sheppard LRT started in 2009 but was later cancelled in 2011.

Meanwhile, the Commission has been working on improving customer service, and public perceptions about the agency, as well as adding service, implementing a new fare system, new express bus network and other service improvements.

5. NEW SERVICE OPTIONS

Toronto's economy has performed well over the last decade, and the city continues to attract new residents, especially the downtown core which has grown by tens of thousands of people over the last few decades. This has created ongoing ridership growth, albeit more moderate in recent years.

Traditionally, ridership growth has been associated with expansions in the economy and population influxes, which makes these recent slower-than-usual increases in ridership notable.

A combination of factors likely explains the slower rates of ridership growth including: cheaper gas prices, frustrations with TTC service and crowding, more downtown residents (leading to an increase in cycling and walking commutes), increased weekend closures for maintenance and upgrades, and the creation of rideshare services like Uber and Lyft, among others. Added together, these factors may have resulted in the loss of close to potentially 50 million rides annually over the last five years, the difference between the current TTC ridership growth of less than 1% and the more traditional 2% to 3% during good economic times. Recently the TTC has also committed to examining how it calculates the Metropass trip rate, with the concern that the assumed trips per pass may not accurately represent the real ridership of users of the pass, making comparisons to past years less accurate.

While there have been recent additions to TTC service, there are many routes where there is overcrowding leading to less reliable and less comfortable service. Experience shows that the fastest and quickest way to grow ridership is to invest in good quality bus and streetcar service.

Improving the rapid transit network in Toronto is important, but 70% of all people who travel on the TTC use bus services for at least part of their trip-making, and another 10 percent use a streetcar to or from a subway station. All in all, over 525 million trip segments were made on bus routes, or around 50% of the total trip segments. "Segments'', as opposed to "rides'', consider the number of times a rider boards (or makes a transfer) a vehicle and a "ride" is the complete trip in one direction

Expanding bus service is quick and relatively cheap

Whereas new subways cost $300 to $400 million per kilometer to construct (LRT, by comparison, is $70 to $90 million per km), and take a long time, expanding bus service is quick and relatively cheap, especially for off-peak service where vehicles are available. While buses are not exciting to many, speeding them up and making them less crowded will improve many riders' lives by getting them to their destinations faster and more comfortably.

New Off-Peak Service is Cheaper and Faster to Add

"Peak" service (roughly 6am to 9am for the Morning Peak and 4pm to 7pm for the Afternoon Peak), requires the use of all or most available vehicles while slightly fewer buses are required for the afternoon peak where rush hour is a longer period with people heading home in less concentrated patterns. Adding service at peak times requires the purchase of new buses, as well as the hiring of new operators.

On the other hand, it's relatively inexpensive to run off-peak service, pre- and post- rush hour, and the period between 1am and 6am when Blue Night Service runs as subways and the SRT are closed. Operating during these hours means only incremental costs including operators' salaries and more diesel, along with some extra money for more servicing of vehicles at the bus garages.

New diesel buses cost around $700,000, take approximately 18 months to arrive once ordered, and require space at garages to house and service them.

5.1 Bus Fleet Size

In 2018 the TTC increased service to help meet ridership growth and this brought the bus fleet requirement to around 1620 buses for morning peak service, rising to 1640 buses in 2019.

Currently the TTC has seven garages with a combined capacity of 1630 buses, but there is also room to store 40 more at temporary facilities such as the leased property near the Malvern garage.

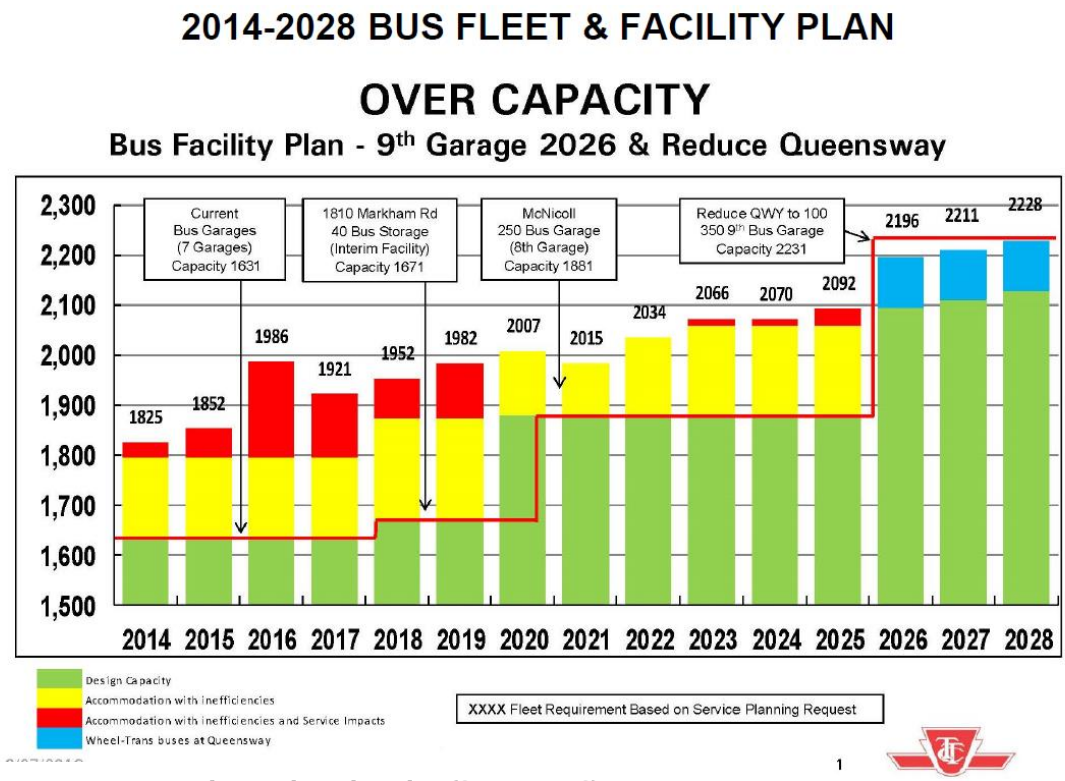
When bus garages are over capacity, servicing buses becomes inefficient and with extreme over-crowding, the servicing inefficiencies ultimately can grow and lead to service impacts, i.e. buses not being available. This can mean that some

bus routes are provided with fewer vehicles than required, leading to overcrowding or wider spaces between buses.

Current bus acquisition plans will bring the total bus fleet to just over 1950 buses at the end of 2018 – that's about 300 more than is directly needed, but there is a reason for that.

In order to prevent breakdowns, the TTC maintains a "spare ratio" of 20% – that is, 20% of buses need to be in for preventative and reactive maintenance at any one time. So the 1620 buses needed for service, actually requires maintaining a fleet of around 1950 buses.

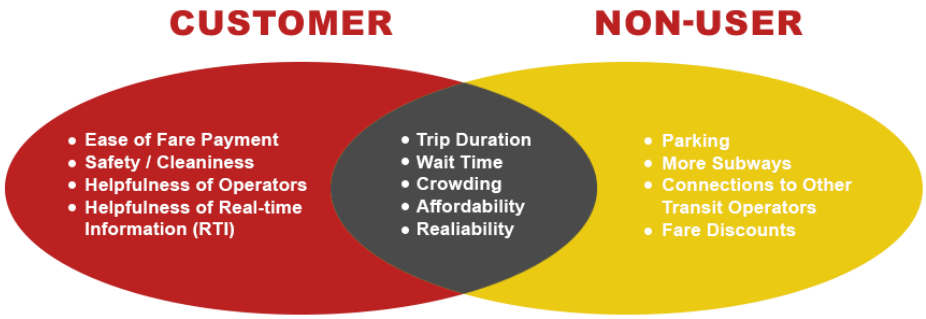
The need for in-service buses will grow to 1640 in 2019, but the TTC will temporarily need fewer spare buses since new buses require less maintenance. This is critical as housing 1950 buses is currently not possible. With the new McNicoll garage under construction, garage capacity will increase to 1880 with its opening in 2020, still short of the 1950 needed, but manageable.



2014-2028 Bus Fleet and Facility Plan (Source: TTC)

5.2 Priorities When Adding Service

When considering what service to add there is a conventional hierarchy to the approach taking by transit planners. It starts with the goal of retaining current passengers as the first priority, typically accomplished through providing good service on existing lines, as this is the easiest and cheapest way to maintain and build a base for future ridership growth. Next comes increasing the use of the system by existing riders achieved through giving them better options leading to higher per capita transit use. And finally come changes to attract new riders, the hardest alternative since it often involves luring them away from other modes of travel, which for the majority is the private car. Getting people out of cars is what



requires the greatest investment in new infrastructure and service as convincing those who already own a car, or have regular access to one, to use transit is very tough, and typically takes a great deal of capital investment in new subways or LRTs to induce them to make the switch. But with so many new potential riders (see paragraph below), not yet tied to a car available to the TTC, capturing 10% of these riders annually as regular riders would bring 15 million new trips, representing 2.7% ridership growth to the TTC every year.

Every year the number of potential new TTC customers is estimated at approximately 10 percent of the population, or around 250,000. These are people moving to Toronto for the first time and looking to figure out the best way of getting around, or they are middle or high school students for whom independent mobility is just becoming a reality and seniors changing their mobility patterns.

For that reason, focusing on new Torontonians and young people starting to make independent travel decisions, or having to travel for their education is the best way to grow ridership. If individuals are offered good, affordable, convenient and reliable service, they are unlikely to switch and adopt the car as their primary

means of travel. This is especially true if the system offers complete accessibility, a feature that makes adapting to new situations in life possible.

Focusing on Basics has been shown to Increase Ridership

While every rider prioritizes elements of good transit differently, surveys generally identify three broad categories of riders' feelings on transit service. The "Basics" of good transit focus primarily on making travel on transit more reliable and convenient as well as rapid. Secondary factors that affect transit ridership are comfort and accessibility of transit services. Finally the last category is that of "cost" or the price of transit services for riders. While obviously a big potential factor at the extremes (free or very high fares), price is not as important a driver of transit ridership as the other two factors.

The "Basics" of Better Service

1. Faster and More Comfortable Service

Increased frequency of service

- More frequent service, especially under 15 minutes between buses, drives ridership growth.

Improved reliability

- While trip time (speed) and bus schedules are important, the reliability of service is one of the most important elements because without it travellers must build in buffers for traffic and bus bunching. As well, the ability to be spontaneous and not have to overly plan a transit trip encourages ridership. Maintaining Service from 6am to 1.30am on every route, at better than 15-minute service can make a big difference to riders' psychology, assuring them they can always find a way to their destination and home. This level of service would likely drive ridership increases above what would be predicted, as it would lead to a paradigm shift, where transit would generally be the most efficient way to get around for most people.

Improved speed of vehicles

- By providing separate bus lanes, queue jump lanes, and transit signal priority, bus speed can be sped up dramatically therefore reducing trip time.

2. Accessible More Comfortable Service

Accessible and More Comfortable Service

- Accessibility isn't just required by law and the right thing to do, but helps makes transit run smoother. It speeds loading of surface vehicles and encourages a larger demographic swath to use transit, from parents with strollers, to riders needing to bring a grocery buggy, to older people with reduced mobility. Accessibility allows transit to be a viable option for all segments of the population, and for everyone throughout their life.

Improved comfort and decreased crowding

- Nobody likes to be pressed in so close that there is no personal space, and packed buses take longer to load leading to slower and less predictable service.
- The levels of service are the most important, but amenities are appreciated and do, to a small extent, increase transit ridership. Cleaner and newer facilities, air conditioned/heated spaces, modern forward-looking public spaces, quick and easy transfers, comprehensible information (static and electronic), and other conveniences and comforts have been shown to contribute to transit ridership in a small way and are certainly appreciated by riders.

3. Affordable Service

More cost-effective

- While no one likes to pay more for service, moderate fare reductions have a lot less impact on ridership than better service. However, targeted initiatives like the two-hour transfer, U-PASS (targeting students) and other specific fare products build ridership, although on a dollar for dollar basis, increasing service will still attract more riders.

5.3 The Price of Success: Keeping Up With Growth

Keeping up with Growth

The TTC's customer base consists largely – almost 70% -- of people who have access to other means of travel – such as a car or bicycle – but choose to take transit for various reasons. These reasons include saving money, avoiding the hassles of congestion and parking, or reducing their environmental impacts. Ensuring that the ride and experience is relatively comfortable is an important step in maintaining strong ridership and a high quality of service.

Over the last number of years, the TTC has struggled to keep up with its traditional loading standards, the rules that guide TTC planners on decisions about adding service on routes. The standards which set the number of passengers that TTC planners expect to be accommodated on a vehicle vary according to the type of vehicle (model of bus, streetcar or subway), and have traditionally recognized that in rush hour, passengers must accept that there will be some crowding, and that outside of rush-hour, most of the time a seat will be available.

The failure to adhere to service standards and to match service with growing ridership as it happens has likely been partly responsible for a slowdown in ridership growth on the TTC.

A 2016 TTC report estimated that decreasing crowding in peak and off-peak on 40 routes would bring close to four million new riders, and cost just over $10 million net after new fare revenue. A similar TTC report from May of 2018, noted that there were approximately 23 bus routes that exceeded the TTC crowding standard in the peak periods during some periods or parts of the routes and 14 bus-routes in the off-peak period in some periods or parts of the routes.

Based on the current analysis, three quarters of the over $10 million annually would need to go to off-peak services, and the rest for peak services. Between 40 and 50 bus and streetcar routes would benefit from this service and thousands of TTC riders would have a more comfortable trip.

Judging from the recent King streetcar example where additional and more reliable service was provided resulting in large ridership increases, there is a large amount of latent demand that may not be accounted for in the estimates of new service required. It is likely that as new service is added, vehicles will fill up quickly and still more service will be needed to be added to meet the latent demand. This is a good thing for riders and good for the city.

Riders left at the curb, but how many?

It is vital for the TTC to properly count and understand their ridership numbers, compare them against existing and projected demand, and ensure that these numbers are used to properly estimate service needs and make the capital and operating purchases necessary to supply this service.

The TTC measures ridership on an ongoing basis using fare box audits, visual inspections and automated means like automated people counters. This allows TTC to add service during one of the 13 Board Periods (when operators sign-up for what routes to drive) that occur throughout the year.

"Board Periods" are when unionized operators get to choose the route and time period of their work. The process is based on the collective agreement signed between the TTC and Amalgamated Transit Union and priority is predominately based on seniority.

Board periods are usually every 6 weeks, but may be as short as 2 weeks which is the length of the period around the end of December, when the high number of holidays effects ridership, the start of service (holiday service) and thus the need for service.

The TTC is unique in having many board periods, which gives it the ability to adjust service as ridership changes. This allows for the optimal deployment of service based on evolving ridership.

Another example (besides around the end of December) of how board periods allow for service to be optimized is the May to August period. At this time service begins to be reduced as some riders switch to other travel modes (like walking or cycling) due to the weather and this trend continues with service being further reduced in May as universities let out with still further reductions in July and August as students are out of school and more people are on vacation. The lowest service levels are in August.

Like many transit agencies in North America, the TTC has reported declining ridership over the past four years. However, passenger observations and commentary, along with TTC staff reports, show that the system is as crowded as it has ever been. The TTC believes that some of the decline may be attributed to how riders, especially pass-holders, are counted. The decline in pass sales that corresponds with the introduction of the PRESTO payment system, not only impacts how riders are to be counted, but reinforces how important it is to have accurate ridership counts in order to make necessary improvements to transit service.

5.4 Options For Service Increases

There are six areas outlined below which offer prudent ways of improving surface transit in Toronto. They are listed in order of priority with reducing crowding and maintaining comfortable/reliable TTC service clearly the most important and the improvement of overnight Blue Night network the least expensive.

Each of the others requires varying degrees of new operations dollars and/or capital with those proposals for service in the peak period, being the most expensive overall, due to the need to purchase new vehicles.

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1) Reducing Crowding

Cost: *$4-6 million per year plus capital costs of new buses and streetcars as needed for ridership growth in the 1-3% level*

In order to sustain ridership and prevent customers from switching over to other travel modes, it is important to provide customers with services that offer a basic level of comfort. While all transit users understand that during peak periods, it is impractical or impossible for everyone to get a seat; they quite reasonably do not want to be crowded to a point of discomfort, with almost no personal space at all.

There is a correlation between routes that experience increases in ridership causing overcrowding, and the number of customer complaints as reported in various customer satisfaction updates. Reducing crowding also supports the TTC's goal of shifting more Wheel-Trans passengers to use TTC's conventional system because it makes it easier to get mobility devices on and off vehicles and ensures that more passengers can be accommodated.

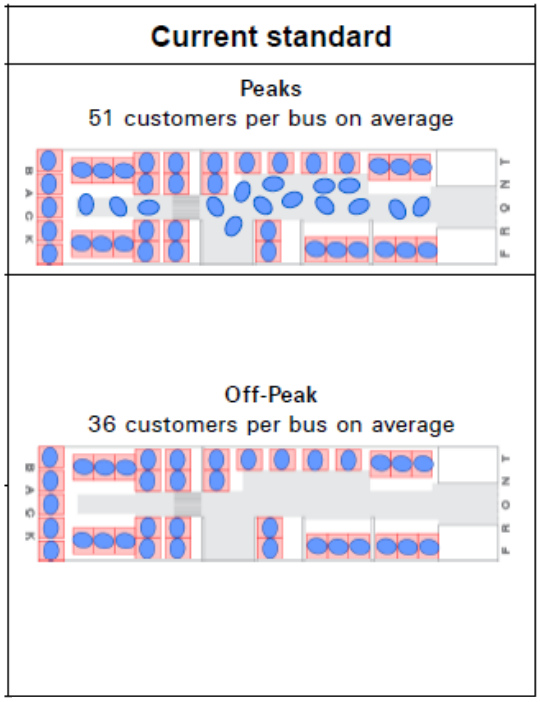
Traditionally, the TTC's operating budgets have not included resources to allow staff to be pro-active in this way. Instead, as ridership increases and overcrowding occurs, TTC staff has to go to the Board and City Council to request extraordinary, out-of-budget funding to address these negative customer effects. By time the additional funding is approved (if it is at all), the overcrowding on routes may have been occurring for several months – and getting worse -- with the risk that some customers will start to abandon transit for other modes.

It is in the best interests of both the TTC and its customers to have enough resources – both vehicles and operators – to be able to add service to routes as soon as there is evidence of ridership growth or overcrowding; that is, to be as pro-active as possible, instead of reactively adding service only after overcrowding has set in and customers complain about it.

Crowding in the peak period leaves people at the curb because buse s are too full, making the voyage slower, less reliable, and inevitably full of delays as a consequence of the increased passenger boarding time. Such interruptions lead to increasing clumping of vehicles and longer waits for riders.

As a result of extraordinary funding approved by Council, service was added in late 2018 to bring the crowding/comfort levels of these routes back to within approved crowding standards.

These improvements were projected to benefit up to 23.7 million trips and generate 285,000 new trips each year, at a net cost of $5.5 million for 2019 (with the new operating costs partially offset by new revenue).



TTC Bus Crowding Standards in 2018 prior to service improvements. (Source: TTC)

<u>Routes with Peak Service Improvements:</u>

- 109 Ranee
- 113 Danforth
- 122 Graydon Hall
- 165 Weston Rd North
- 185 Don Mills Rocket
- 195 Jane Rocket
- 198 U of T Scarborough Rocket
- 199 Finch Rocket
- 29 Dufferin
- 89 Weston
- 102 Markham Rd

<u>Routes with off-Peak Service Improvements:</u>

- 24 Victoria Park
- 25 Don Mills
- 29 Dufferin
- 36 Finch West (East of Keele)
- 54 Lawrence East
- 63 Ossington
- 95 York Mills
- 100 Flemingdon Park
- 102 Markham Rd
- 112 West Mall
- 129 McCowan North
- 131 Nugget
- 198 U of T Scarborough Rocket
- 199 Finch Rocket

Off-peak travel is typically more discretionary and as a result demand is more elastic than at peak times, which is mostly people getting to and from work. The TTC has always tried to offer less crowded service for off-peak travel to attract passengers during periods when they have other options.

Of the total cost (capital and operating) of adding more service, buttressing off-peak travel is less expensive. Buses are available from the large fleet required to meet peak demand as not all of them are used outside of peak periods.

To continue to increase peak service, additional buses are required, as well as more storage capacity that the new McNicoll garage (opening late 2020) may be able to provide. In order to fully implement service additions on streetcar routes another 40-60 streetcars, above and beyond those that are currently on order, will be required. At the option price of around $3.5 million per new streetcar "options" (that is, minus the initial cost of engineering and design) the cost would be cost $200 million in capital funding, over a number of years.

Adding and Upgrading Service as Ridership Grows

In order to avoid this situation of always playing catch-up in service – forcing customers to be overcrowded and uncomfortable for varying durations of time pending approval of additional funding – it would be prudent for the Board and Council to approve, as part of the operating budget for the upcoming year, an amount of funding sufficient for staff to pro-actively address ridership increases as soon as they occur.

As TTC staff carefully and continually track ridership trends on all TTC services, and improve the accuracy of their tracking, this would be able to provide a reasonable and responsible estimate, based on observed trends, of budget requirements for service increases for the next year. Addressing increases to ridership before the effects are felt, would allow customers to be as comfortable as is practical in a heavy-demand system like the TTC, and help address customer relations issues and negative perceptions of the service.

The annual net cost would vary, depending on the rate of ridership growth, where the growth occurs, in what time periods it occurs, etc. The May 2018 report noted that the net annual (2019) cost (after revenue from new riders) of the bus and streetcar crowding improvements (excluding the subway and express bus improvements) would be $5.5 million.

The term ***"Service Standard"*** identifies the level, quantity, or standard at which various aspects of service are set in order to achieve a certain level of quality of service for customers while adhering to budgetary limits.

Service Standards can be set for many service parameters such as the maximum amount of crowding (maximum number of on-board customers, on average) which should be allowed on transit vehicles during peak or off-peak operations; the maximum waiting time (or time between vehicles) which should be allowed on a route during various operating periods of the day; the maximum distance which customers should have to walk, on average, to get to a bus or streetcar stop; or the minimum number (volume) of customers which would be required to justify adding new service during various operating periods of the day.

Service standards will vary for different properties or systems, because they reflect both the level of service quality or comfort which a transit agency aims to provide, as well as the financial resources available with which to provide them. Thus, service standards are used to achieve the best possible balance between service quality and resource availability or constraints.

A provision of $4-6 million per year in the operating budget would give the planners a fair amount of ability to make necessary adjustments as per the Commission approved Service Standard. If ridership was flat or declined, the money would go unspent. One final note, depending on the current fleet available, there could be a need to purchase additional buses (or streetcars in the future) as well, and that that would need to be addressed in the capital budgeting process.

Mode	Peak Standard	Off-Peak Standard
Low-Floor Streetcar	130	70
Scarborough Rapid Transit	320	160
Toronto Rockets (YUS line)	1100	540
T1 (BD Line)	1000	500
Standard Bus	50-53	35-38
Articulated Bus	77	46

TTC vehicle Crowding Standards in 2018 prior to service improvements. (Source: TTC)

Express Bus Services

The TTC has recently increased the number of Express buses and launched a new Express Bus network.

There are three types of express service that the TTC runs:

1. Express Buses
2. Rocket
3. Downtown Premium

Service Type	Time-Saving (Median)	Cost per Boarding (Median)	Boardings per Hour (Median)
Regular Bus service	**N/A**	**$1.30**	**64**
Average all Express services	**20%**	**$2.49**	**46**
Express	**27%**	**$2.35**	**45**
Rocket	**26%**	**$2.62**	**64**
Downtown	**23%**	**$10.22**	**17**

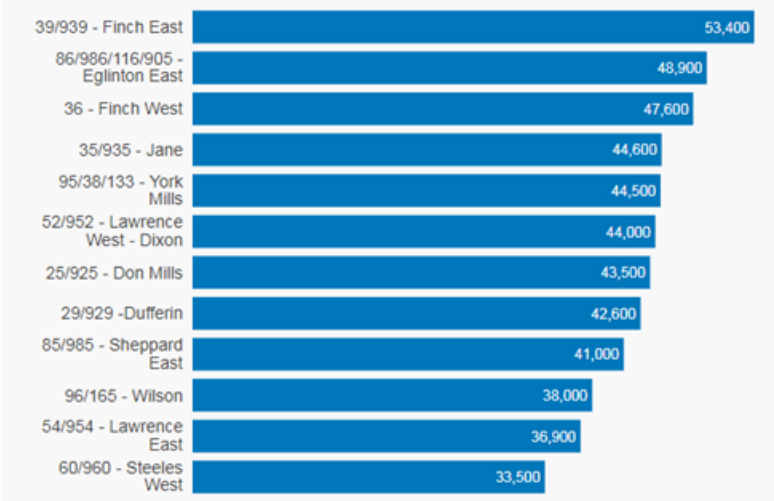
Express buses are very popular with TTC passengers, and where available they reduce travel time by as much as 20%. On high demand routes with the right pattern of boardings and exits, the cost is just under double the average cost of regular service.

The Downtown Express services are by far the most expensive express service to provide as they have the lowest number of boardings per hour, and thus the lowest ratio of fare revenue to operating costs. This is primarily because unlike the other Express services where riders board in each direction (although usually heavier in one direction than the other), there are virtually no passengers using the Downtown Premium Express buses in reverse direction (i.e. from downtown); buses are therefore empty for half of all of their trips. The TTC had considered removing the double-fare for these buses to increase ridership, but this does not easily address the issue with lack of demand in the reverse direction.

Beyond proactive planning and budgeting in the short term, the TTC would also benefit by having comprehensive policies to facilitate service upgrades in response to long term ridership growth. Some of this planning would be tied to development and population growth and the City of Toronto's Official Plan, as well as local plans and secondary plans.

The TTC also needs support from other City of Toronto departments, as well as Council, to implement many of these service improvements, as they will require changes to the design of roads and streets to facilitate transit service.

The graph below, which shows average daily ridership for the TTC's top bus routes, indicates how many people the TTC is able to move with a combination of frequent bus service and express bus service.



Top bus routes in 2018, based on average daily ridership (Source: TTC)

Some of these corridors have been proposed for upgrades, including Higher-Order Transit (upgrades that speed up service but do not fundamentally change street design) and Rapid Transit (conversion of the street to a Rapid Transit corridor and the routes to a rapid transit line. Rapid Transit is currently being built on Finch West, and Eglinton East, and construction was started on Sheppard East. Jane, Don Mills, and Steeles have also been proposed as Rapid Transit corridors.

2) 20 minutes Minimum

Cost: $16-18 million

Some 10 years back, there was a proposal to adjust the minimum service standard to 20 minutes on all routes. At this point, mostly all of TTC peak service runs on better than 20-minute service. But this doesn't help residents who live in

parts of the city where bus service is less frequent, and those traveling at off-peak times.

A 20-minute promise for these riders would make a big difference, and also move bus service closer to the every 15 minute level, the psychological point at which, studies show, riders begin to be confident and comfortable enough with service levels to just show up. At every 15 minutes, service is frequent enough that the average wait is 5 to 8 minutes, a period of time, for which it has been demonstrated, riders are reasonably willing to wait.

Originally this proposal was expected to attract around three million rides and improve service for 18 million riders, but these estimates are now out-of-date and overall ridership has grown on routes, resulting in some of the routes (as noted below) already having met the 20 minute service standard, due to ridership growth.

When a standard of 20 minute or better service was originally proposed, the proposal would have seen additional service on 75 routes for a total cost of $19.8 million and a net (after fare revenue) cost of $14.9 million, all in 2009 dollars. Today a similar proposal would only affect about 50 routes (51 as of May 2018 schedule) because the other routes have – due to ridership growth – already have had service added.

Generating an exact cost for 20 minute or better service requires analyzing the number of service hours needed for a vehicle to do its runs and still maintain 20 minutes spacing. To estimate the cost of establishing this level of service on 50 routes today (as opposed to the 75 proposed ten years ago), a top-level review determined that two thirds of the hours needed for the 2009 program would be required to institute this new service level.

The estimated cost of changing all TTC services from 30 minute to 20 minute service, affecting roughly 50 routes, is $16-$18 million when the inflation adjusted costs are taken into account.

3) Improving the 10 Minute Network

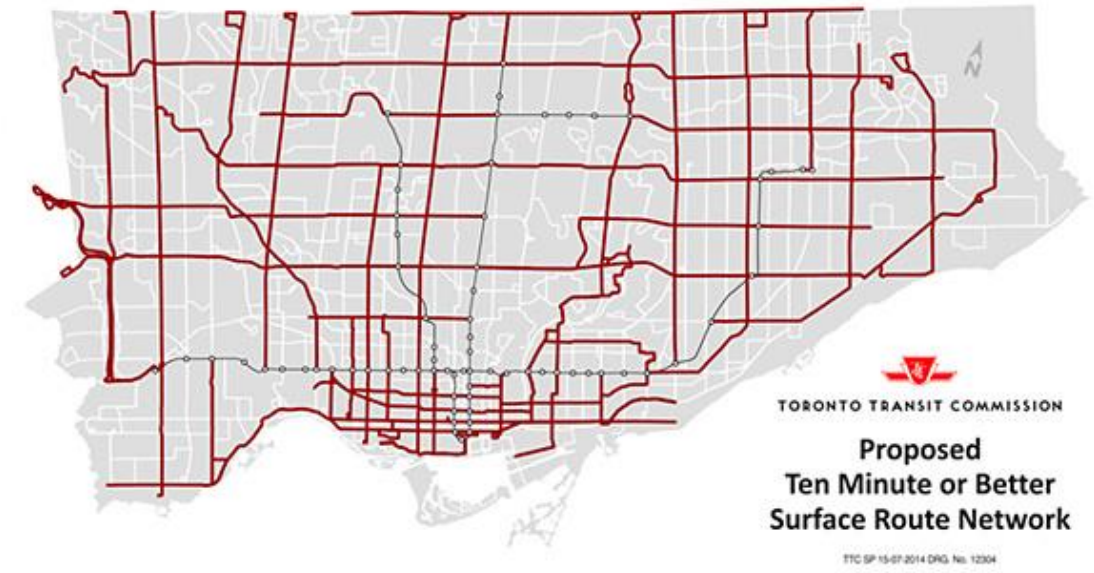
Cost: $5 million annually

As noted above, study after study has shown that at waits of under 15 minutes, peoples' perception of transit changes dramatically, and spontaneous trips become easier to plan and more common.

At 15 or more minutes between buses, riders are very dependent on schedules to avoid just missing a bus. At 15 minutes or better and certainly at 10 minutes, most people will simply go to a bus stop expecting to wait on average 5 minutes. Providing service that requires customers to wait the 15-minute or less has been shown in cities across North America to increase ridership substantially. Not having to think about schedules or wait time is important.

Building on TTC's 10 Minute Network

TTC already has a network of around 35 bus routes that run on 10 minute or better service, and in 2015 a specific effort was made to expand the 10 minute network, increasing the number of routes to 52.



TTC's Ten-Minute Network in 2018

In 2016 over $11.3 million ($7.6 million net of fares) was allocated to increase the 10 Minute network to another 36 routes. This was projected to improve service for 48 million trips a year, and increase ridership by close to two million rides.

Expanding the 10 minute network and the Express Bus network, so most riders are within walking distance of one of the routes of either network, is an approach that would increase ridership. It's part of inspiring confidence in the quality and reliability of the network and points to the creation of a new transit paradigm.

However, in order to maintain reliability and frequency, the City of Toronto will have to consider enhancements and road designs including turn restrictions, transit priority signalling, bus stop relocations, and bus/HOV lanes.

As the next step, the network could be further expanded by 25% to a total of around 45 routes, or about one quarter of the entire TTC bus network, at less than $5 million net annually, and could be phased-in over a couple of years.

Some transit agencies have introduced separately branded express bus services, with distinct bus livery, bus stop design and other features, which is another way to build ridership.

Swift Bus Rapid Transit is a bus rapid transit system operated by Community Transit in Snohomish County, Washington, part of the Seattle metropolitan area. (Source: Wikimedia Commons)

Hillsborough Area Regional Transit (HART) provides public transportation for Hillsborough County, Florida, outside Tampa Bay (Source: HART)

Grand River Transit introduced five iExpress routes in 2005. (Source: Wikimedia Commons)

Grand River Transit introduced the iON 302 Adapted BRT route in 2019, along with the iON 301 Light Rapid Transit line. (Source: Wikimedia Commons)

Consideration could be given to allocating more resources to better promote the network as a concept and brand the service as has been done with some BRT lite and Express bus services. Depending on the approach chosen, this may add

an extra level of complexity for TTC operations and reduce their flexibility to respond to service need.

For example, separate branding of Local, Frequent, and Express buses may not be possible, but a growing network may justify the design costs and landscaping associated with special bus stops.

York Region Transit introduced "vivastation" bus stops with the viva express bus network in 2005. (Source: Wikimedia Commons)

Brampton Transit introduced specially designed bus stops with the Zum express bus network in 2010. (Source: City of Brampton)

4)

Adding New Express Bus Service

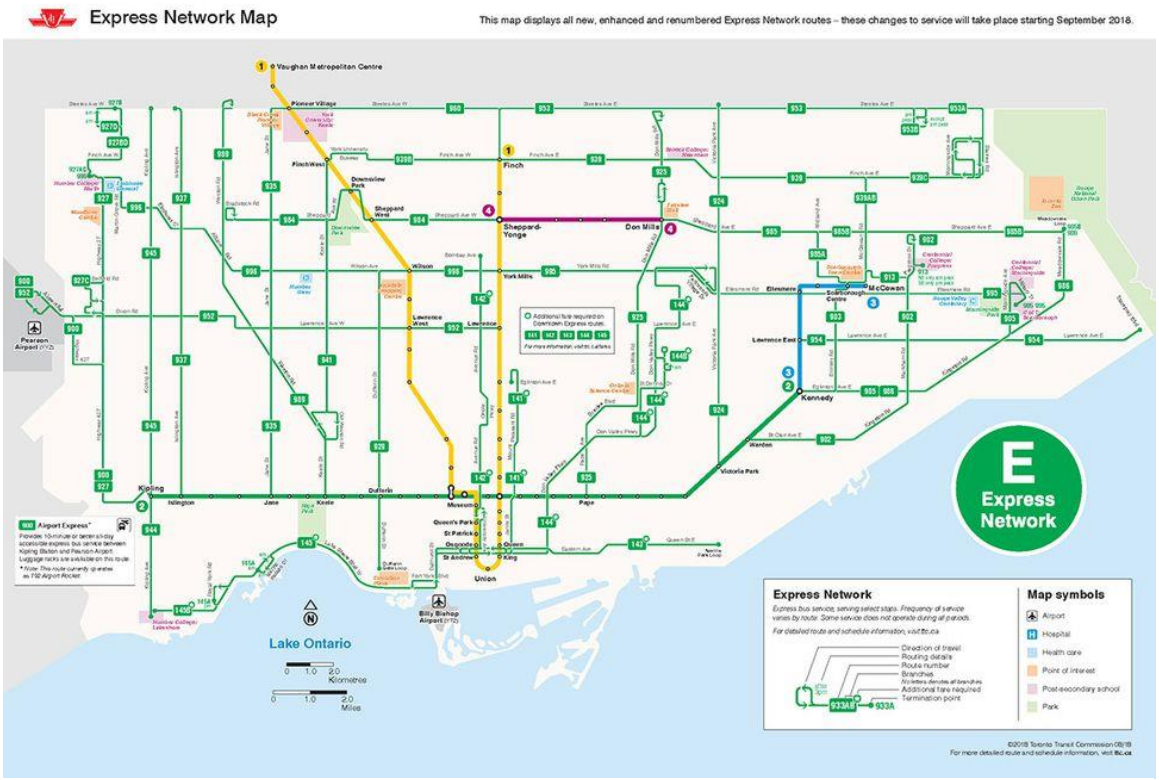
Cost: Up to $10 million beyond current commitments

Express bus service should be added judiciously and targeted very specifically due to its higher cost. Generally express stop service running along a route with existing heavily-used service (like Finch West) works best, although even here, the distribution of passengers' boarding/alighting needs to be studied, to determine the best of type of enhanced service.

If there is heavy boarding/exiting along the whole route, the introduction of Express Bus service may offer advantages. Express buses can affect local service branches by reducing service levels, but if well designed, Express buses represent a way to positively improve bus service in the corridor.

Over the last few years including earlier in 2018, the TTC has announced more Express Service including five new routes to start between 2018 and 2021 (Lawrence West, Islington, Weston Road, Dufferin, and Markham) ultimately bringing the total number of new routes to 28. In July 2018, the TTC approved an expansion and rebranding of the Express Network. Updated services on new route numbers and additional corridors began in late October 2018.

In the end, the stated goal of the TTC is to serve one in six bus passengers with express buses, thereby reducing their travel time.



TTC introduced a new Express bus Network in 2018, with new route numbers (900-series) and route colours, as well as a distinct Express Network map. (Source: TTC)

Downtown Express Service – High subsidy Per Rider and Low Ridership

There has been an ongoing discussion around implementing the very expensive Downtown Express services. There are currently five routes and they carry a total of 400,000 people a year. As they require dramatically higher subsidy levels per ride and have the cost of new bus purchases (since many operate in rush hour), further expansion of this form of express bus should not be prioritized.

TTC staff reports have recommended removing the double fare from the Downtown Express buses and incorporating them within the new Express network, but this would increase demand, causing additional pressure on an already stretched budget and bus operations.

5) Options for Improving Blue Night Service

Cost: $2 million annually

The Blue Night Network is the TTC's overnight bus and streetcar service that operates between approximately 2:00 and 5:00 a.m., after the regular daytime and evening bus, streetcar, and subway services have ended. The Blue Night routes provide overnight transit service, every 30 minutes or better and is predominantly used by people who work shifts and have few other options.

New overnight service should be introduced on around 10 bus and streetcar routes to make the network more comprehensive. This service improvement would increase the overnight service area coverage and reduce the time customers spend walking. Current policy is to have a route available for 90% plus of residents to be able to access overnight transit within a 15 minutes walk versus 95% plus of the population being within a five minute walk of a stop for regular daytime services.

Up to four million customer-trips each year are now made on the Blue Night Network or 12,000 to 14,000 system wide per night. It is projected that the expanded network would attract approximately 300,000 (1,000 new riders per day system wide) new customer-trips each year and as trips are usually quite long, the impact for affected passengers could be substantial. The expanded Blue Night Network could be implemented relatively quickly.

As ride-sharing evolves, the consideration should be given to the possibility of using ride-sharing in the overnight hours when service and ridership levels are low as this may offer a way to improve service and reduce costs.

U-PASSU-PASS

6. IMPROVING SERVICE QUALITY AND RELIABILITY

Reliability is often as important as speed

Reliability of transit service is critical to growing transit use, and in most cases is as important as speed, especially for trips like the commute to work and key appointments. Every transit user has had the unhappy experience of planning a trip and then discovering that the vehicle they are waiting for is nowhere in sight at its scheduled, or expected, time of arrival.

While speed obviously affects the trip time, the problem with unreliability, is that riders learn to build in buffer time, making their regular trip much longer than it would otherwise be.

The buffer time people build in can add a lot of time to their trip. For example, if the regular travel time on a bus or streetcar is 20 minutes, but the ride often takes an extra 8 minutes due to a longer than normal waits for a bus or streetcar, riders leave themselves extra time, extending the entire trip duration. A good example of how things should/could work is the subway. With rush-hour trains leaving every 2-3 minutes and a 98% on-time performance, people who rely on the subway alone do not generally need to build in much buffer because trains are much less frequently delayed and most people can tolerate a slight delay a couple of months without serious implications.

6.1. All-Door Boarding and Proof Of Payment On Streetcars

Passenger Boarding Delays

One of the main ways transit vehicles are slowed down is through the delays in passenger boarding and exiting of vehicles. On surface vehicles, on average one out of every five minutes of travel time is spent on passenger boarding and exiting. Rapid transit, like subways, on the other hand avoids some of these delays as it allows people to pay before they board, and to board by all doors. Level boarding is also an advantage to those in mobility devices as they are able enter the vehicle at roughly the same speed and ease as other passengers.

Reducing passenger boarding delays on surface routes would speed up service and reduce passenger trip time, as well as likely increasing the carrying capacity of vehicles by preventing the bottleneck at the front of the vehicle.

As speed and carrying capacity increase, the cost to carry each passenger goes down as a result of faster buses lowering the subsidy per passenger required as a smaller number of vehicles (and their associated costs) are required, to carry

the same number of passengers as they can make more trips (and therefore carry more passengers) in the same time. A win/win for riders who are also taxpayers.

Implementing All-Door Loading

The catch with applying all-door loading on a system wide scale is that in order to be fiscally responsible, all-door boarding requires an efficient and effective manner of verifying payment to prevent a large loss in fare revenue from fare evasion. The transit industry standard is to inspect 1 in 20 passengers. With over 500 million passenger trips on buses and streetcars a year, this would require around 25 million fare checks, although if the system were only implemented on the busiest lines this number would obviously be reduced.

Currently fare enforcement officers have a total incremental cost of around $100,000 per year. “Incremental’’ costs include direct salary, benefit and equipment costs, but not the overall costs of running the department. As we have noted elsewhere in this report, fare evasion is estimated at 4%-5% and previous experience with all-door loading with little enforcement at all, (on the 501 Queen Street Proof of Payment) shows that fare evasion rate would be double that amount.

It has been estimated that 100 fare inspectors would be required to service the streetcar routes (which represent 15% of all trips) once all streetcar routes are converted to all-door loading and meet the inspection standard to prevent higher fare evasion. These would have a cost in the order of $10 million but, if they were able to hold the line on fare evasion to the current 4% to 5% (still double the rate 10 years ago); they would pay for themselves. The difference in lost fare revenue between 4%-5% and 8%-9% (the level of fare evasion on routes with all-door boarding and little enforcement based on reviews of the Queen Street Proof-of-Payment program one of the first POP programs in the city) is upwards of $40 million per year.

6.2. Bus Lanes

Giving buses, which in rush hour often carry 60-plus riders, priority over private cars just makes sense if we are serious about moving the greatest number of people in the most efficient way possible.

New York has had an effective program since around 2007 (Select Bus Service) to implement dedicated bus lanes with some transit signal priority, off-board fare

collection, and level boarding, and the City announced this year that they are planning on expanding the network by 21 routes.

Distinct Bus Lanes on the Select Bus Service in New York City. (Source: Wikimedia Commons)

This type of treatment has a cost of approximately $2 million per kilometre, a very low cost by any standard, as it simply involves painting red bus lanes that have been created by dedicating existing vehicle travel lanes, or by reducing on-street parking. This has increased both the speed of the buses by 10% and ridership on those routes by 8% to 10%. The program also includes transit signal priority, some queue jump lanes, and camera enforcement.

Implementing bus lanes in Toronto in a similar cost-effective manner as New York would likely increase bus ridership and cut operations costs since the same vehicle would move faster and therefore make more trips, as well as generally improving the quality of the service, which has been shown to grow ridership.

Previous attempts to implement and manage bus lanes in Toronto have not worked that well, but it's time to try again. The success of the King Street Pilot has led to increased appetite for more transit priority projects. Calls for improvements to pedestrian safety (such as the city's call to introduce photo radar) can be tied to investments in transit priority. It will be important for the City and TTC to obtain permission (as they have in New York City) to use cameras to enforce the lanes, as police forces will never have sufficient resources to patrol a large network on a consistent and ongoing basis.

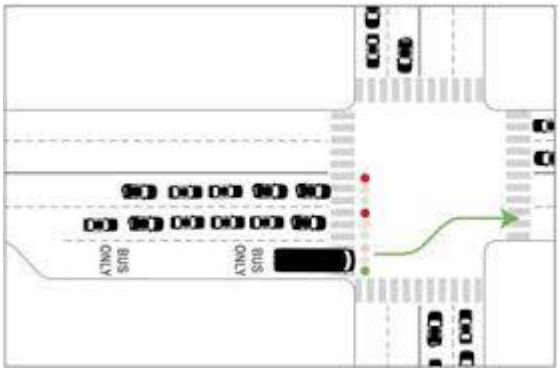
One way to start would be for the TTC to pick five different routes that combine various urban forms, and test how this concept could be implemented within a Toronto context. As these routes take time to plan and put through the proper reviews and community process, a five- year pilot (around 30-50 kilometres of roadway) would cost around $12-$20 million per year in capital cost savings, but would lead to immediate operating savings and service improvements.

6.3 QUEUE-JUMP LANES AT APPROPRIATE INTERSECTIONS

The intersections of major arterial roads are often significant 'pinch-points' for traffic flow. Buses experience long queues of traffic on the approach to intersections, and are delayed within these queues.

The implementation of queue-jump lanes at congested intersections can significantly reduce delays on some of the longer bus routes. These consist, essentially, of elongated right-turn lanes which allow buses to bypass traffic, travelling quickly through an intersection to bus stops placed on the "away" side of the intersection. A bus approaching the intersection can therefore "jump" the queue of stationary traffic, as cars wait to turn right from the curb lane. Peremptory "bus only" signals are added to further enhance the benefit for buses.

The introduction of queue-jump lanes, as has been proposed by the TTC previously, would allow for measurable and perceptible improvements to several of Toronto's busiest bus routes – in short, faster and more-reliable service for a relatively small capital investment. If combined with transit priority signalling, this could also help improve safety at intersections.



Queue Jump Lanes allow buses to bypass traffic at intersections. (Source: Wikimedia Commons)

Virtually all of the intersections suitable for queue-jump lanes are located outside of the city core as there is more space available in the street rights-of-way. The curb realignment and associated road work is estimated to be upwards of $500,000 per intersection in capital costs for the installation of a queue-jump lanes. There are likely around 20 locations where the installation could be relatively easily done with limited property impacts. A further review involving Transportation Services would be required to determine the total number of intersections that could accommodate a queue jump lane.

6.4 Improving Rider Amenities

Riders experience the TTC not only when on a vehicle, but also when waiting for the bus, planning a trip, or trying to navigate transit in an assisted-mobility device.

Providing more shelters (around $30,000 apiece), more information screens for service alerts and next vehicle information, and more amenities like bike-storage are low-cost items but they help make riders' movement through the system more easily and more pleasant.

The TTC traditionally focuses on major transformations, like new vehicles or lines, or large-scale station renovations. However smaller changes implemented as part of a concerted program also has the potential to effect riders' experience of the system in a positive way. Infrastructure, for example, that looks run-down generates demoralization and lack of identification with the system. Taking time to do little repairs of tile and floors, and matching finishes does not transform the system, but does, over time, transform how the system is viewed.

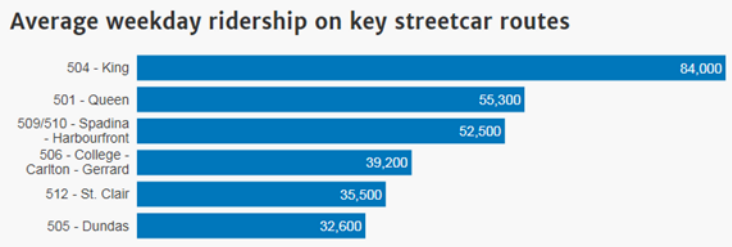
Many systems in Europe and North America have made specific efforts to complete the small repairs that over time do collectively change the perception. This includes, more frequent painting of ceilings, tile and terrazzo repairs or replacements that match existing colours and formats, replacement of broken ceiling slats, and perhaps a better way of managing the removal and replacement of slats so that the system does not look like it is under constant repair.

Ultimately, over time, more work should be done to update stations and make them more comfortable for riders. Ultimately the TTC may want to consider what cities like New York, London, Paris and Seoul among others do, which is to put all their stations on a rotation for major renovations or restoration to ensure that updating needs don't fall off the table. When this sort of strategy has been employed, it has required around $10 to $15 million per station, not including major structural or accessibility upgrades.

6.5 Growth of The Downtown And Growing Streetcar Service

Over the last decade, the downtown has grown dramatically adding tens of thousands of residents and jobs. Almost 50% of all downtown growth has occurred in the King-Spadina and Waterfront West neighbourhoods, with the Bay Corridor, King-Parliament and Waterfront Central accounting for around another approximately 35%, of new residents.

Similarly higher-density development is now beginning on the Dundas, Carlton and St. Clair corridors and is spreading away from the central part of the city where the subway is the primary mode. As this development pattern continues, more streetcars will be needed.



TTC Average weekday streetcar ridership. (Source: TTC)

The Eastern Waterfront is also experiencing growth and ongoing high-density development in the Western Waterfront of the downtown and continuing into Etobicoke, new higher capacity transit lines like LRTs will be required to meet expectations and ridership demand.

These new residents and jobs in the area served by streetcars have generated a 20% increase over the last decade in streetcar ridership. This growth has greatly outpaced the general growth across the TTC's various transportation modes in the same timeframe.

According to recent City reports:

> ***"Recent revisions of the projected employment and population growth for Downtown Toronto has introduced higher forecasts which now extend to 2041. The revised estimate of the number of new residents in the Downtown is 500% greater than originally projected. The revised estimate of new jobs in the Downtown is 200% greater than originally projected."*** ***City of Toronto report***

Growth numbers like the ones outlined above will create challenges in meeting the residents' (many of whom live mostly car-free lives) expectations of good mobility and increasingly strong transit service. While many downtown neighbourhoods have pedestrian and cycling modal splits of over 50%, there will still be a strong demand for better transit service.

One indication of growing pent-up ridership demand in the downtown core is that over the last few years, when the new low-floor streetcars were added, thus increasing capacity, that capacity was quickly filled, demonstrating that there is latent demand for service on downtown routes. King Street is the best example;

when new service was added as part of the King Street pilot project now underway, the first few months of operation saw over a 15% increase in all-day weekday ridership, to approximately 85,000 average daily riders. It is likely that with more and better service on other downtown streetcar routes, more riders would be attracted, than the ridership models predict.

Streetcar Fleet Requirements

According to the TTC, by 2033, the peak service requirement will be 287 streetcars for service, which means a total of 345 will be needed including maintenance spares. Procurement will have to begin soon in order to respond to successfully replace the non-accessible Canadian Light-Rail Vehicle (CLRV) and Articulated Light-Rail Vehicle (ALRV) which will be retired at the end of 2019, and meet ongoing growth and maintenance requirements.

6.6 Streetcar Service on King St

King Street has long been the TTC's, and North America's, busiest surface transit route, now carrying over 80,000 riders per day. Given further development along the corridor, it has the possibility of exceeding 90,000 riders per day, if more streetcars were available and ridership trends continue.

The idea of giving streetcars priority on King Street goes back to the late 1990's and early 2000s. At that time "Diamond" lanes were set-up on the lanes with streetcar tracks prohibiting cars from using them during rush hour. You can still some of these signs, but these lanes were never very effective.

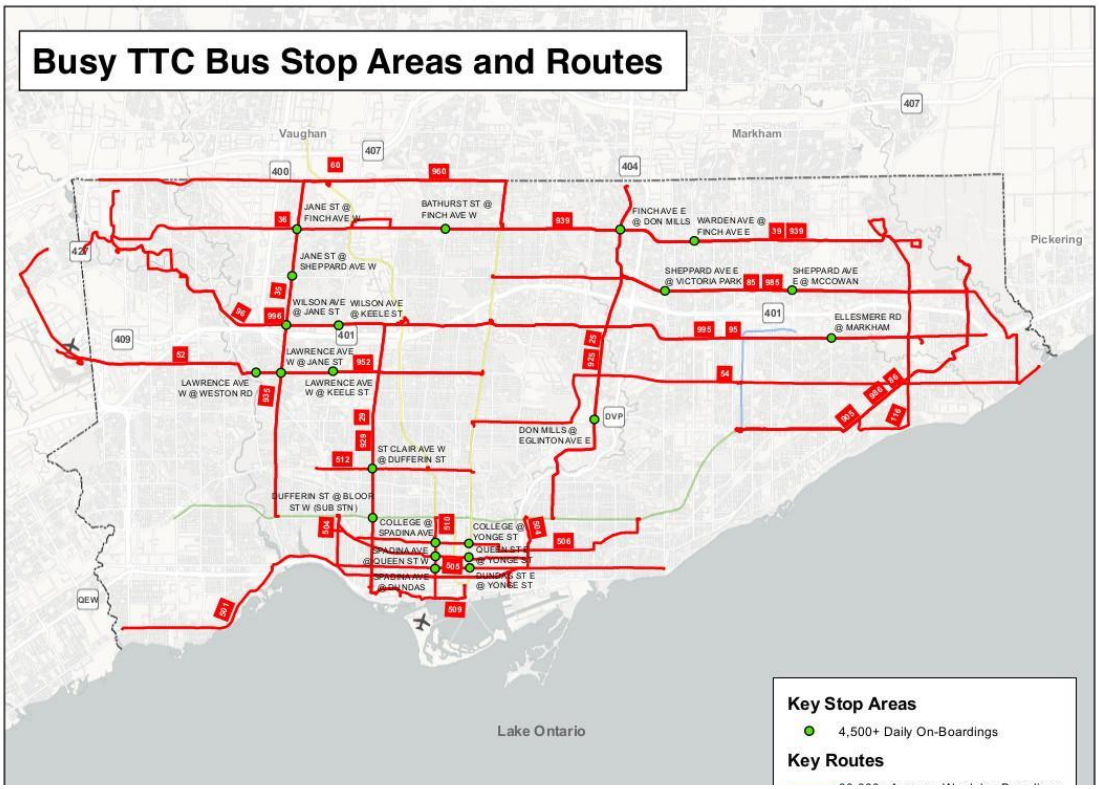
During the original pilot project for this line, the TTC paid for paid-duty police enforcement but after thousands of tickets were issued over the life of the pilot project there was little overall reduction in abuse and the project was cancelled. In 2006/2007 the TTC refined an earlier design of the current King Streetcar pilot and focused on reducing overall private vehicle traffic on the street. The TTC chose not to pursue the pilot at the time due to pushback by residents and business owners, and attention focused on new proposed LRT lines.

While the current pilot project has been successful and the ridership increase of over 15% is impressive (or around 18,000 additional riders per day), the main observed benefit of the pilot has been to make streetcars more predictable than they had been, the value of which can be seen with the bump in ridership. On April 16, 2019, Council voted to make the King Street pilot permanent. Commentary around the subject suggests that a desire to look for other busy corridors w here transit priority can be implemented in future.

Definitions:

Run-times: Buses are given "run-times", the modelled time it takes to complete a route at a particular time of day, and are scheduled to meet known or forecasted ridership demand. Schedules can also be set based on policy, i.e. a bus every 10 minutes. In rush hour more, time is allotted for "run-times" than in the middle of the day or later at night due to obvious traffic implications.

Headway: This is the scheduled time between vehicles. The maximum service headway (time between buses) on the TTC is 30 minutes, and the busiest bus routes have scheduled service as often as every three minutes.



TTC`s busiest bus routes and bus stop areas in 2018. (Source: TTC)

7. IMPROVING SERVICE RELIABILITY

7.1 Bunching on Surface Transit Routes

Bunching is one of the most frustrating issues that riders face, and has proven one of the most difficult transit challenges to address in many cities, including Toronto. One of the truly annoying experiences as a rider is waiting a long time, only to have two; three, or even four buses come in quick succession. These large numbers of buses in “pack” formation are common on high-volume routes like Finch West or Dufferin.

There are many causes for bunching, but at the end of the day it’s the result of not adequately managing bus routes for the conditions. Those in public roles like to announce new bus service, but managing existing service is often as important though it requires additional resources and/or attention.

Bunching – The Basics

When a bus is delayed along the route, by more red lights than anticipated in the modelling, longer boarding times (perhaps caused by a large group of people waiting for a delayed bus) or other hold-ups on the route, the headway becomes irregular. The bus behind the front bus begins to catch up assuming it does not suffer the same causes of delay, and bunching begins.

This is mostly an issue on routes with frequent service. If a bus is scheduled every four minutes, for example, that's only 240 seconds apart. Each time a bus "misses" a light, it likely loses 30-45 seconds, and every time there are a higher than usual number of boarding passengers, the space between buses (assuming the second bus does not suffer all of the same delays) is reduced and it doesn't take long for them to begin to travel in "packs" or back-to-back.

How do you fix it?

It's a complicated problem, but let's start here: buses have GPS and are tracked at the bus divisions (This function is being centralized at Transit Control) by staff in front of computer screens that can see the location of all the vehicles on the route. There are also some on-street supervisors who have handheld devices and are able to see all the buses on the route.

Busy routes like the Eglinton East or Dufferin, might have one person assigned to the route, while for less busy routes, one employee may be overseeing several at the same time. Each supervisor can be in contact with the operators of each bus, and has access to a number of tools to keep buses running.

One common situation that occurs is a bus "running hot", i.e. ahead of schedule and close to the bus in front. In this case the supervisor may ask the driver to hold for a few minutes at the next stop to try to space out the vehicles. This is easier said than done because the same instructions might have to be given to other buses on the route to avoid creating a new bunching situation, resulting in a lot of passengers being delayed while their buses stop and hold. It also requires a lot of staff time to communicate with each bus, although new communications technology is making this easier.

Another way this bunching situation can be managed, especially if there are several buses backed up, is that one of the vehicles can be directed to offload passengers, and either express ahead (or "leap frog") or turn around to fill in a gap in service in the opposite direction. Then at the same time, the middle bus can be sent through while the last one is held at a stop to get the spacing right.

Obviously reducing streetcar bunching is more difficult as there are more limited places to turn a streetcar around and streetcars cannot go around each other. However, many similar processes can be used to reduce streetcar bunching on the major lines across the city.

It's a fine balance getting scheduling right and it's always evolving. If there is not enough time built into the schedule, the bus will not run to schedule, and this will make managing the route difficult, particularly as the bus operators must have legally-mandated breaks at specific points where relief operators can step in. If there is too much time, then the bus operator may have to run more slowly, increasing trip time on the route and increasing costs.

Dedicated supervisors needed

Keeping buses to schedule takes a sufficient number of dedicated supervisors (both at Transit Control and on the street) working as a team, with the right technology and constant daily vigilance in order to keep busy surface routes moving as they should. The TTC is not alone among large urban transit agencies in North America in struggling to maintain on-time performance of major bus routes.

Gap Vehicles

Gap vehicles – buses, streetcars or trains stationed at key points on busy lines to help fill in gaps – can be used if there are sufficient vehicles and operators available, along with the associated funding. Buses can be parked on side streets along the route, whereas streetcars need to be on a loop or track (an example is York Street south of Queen Street) on roads where there aren't actual stops. Traditionally this approach has been used with streetcars or subway trains.

Essentially solving the problem of poor bus and streetcar service requires ongoing and constant vigilance, as well as good technology and enough people to keep an eye on the little things. Along with a few more vehicles and some overtime/more salary dollars for more service, this collectively is the difference between good and poor service.

7.2 Good Headway Management

One game-changing proposal, as suggested above, might be the switch from schedule-based to "headway-based" management on high frequency routes.

This relatively inexpensive change in how service is run is essential if real improvements in the experience riders have with the surface services is to be improved, particularly in terms of reliability. It's theoretically easy, but implementation is difficult and would take concerted ongoing service management.

What passengers care about is that buses come at regular intervals – especially on less used lines, every 15-20 minutes at minimum and more frequently in rush-hour. They are not interested in whether a specific bus arrives out of its scheduled order.

But most lines are managed in such a way as to ensure, ("runs" – i.e. specific buses and operators' pairings) come in sequence. This has repercussions for operators who are directed to focus on keeping their arrival at different points along the route (also known as "time-points") consistent with the schedule. This occurs, despite the fact that often the timing for a particular bus or streetcar route is based on assumed traffic conditions that don't consistently accurately reflect the reality on the street.

With all surface vehicles having been equipped with GPS systems for over a decade, it should be possible to keep buses and streetcars more evenly spaced by better monitoring of operations, but as discussed, this will require ongoing continuous communication with individual operators to get some to slow down at some points and speed up at others. As AI (Artificial Intelligence) develops and autonomous vehicles become more cost effective, this may become cheaper san

Headway management can help, but it creates a lot of challenges when operators have requirements to get on and off shift or break at certain times and in certain places meaning that creativity and additional resources may be required.

What gets Measured gets Managed

It might also make sense to consider moving to an outside audit of on-time performance for objective review on the theory that what is measured and reported is managed. This is an approach that has worked to focus attention on cleaner stations and vehicles, and would likely satisfy critics of the current biased in-house reporting on on-time performance.

7.3 Subway Delays – Reaching 99% + Service Quality Levels

New advanced metro systems in Asia and Europe routinely reach on-time performance levels of above 99%, while older lines in systems like New York struggle to maintain 80% or more. The TTC typically maintains on-time performance of 98% or more on all subway lines, but this masks some of the delays based on how they are calculated, and even a delay in one in 50 trips means frequent travelers (average Metropass use is above 60 trips per month) may experience one delay or more a month.

The main causes of subway delays are part-equipment related, and part-passenger oriented. Signal problems and mechanical problems with trains can be improved by installing (and maintaining) new signal systems like Automatic Train Control installation (underway on the Yonge-University-Spadina Line and planned for Bloor Danforth later in the 2020's), and the implementing of a strong preventative maintenance regime for trains.

The new Toronto Rockets are better designed than the trains they replaced (T1s), resulting in dramatically less breakdowns per train. They are also designed using a "plug and play" concept so that many onboard systems can be easily removed and separately repaired while a spare unit is quickly installed, thus preventing the entire train from having to be pulled from service for a long time.

Passenger-oriented delays include problems with door jams, (usually caused by passengers holding doors forcing them open), sick passengers, boarding delays, and tiny track level fires caused by litter contacting the third (power) rail and going up in smoke. Rarely are these fires causes for concern, but very sensitive smoke equipment sounds the alarm (which stops trains) to ensure safety. Over the last few years, better cleaning of the tunnels and education has reduced this delay factor. Good on-time performance requires attention to all causes of delay and quick responses to evolving problems.

Potential ways of reducing delays

1) Platform Screen Doors

The reality is that in a busy system with people packed in, there are going to be delays in loading, and door jams. One way to mitigate these delay factors in the long run is the addition of Platform Screen Doors (PSD) that separates the platform from the tracks.

Platform Screen Doors can be designed for full coverage in underground stations, and partial coverage for surface and above-ground stations. (Source: Wikimedia Commons)

PSDs would improve safety, as they prevent unauthorized people from being able to access the tracks, and would speed up service because they generally prevent door jams, allow trains to enter stations more quickly, and prevent track fires owing to the fact that less litter can reach the tracks.

But this is an ultimate solution. The addition of platform screen doors would be expensive and complicated. It is estimated that they would cost upwards of $1.5 billion to install at all stations and platforms, and probably take many years to put in place as a lot of new electrical and communications cabling would need to be installed, and platforms partially rebuilt in some cases.

A related issue is the ventilation of the system that comes from the “piston” power of the trains pushing air through tunnels into stations; careful design would need to be undertaken to preserve good air movement, which would likely mean the installation of Platform Screen Doors to a height of only around 1.5 to 2.5 metres

2) More Platform Staff at Key Stations

With hundreds of metro type systems in operation around the world, there are techniques that may be adapted and used in a Toronto context even in the absence of platform screen doors.

Placing platform attendants at the location of the doors of the trains to help the door close is one way to help trains stay on time in large systems with busy stations. A version of this technique was first instituted at Bloor/Yonge Station over a decade ago and has been enforced with various levels of rigor over that time and continues today. Bloor/Yonge is a key station for the Yonge line as it is one of the choke points that cause many delays in service due to the high passenger volumes exiting and boarding the train.

The attendants that were added, along with barriers of poles and ropes to separate boarding and exiting passengers, allows the line to carry an average of up to 2000 more people an hour (two trains) in rush hour when the program is fully utilized. This is the equivalent of an 8% increase in capacity; with a cost of up to $350,000 a year in addition salary costs.

Implementing the model system wide at every station would be expensive and unlikely to lead to much improvement, as most stations don't have enough crowding to require this treatment. The current situation with attendants at Bloor/Yonge isn't very expensive as most personnel are on "alternate work duty" meaning they are temporarily redeployed from their regular duties and therefore do not have a net new cost to the Commission. A much larger deployment would likely need new hires, as there is not enough staff on alternate duties to redeploy.

There are probably only a few stations where conditions would warrant this level of passenger management. All these are likely transfer points or particular stations on the Yonge line, like the one at King Station, which has a small platform relative to passenger volumes on the platforms, thus slowing boarding and exiting.

3) Working Closely with Emergency Medical Services

Another way that has been demonstrated to improve service is expansion of the partnership between the TTC and Toronto Paramedic Service to reduce response time for medical delays.

One of the biggest sources of delays is passenger illness. No one plans to be sick, but each time a passenger needs to be taken off a subway train due to

illness, there is a delay of around 8 to10 minutes or more, which is the time it takes to get paramedics onto the platform and to the afflicted passenger.

In the rush hour, a train comes every two to three minutes, meaning that the equivalent of three to four trains can be delayed in passing through a station during the response to even a minor medical emergency resulting in a large disruption, especially to a system with little excess capacity at rush hour.

Over ten years ago, the TTC started a pilot project placing paramedics and a TTC supervisor together at Bloor and Yonge station during the rush hour, when capacity issues are the highest. Their job was to deal with some of the more than 1,200 situations yearly in which a rider becomes ill on the system, often requiring their removal by paramedics that culminating create thousands of minutes of over the year.

An expansion of the project saw a paramedic team added at Spadina station and it was noted that the paramedic/TTC inspector team could reach ill passengers at various stations in all directions from Spadina or Yonge using the system, in most cases, more quickly than an ambulance.

Further expanding the program, perhaps to interchange stations like Sheppard-Yonge, Union Station and St. George, to ensure service on the over-burdened Yonge line is kept moving as much as possible, along with placement of paramedics at other Bloor Danforth stations, might end up more than paying for itself in reduced delay minutes.

4) Gap Trains

There are a few places where a “pocket” or extra track space exists in the subway network (for example between Ossington and Christie stations, between Eglinton and Lawrence stations, etc.) and where “gap” trains can be located to be used at peak times. However, there are limits to the number of gap trains that can be used due to limits in the signal system and limits to the amount of track space and available trains.

Extra gap trains have the advantage of being able to be put into service just at the moment when the network is busiest (they deliver an empty train with capacity of 1000), and can help relieve crowding on platforms or to fill a gap in service.

Gap trains do not solve the problem of delays, but they allow the system to respond more quickly to reduce their impact, and get passengers on their way as quickly as possible. The TTC recently restarted the use of GAP trains as a way

to reduce the peak hour crowding on the Yonge line and additional gap trains would help further mitigate crowding and could be considered as signal and train availability permits.

7.4 Transit Signal Priority

Moving the most people as efficiently as possible should be the City's priority. Enabling vehicles carrying large numbers of passengers like the new streetcars, the right-of-way through an intersection helps make this possible.

Signal Priority works by giving a transit vehicle the ability to automatically hold a green light (for a certain period of time) or slightly speed up the changing of a red light to green. Installing the technology can make long bus trips up to 10% quicker for the many riders that use these routes, especially in parts of the city like Scarborough and Etobicoke where many people face long bus trips to the subway.

There are over 2,200 signalized intersections in Toronto, a majority of which have transit service passing through them. Of these, only around a quarter are currently equipped with transit signal priority technology, mostly on streetcar routes, and some busy bus routes like Wilson, Jane and Bathurst). Even where present, not all of them may be fully operational, due to ongoing maintenance issues.

An August 2014 TTC report proposed that up to 80 intersections be installed per year creating 400 over five years. Previous TTC staff reports (2009) had been more ambitious and recommended a total of 1,130 additional intersections over 5 years.

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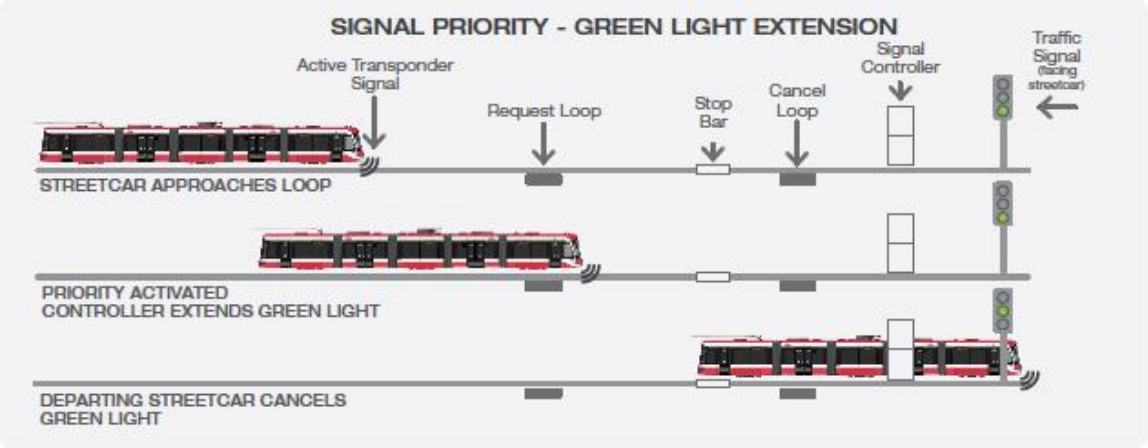


Transit Signal Priority – Extended Green Light. (Source: TTC)

The King St. project reduced the average evening rush hour travel time along the pilot project stretch by around 4 minutes (20-24% of pre-pilot travel time) in end-2017. The figure was further reduced by up to more than 2 minutes by the time Transit Signal Priority was enabled in mid-2018.

Besides faster trips for riders and the growing ridership that comes with faster service, Transit Signal Priority allows buses or a streetcar to make more round trips in the same time which means vehicles end up carrying more passengers. This a way of increasing the efficiency of operations and speeding up service, saving millions of dollars that would otherwise have to be spent to accommodate the growing ridership on some of the city's most congested routes. Properly implemented, such technology has only limited effects on cross-street traffic and could be rolled out as part of an updated traffic management system.

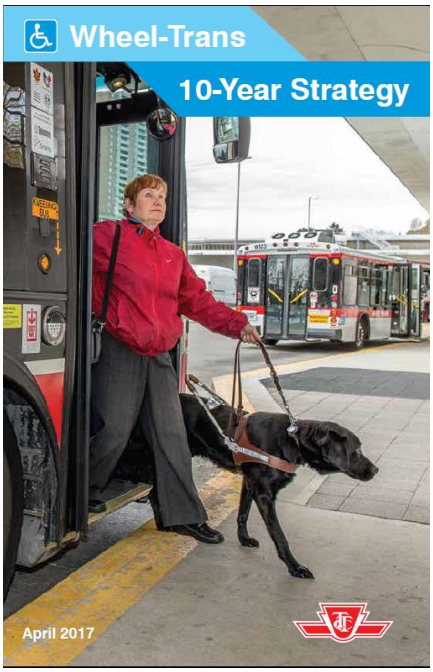
Transit Signal Priority Pays for Itself

Previous reviews by the TTC and Department of Transportation have determined that there is a business case for signal priority at least 1,500 intersections. As well, previous TTC reports have also shown that 75% of the capital costs of installation would be recouped by cost savings in bus operations over five years, suggesting that total cost recovery in seven is possible. This cost-benefit analysis suggests that a large TSP program is a logical addition to Toronto's traffic improvement plan.

8. ACCESSIBILITY & WHEEL-TRANS SERVICE

8.1 Moving Towards Full Accessibility

Accessibility goes beyond accommodating people using mobility devices. Many passengers, including parents with strollers or those with buggies benefit from better accessibility measures. There are many types of accessibility issues that transit agencies need to consider, including those of people with mobility challenges, those with cognitive disabilities, vision or hearing loss, or those who can't communicate in English. A more accessible TTC benefits everyone. The TTC is in the middle of implementing an overall of Wheel-Trans service as part of the Wheel-Trans 10-year strategy.



Wheel-Trans 10-Year Strategy, introduced in 2017. (Source: TTC)

Improving Wheel-Trans

The TTC's Wheel-Trans service (operating since 1975) provides pre-booked, accessible transportation for persons with disabilities using accessible Wheel-Trans buses, and partnerships with accessible taxis operated by contract with private companies. Recently, in accordance with the AODA (Accessibility for Ontarians with Disability Act), customer eligibility for Wheel-Trans was expanded to include customers with cognitive, sensory and mental health disabilities, in addition to those with physical disabilities, the required service window was extended to 24 hours and the newly implemented service within one-hour service standard, essentially making near spontaneous travel possible.

Making the Conventional System More Accessibility for Everyone

But making travelling accessible means more than improving Wheel-Trans service. It also means making the conventional system usable by those with mobility challenges.

In accordance with the Ontario Human Rights Code and the AODA, the TTC's Easier Access program is working to make subway stations accessible by 2025,

with elevators, wide fare-gates and automatic sliding doors slated to be installed at stations. There is expected to be 45 accessible stations by the end of 2018; by the end of 2022, the current plan is to have 55. This will still leave 20 stations to retrofit before 2025, which will mean that the TTC would need to triple the current rate of installation immediately in order to meet the 2025 deadline. Regardless of the need for increased funding to complete the project, the amount of work involved makes it unlikely that the TTC will be able to meet the deadline.

Making the system accessible is not just about buying new vehicles or making stations accessible. It also means more training of staff and continued discussions with disability rights advocates to help understand exactly what is needed. It's essential that this take place to guarantee that the system evolves to allow those with disabilities to live complete lives, and fully participate in their communities. This includes ensuring dependable and easily accessible transit is available to get people to work and social activities.

8.2 Wheel-Trans Demand Growing By 10% Annually

Toronto has an expanding, aging population. In 2018, over 15% of residents are over the age of 65 and that percentage will continue to increase. Wheel-Trans ridership is at 4.3 million annual rides, with demographics the driving force for ridership growth of 10% or more annually. That will likely lead to Wheel-Trans' total budget more than doubling to $350 million by 2025, factoring in inflation and the need to service twice the number of rides as currently provided.

This scenario has significant implications for the City as the main funder of Wheel-Trains, as well as for facility and operations planning, since existing models will struggle to have capacity, both on the public and private sides, to meet demand.

While efficiency measures (like changing the delivery of services to more contracted taxis and tightening eligibility criteria) has blunted budget increases, the value of further efficiencies will likely be smaller – and yet demand will continue to increase by around 10% a year, with thousands of new registrations annually.

Wheel-Trans is both expensive to operate and an often inconvenient alternative for passengers. A Wheel-Trans trip that provides door-to-door service currently averages around $31 a trip to provide (includes fares collected and subsidy), and 95% or more is covered collectively by taxpayers. In addition, Wheel-Trans service has struggled to keep up with the rapidly growing demand attributable to changes in the AODA that is expanding access, demographic shifts created by an ageing population (75% of Wheel-Trans riders are over 65) as well as cultural changes, favouring more integration into the community for work and social

purposes. This has resulted in booking and vehicle delays and other frustrating experiences for customers.

While the average cost is $31 per trip, the cost of moving Wheel-Trans customers varies. Wheel-Trans buses (of which there are around 200) carry about 45% of all riders (at a cost of around $46 per trip), and are useful when several people are going in the same direction, and because they are large enough to transport all types of mobility devices. Another 35% to 40% of riders use accessible taxis at a cost of around $20 a ride, with regular taxis and mini-buses carrying the remainder of trips at a cost of around $22 a trip.

Over the last five years the Commission has taken some actions to reduce the number of people who are eligible for Wheel-Trans service. While there are some ways to reduce eligibility further, this will likely be politically difficult as disqualifying people who already have reduced access to services would likely be considered a “mean” or “cruel” way of cutting costs. As well, much of the increase is due to the growing number of seniors, a group of politicians have been reluctant to touch. Beyond politics, current legislation may also prevent the curtailing of services.

As a result, there are limited numbers of further efficiency measures possible, meaning an imminent return to double-digit budget increases, unless other factors blunt the increase. One exception may be the limited use of ride-sharing services to reduce costs for servicing the part of the Wheel-trans ridership segment that uses sedan taxis (good for those people entitled to Wheel-Trans, but who do not use mobility devices and can get in and out of cars by themselves) as is being tested in other cities. Lack of driver training, insurance issues along with other concerns will need to be explored as this type of service provision is considered.

On-Demand and Full Accessibility

Once all transit stations are accessible, there will be a strong rationale to change some eligibility criteria and service provision models to encourage use of the conventional system and reduce costs while improving service. As such, it just makes sense to push on aggressively with making the system fully accessible to more people as quickly as possible.

Two areas which offer promise to help stem the increase in demand for Wheel-Trans involve the use of ride-sharing services or at least their app-based booking platforms and trip-organizing algorithms.

Cities like Boston and others are using ride-sharing services to help deal with peak demand, on-demand paratransit services, and service in areas with low demand, or at times (overnight) where few riders need to travel.

While these services can only accommodate a portion of the Wheel-Trans community because they don't offer driver assistance for boarding and exiting, their platforms and algorithms can be licensed to improve service by Wheel-Trans and other accessible taxi providers.

Ensuring Accessibility Features Work – All of the Time

Improving accessibility of the conventional system, ultimately ending in near full accessibility, is critical to stemming demand for Wheel-Trans; but building accessibility structures is only part of the issue. To have true ongoing accessibility, the TTC will also need to improve its maintenance and response time to escalator and subway breakdowns since these can leave passengers stranded in stations with few other options. This will also entail more resources for the ongoing preventative maintenance program in order to ensure service reliability, a key component of accessibility.

Likewise, there will need to be better cleaning of snow and ice from stops to allow accessible boarding, as well as better sidewalk cleaning and maintenance in general to end impediments to reaching transit facilities.

Finding Ways to Get Wheel-Trans Passengers on the Conventional System

While there has been limited success to date in training and education programs to shift some existing Wheel-Trans passengers to the conventional system, new techniques and methods need to be deployed and other cities have had greater success with their support and training programs. It may be that for some passengers not all trips can be shifted, but even shifting some of them would help mitigate Wheel-Trans' growth. With growing accessibility, it is more likely that trips will be made that combine some fort of Wheel-Trans service with the conventional system.

In this scenario a passenger who today is taken all of the way to their destination on a Wheel-Trans vehicle or contracted taxi may find themselves picked-up and taken to a subway station, and then taken from the subway after their ride via a paratransit vehicle to their final destination, if surface transit services can't meet their needs. As this service delivery model will entail two transfers, better coordination of accessible services will be required to prevent the trip from becoming much longer than a comparable trip on the conventional service, and excessively arduous.

If, for example, 5% of the ridership (4.3 million rides annually) were diverted – 200,000 riders – this would result in annual savings of up to roughly $6 million. Further incentives around things like offering free rides on the main network, or further improving the conventional system for accessibility, need to be tried so as to help limit the expensive growth of Wheel-Trans service, and provide better transportation options for those with restricted mobility.

A Competitive Cost Structure

The Wheel-Trans $31 per trip price-tag is derived by averaging the costs of the system's three transport methods – taxi, minivan and full Wheel-Trans bus. While high compared with the roughly $3 cost of providing an average trip on the TTC, $31 is on the low side of costs compared to other services of this kind.

A Paratransit Peer Report by New York City's MTA compared 15 of the largest paratransit organizations in the United States, and noted that the cost range was between $28-$68 per trip in 2009 (or $31 to $75 in 2014 dollars). This puts TTC service costs at the low end of the spectrum, especially considering that some cities have a much lower cost of living.

8.3 Accessibility On The Conventional System

Even a completely accessible system will not alleviate the need for Wheel-Trans, as there is still the "first and last mile", a term used to describe getting to and from transit stops. Sidewalks need to be wide enough and level, and provide clearance around obstacles to allow people with mobility issues to navigate properly if they are expected to get to a transit stop. Many sidewalks in Toronto don't meet these standards.

In addition to accessible communities, more attention needs to be paid to small details on the transit system, like ensuring that the level of station platforms are aligned with vehicle doors, which if not aligned can prevent access even if users can make it to the platform. Making the system fully accessible will require substantial City capital dollars, not only for the big items like new elevators, but also for more frequent inspections and repairs to components like escalators/elevators, doors, gates, the subway leveling device, etc., as well as for the larger transformation of the street environment discussed above.

Further work will need to be done to identify the safety and service issues in the conventional system that create barriers to TTC use, and further education and communication programs are required for both Wheel-Trans passengers and TTC staff. All this is part of an essential package of inducements key to getting more Wheel-Trans passengers shifted to the main system.

The accessible situation is further complicated in inclement weather, and better sidewalk clearing and drainage protocols and systems will have to be in place to improve conditions for those less able to deal with adverse weather conditions. The goal is to get to a point where those with mobility challenges can count on using the conventional system on a regular basis regardless of most weather conditions. Ensuring that the conventional system and its access points are kept accessible is essential to getting Wheel-Trans customers to switch to the conventional system. Doing so promotes the further integration of Wheel-Trans users into the community as they are better able to access jobs and social activities.

Eligibility Assessment for Wheel-Trans Applicants

Another change in regulations that will likely increase the number of new Wheel-Trans users by expanding the eligibility categories, specifically by making it easier to access temporary or "conditional" use of Wheel-Trans. The end result will be an increase in the number of those eligible for some component of accessible transit services and the resulting increase in demand.

Starting in 2017, the TTC was required by the Provincial Government to offer eligibility under three categories (text below adapted from Provincial regulations):

1. **Unconditional Eligibility**
   - Definition: A person with a disability that prevents them from using conventional transportation services shall be categorized as having an unconditional eligibility and have the right to access Wheel-Trans at any time.

2. **Temporary Eligibility**
   - Definition: A person with a temporary disability that prevents them from using the conventional transportation services shall be categorized as having a temporary eligibility and have the right to access Wheel-Trans for a certain time period.

3. **Conditional Eligibility**
   - Definition: A person with a disability where environmental or physical barriers (like snow) limit their ability to consistently use conventional transportation services shall be categorized as having a conditional eligibility and have the right to access Wheel-Trans at certain time under specific conditions.

8.4 The Future And Better "On-Demand'' Wheel-Trans Service

Today, TTC riders have the option of traveling on relatively little notice, whereas Wheel-Trans riders must book the day before or risk not being accommodated. Increasingly, people who depend on Wheel-Trans will expect to have similar mobility options.

Shortening the pre-booking period, and moving to a permanent on-demand (verses trial) service, similar to what is available with on-demand ride-sharing apps, will add tens of millions of dollars to the budget yearly, as the higher service level will increase the demand for trips. But this upgraded service, importantly, would further allow those dependent on Wheel-Trans to experience the same freedom others have using the conventional system.

Based on experiences in other cities like Boston, full implementation of "on-demand" Wheel-Trans service will result in a 15%-25% increase in use of paratransit service. Many people who qualify for service, but don't use it due to its inconvenience will likely take advantage of this service as it represents a substantial improvement over the pre-booking Wheel-Trans.

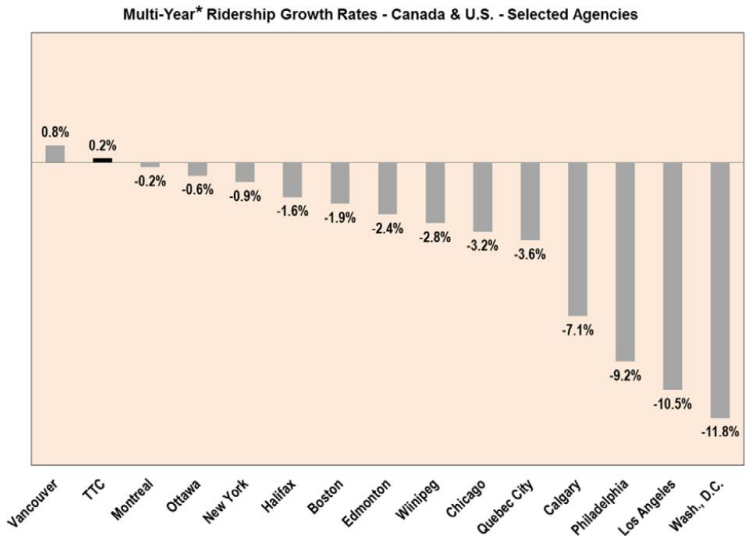
9. OPERATING BUDGET

The TTC budget is divided into operating and capital, and what is assigned to each is defined under provincial legislation, similar to how municipal budgets are divided. Unlike a City department, the TTC has more control over how it spends money allocated by City Council, although tension exists between the Council, the budget Committee and the TTC Board over the degree of independence of TTC spending. Over the last few terms of Council, the City has been slowly tightening its control over the TTC budget. Currently there is a line-by-line review by both City staff and the Budget Committee and in-year changes require City permission.

Most of the operating budget is paid for through riders' fares and ridership drives the budget. As more riders climb aboard TTC vehicles, the Commission needs to add service, which at an average cost (to operate) of around $3 per ride can put a lot of pressure on the budget when there are millions of riders. Of course, where and at what time the ridership rise occurs (off-peak generally has more capacity to absorb ridership increases) will determine the actual cost; generally, even a ridership uptick of 1 to 2% can add millions to the budget.

The current subsidy per ride is in the $0.95 to $1 range, one of the lowest among transit agencies in developed countries. And it has actually declined from 2010 by about 15% (adjusted for inflation), when it was $1.09 in 2018 dollars.

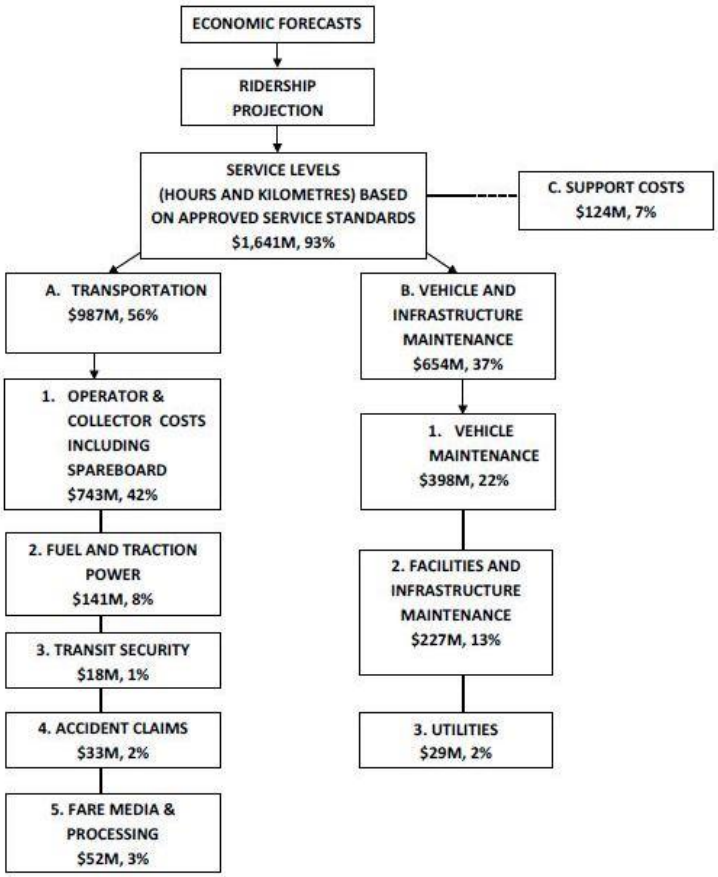
The operating budget carries salaries for operators and the staff (that do daily maintenance like cleaning and simple bus and facility repairs), the two groups that constitute the majority of TTC staff. It also carries the salaries for other non-hourly supervisory and administrative staff.



Multi-year Ridership Growth Rates in Canada and the United States. (Source: Wikimedia Commons)

Large repair projects, the building of new infrastructure or purchase of vehicles are instead included in the capital plan and budget.

An economic forecasting model for the TTC (Source: TTC)



9.1 Current Operating Budget: $1.910 Billion

The current operating budget for 2019 is $1.910 billion up from just over $1.844 billion in 2018, with increases kept low by a series of one-time issues discussed below. Typically cost inflation increases the budget by around 3 to 4% annually, usually twice the rate of general inflation.

2019 Recommended Operating Budget										
($ Millions)		TTC Conventional			Wheel-Trans			Combined		
Description		Expense	Revenue	Net	Expense	Revenue	Net	Expense	Revenue	Net
2018 Approved Budget		1,844	1,247	597	153	9	144	1,997	1,256	741
2019 Proposed Budget		1,910	1,288	622	149	8	141	2,059	1,296	763
Total 2019 Pressure	$	66	41	25	(4)	(1)	(3)	62	40	22
	%	3.6%	3.3%	4.1%	-2.5%	-6.0%	-2.3%	3.1%	3.2%	3.0%

2019 Recommended Operating Budget from TTC Staff. (Source: TTC)

In addition to general inflation there is the cost of new service to meet ridership levels (that typically grows at 1% to 3%) or improve service that is usually included in the budget request. It was estimated that for 2019, inflationary cost increases and new service to meet ridership would alone add just over $100 million to the budget. In addition, new costs for PRESTO would add close to $40 million, and the new subway extension would cost an additional $26 million to operate. TTC Staff also noted the following:

A key goal of the 2019 Operating Budget process was to preserve service improvements and initiatives introduced and/or reinstated over the past five years including:

- Two-hour Transfer (Introduced in 2018 with a 2019 annual cost of $20.5 million)
- Capacity Improvement Initiatives (Introduced in 2018 with a 2019 annual cost of $13.5 million)
- Toronto-York Spadina Subway Extension
- 10 Minute Network
- All-Day Everyday Bus Service Restored
- Expanded Express Bus Network
- Expanded Blue Night Network
- Early Sunday Opening
- Free Child Rides
- Subway Resiliency
- PRESTO implementation

Key staff goals in designing the 2019 Budget. (Source: TTC)

Incremental funding pressures in 2019 included $18.5 million for PRESTO transition, $14.4 million (annualization) for the 2 hour transfer, $8.5 million (annualization) for capacity improvements, $5.0 million for adherence to service standards, $29.2 million for collective bargaining, $13.0 million in Diesel price change, and $7.8 million for Eglinton Crosstown Bus Augmentation.

Key Components of 2019 Funding Pressure		
Key 2019 Incremental Pressures ($Millions)		
PRESTO Transition	18.5	Council Directions
Two Hour Transfer (annualization)	14.4	
Capacity Improvements (annualization)	8.5	
2019 Service to Adhere to Service Standards	5.0	
Collective Bargaining	29.2	Economic Factors
Diesel Price	13.0	
Eglinton Crosstown - Bus Augmentation	7.8	
Total Key 2019 Incremental Pressures	**96.4**	

Key components of 2019 funding pressure. (Source: TTC)

This compares to a 2018 estimate of more than $160 million in new costs, with offsets or savings to limit the impacts of these increases and limit the need for new funding elsewhere in the budget.

Off-setting the full TTC budget shortfall with property taxes would require the equivalent of a 4% to 5% property tax increase each year, as each 1% equals around $25 million in revenue. This reality often drives the look for additional cost reductions.

In 2019, the estimate of new costs of $96.4 million were balanced by $48.8 million in reductions in base expenditures ($45.5 for Conventional service, $3.3 million for Wheel Trans), a request of $25 million in increased subsidy from the city, and $25.6 million from a $0.10 (ten cent) fare increase.

One of the major sources of budget funding is the use of prior year surpluses (with council approval) that can often total in the millions of dollars. While this sounds like a lot, it's usually the equivalent of only 1%-2% of the budget and is the result of delays in spending or lower costs than budgeted for items. For examples, there could be less spending than anticipated if the implementation of new service is delayed (due for example to the new buses arriving late making

the new service impossible to offer) or there could be unexpected lower costs of commodities like diesel which has large swings and represents millions in commission spending.

Fare increases are also a funding source, but were not used (as is typical in an election year) in 2018. The 2019 $0.10 fare increase for the TTC will help respond to the ongoing and incremental budget pressures identified, but would still require a $25.3 million increase in the City of Toronto's subsidy for conventional TTC service.

Actions Taken to Reduce Pressure 2019 TTC Conventional Base Operating Budget	
($Millions)	TTC Net
Operating Budget Identified Pressure	**177.0**
Operating Impacts of Capital	
Bus Fleet Renewal	(4.8)
Legacy Streetcar Retirements	(1.7)
Automatic Train Control	(0.8)
Base Changes	
Line by Line Review	
Benefits	(16.6)
Traction Power	(14.4)
Expenditure Reductions	
Diesel	(9.5)
Absorption of Material Price Increase	(4.5)
Paid Emergency Leave Elimination	(4.1)
AG Procurement Recommendations	(2.0)
Other Expenditure Reductions	(4.9)
Funding Strategies	
Stabilization Reserve Draw	(15.4)
Accident Claims	(10.0)
Revenue Changes & Initiatives	
Average Fare (Net of Ridership Change)	(6.0)
Short-Term Revenues	(4.6)
Lane Occupancy: Cost Recovery	(0.3)
Ancillary Revenue Changes	(2.5)
Subtotal: Reduction Actions	**(102.1)**
2019 TTC Conventional Pressure After Reduction Actions	**74.9**
Additional Actions Taken:	
Undetermined Corporate Reduction	(24.0)
Fare Increase, Effective April 1, 2019	(25.6)
2019 TTC Conventional Subsidy Pressure	**25.3**

Actions taken to reduce financial pressures in the2019 Operating Budget. (Source: TTC)

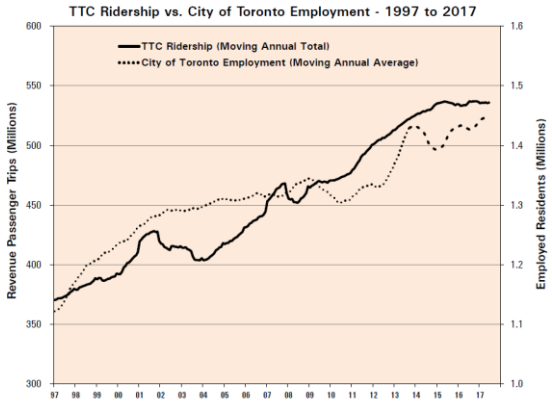
9.2 What is Driving the Operating Budget?

The Major TTC operating Budget Drivers:

Wage Increases and Pension Issues:

One of the prime drivers of operational budget increases are wage increases for the Commission's 11,500 unionized workforce, now largely determined through binding arbitration (the TTC has been an essential service since 2012), and increases in benefits (pension and medical) awarded as part of labour agreements also subject to arbitration. Non-unionized workers are generally awarded the same increases and benefits improvements as unionized staff.

In the 2018 budget, there was no provision for the current round of collective bargaining which ended in a 3-year deal being imposed in October of 2018 which has, among other provisions, a 2% per year wage increase. This was done, because doing so, would effectively telegraph the TTC's bargaining position.



Arbitration for the 2018 collective agreement involved issues regarding TTC proposals for part-time workers (associated with a proposed ride-hailing pilot project) and partial contracting out services (with the TTC proposing to work with York Region Transit to operate service on Dufferin into York Region). The arbitrator dismissed the TTC`s position, but it should be noted that this may be the beginning of more debates about the role of TTC operators as automation and alternative forms of transit (autonomous shuttles, ride-hailing) become more common.

The 2019 budget makes note of $29.2 million for Collective Bargaining, along with 10.8 million for employee benefits and benefit utilization. On average wage increases have been on the 2%-3% range over the last decade. This is likely slightly higher over the long-term than freely negotiated labour contracts as history has shown that arbitrators generally award slightly higher increases to essential service workers than they expect would have been negotiated in regular bargaining, sometimes noting that a small premium awarded representing

compensation for the workers loss of the democratic right to collective bargaining when they are designated essential service workers.

Pension Issues

On the pension front, the TTC is part of a joint employee/employer defined-benefit pension plan that can create a funding liability from time to time, especially in the low-interest environment we have currently. Funding formulas are set by government legislation and regulation, and focus on theoretical models designed to ensure that pension funds can pay out promised benefits in the future.

Based on the calculations, funding deficits must be funded by increases in contributions from the Commission and employees at a 50/50 rate as it is a joint-sponsored plan, meaning both the TTC and the employees control 50% of the TTC Pension Board seats and contribute equally to the plan.

Currently, beyond the sums allocated as part of the wage budget for pension contributions, there are actually no major funding deficits, as have occurred periodically in the past, which have required increased contributions from the TTC.

However, unlike other defined benefit plans, the TTC pension plan does not automatically index benefits as most other public pensions do, meaning fewer funding shortages, and more discretion around whether joint employee and employer contribution increases are delayed or offset by benefit freezes.

With higher interest rates on the horizon and the ability of the pension board to control rates for pensioners, future deficits are much less likely. However, with economic uncertainty, events like large stock market devaluations could hurt the pension fund returns and thus require increased contributions.

Energy Costs:

The TTC is the second largest user of electricity in the City. Most of this electricity is used for vehicle traction power. In addition, the TTC uses 90 million litres of diesel annually as well as smaller amounts of natural gas for heating. Diesel costs were estimated at $93 million in 2019, compared to $80 million (est.) in the 2018 budget. The TTC has also been able to benefit from price hedging, so estimates of 22.5 million in increased costs in 2018 have been adjusted to $13 million for 2019. In 2018 energy costs (beside diesel) added a net of $5 million for increases to both electric and natural gas. In 2019 the estimate is $6 million.

Electricity

The Commission's total electricity costs are around $60 million. Of this, the delivery charge and other non-electricity service charges are regulated and total approximately 40% of the bill. The remaining 60% represents the cost of the actual electricity and this is not regulated. It is purchased at market prices that fluctuate hourly, daily, weekly and on a seasonal basis, either via the "spot" market or through a hedging (buying futures on the Futures Market) process.

Generally, the 60% portion is split; between one third and one half of the required electricity being purchased through a hedging process with the City. The remaining amount is purchased through Toronto Hydro at "spot pricing". The hedging approach provides a higher level of budget certainty, and reduces the Commission's exposure to the risk of significant future price fluctuations.

Diesel Fuel

Diesel costs are determined both by the actual cost and by the TTC's buying of diesel on the Futures Market (as is the case with electricity) in attempts to stabilize budget impacts. The best example of this occurred in 2008 when the TTC saved more than $30 million because the agency had hedged its diesel use and locked in at 2007 prices thus being spared the 2008 price hike when oil reached $150 a barrel.

The TTC has contracts with outside experts to advise TTC on how and when to hedge on the futures market. In 2018 over 80% of the fuel purchased will be through a hedging process, although the percentage fluctuates with the market conditions and expectations of the futures market.

Battery Technology Advancing Quickly

New advances in battery technology have made back-up power for entire transit systems possible. These large battery networks besides providing back-up power also allow the transit systems to avoid paying peak power rates, by switching to battery back-up power at peak-times. The use of batteries to avoid peak charges is now an economical proposition and many energy intensive industries are employing this strategy to reduce costs.

Inflation on Materials:

There is an average across-the-board 2% inflation on the supplies and materials procured by the TTC.

PRESTO:

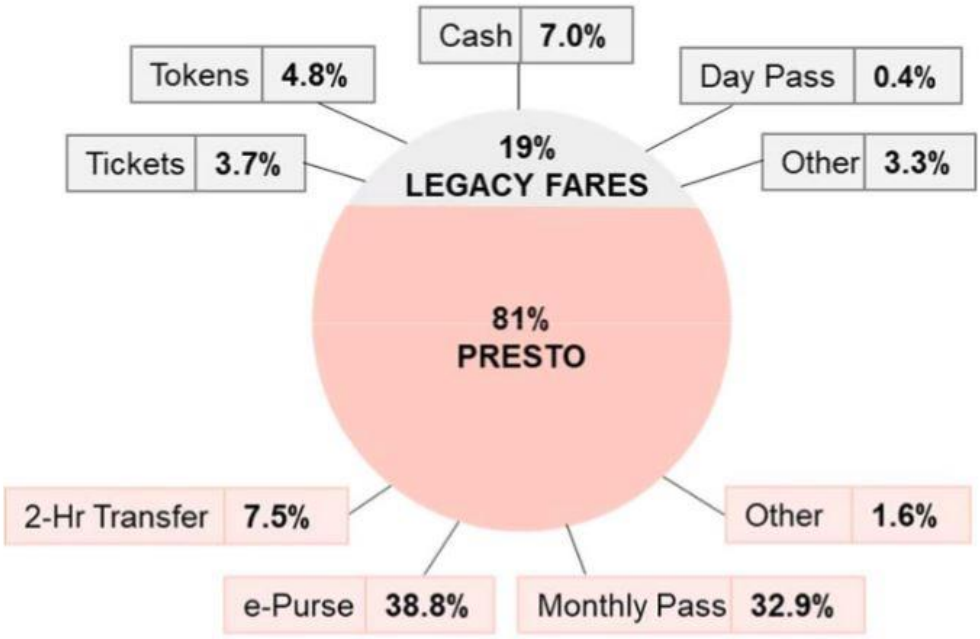
With this system, the TTC must make payments to Metrolinx based on ridership. Currently the TTC pays 5.25% of the revenue collected by PRESTO. In many cases, costs associated with existing fare collection systems have not been able to be totally eliminated the way cash handling and station staff have. The total cost for PRESTO will be $35-$40 million in 2018.

Delays in PRESTO implementation have forced the TTC to retain traditional fare media for a longer period than expected, which has created additional unanticipated costs. Issues with fare avoidance & evasion have also created additional pressures, and the TTC have acknowledged that their assumed 2% rate for fare evasion/avoidance may not be accurate.

Fares:

The average fare dropped 3.2 cents over in 2018 compared to 2017, likely a result of less people paying the single “cash” fare which at $3.25 is higher than the $3 token/PRESTO price. Then there is the reality that Metropass users are making more trips for the fixed price. This trend generates more rides (i.e. cost in some cases) but static revenue. In a connected matter, Metropass sales are also lower resulting in $2.8 million less in revenue for 2018.

Revenue Rides by Key Fare Payment Type
Legacy fares and PRESTO totals are rounded



Changes to ticketing and pass permissions associated with PRESTO migration, including the elimination of the transferrable Metropass at the end of 2018 and the implementation of new paper tickets (to be rolled out in 2019), will lead to changes in revenue. The TTC has already noted an anticipated $6 million increase in revenue for 2019 as more people use PRESTO to pay one-time fares rather than pre-purchase fares through a Metropass.

The new TYSSE Spadina Extension:

The opening of the Spadina subway extension to York region will increase ridership by around 1.2 million new fares (worth about $2.5 million in fare revenue), but the net total cost, for which the TTC is fully responsible, is around $26 million. The cost recovery of the TYSSE portion is projected at 58% compared to 70% for the entire TTC network.

Changes in Ridership:

There are 4.8 million additional rides projected and assumed to be the product of economic growth (more people working means more people going to work), bringing in around $10 million in revenue with an average fare of just over $2.

The average fare is lower than the cash fare as it includes an average of lower student/senior fares and a pro-rata revenue amount per ride for Metropass use.

Employment drives ridership because a person working full time makes a total of 21 round trips a month (the number of workdays in a month), meaning they have to make 42 trips and a Metropass is currently priced at 49 trips.

At 49 trips a month, the average fully employed rider can, for a small premium or after consideration of other non-discretionary work trips are factored in, get unlimited rides by purchasing a Metropass and most full-time employees using transit do. This drives-up their average monthly trips from the mid-forties when they had to pay for each trip to over 60 (this number and how it is calculated is currently under review), although there is not new revenue growth to support the potential need for (albeit most of the growth is in the less capital expensive off-peak periods) service. Nonetheless, ridership is basically flat from 2017.

The economy has continued to grow in Toronto; ridership has not grown in the same fashion as in the past. Strong economic growth and job creation is usually associated with strong ridership growth. This new disconnect between ridership and economic growth may be the result of new mobility patterns (ride-sharing and an increase in active transportation modes like walking and cycling as well more working from home in the "gig" economy) although the large number of early closings or weekend closures on parts of the subway network for track/tunnel repairs may have driven 500,000+ rides away according to the TTC. Likewise, many routes remaining overcrowded, constraining the ability of the system to accommodate new riders.

Benefits (Health, Dental, Disability, etc.:

The cost of providing employee benefits is around $300 million but has decreased $9.7 million in the current budget year. Employee benefits costs are generally dictated by the collective bargaining process and insurance industry cost increases. The price tag has generally been increasing faster than inflation in recent years.

Recent criminal investigations, however, have broken up fraud rings that had been illegally defrauding the TTC through false claims leading temporarily to lower costs, but in future years, the cost of benefits is likely to return to a growth trajectory with the regular inflationary pressures.

Other Pressures

Provincial Gasoline Tax funding for Public Transportation was introduced by the Ontario government in 2004 and since then, has provided over $3.8 billion in funding for municipalities. In 2013 the amount was fixed at 2c/L and made permanent. In 2017, the provincial government committed to increasing the Gas Tax transfer to 4c/L by 2020/2021. However, in 2018 a new provincial government was elected and in 2019 the government decided to cancel the phased increase of the Gas Tax amount for public transportation after the TTC and City of Toronto had appproved their 2019 budget documents.

The City of Toronto allocates approximately 50% of Gas Tax funding received to the TTC operating budget, and 70% of the total Gas Tax revenues received are spent on items related to the subway network.

The decision to cancel the increase in Gas Tax funding has created a significant hole in the City of Toronto's budget, estimated at $24 million for 2019 alone but increasing in line with the anticipated increase in funds for 2020 & 2021. The estimated hole created in the City of Toronto's 10 year capital plan is $1.1 billion.

Anticipated End of Provincial Subsidy for GO-TTC Discounted Double Fare (Co-Fare) Program

The GO-TTC Co-Fare was introduced in October 2017 and began implementation on January 7, 2018. PRESTO card users who used both GO and TTC were eligible for a discount from a TTC PRESTO fare, for example, $1.50 instead of the $3.00 adult PRESTO fare. Although the 50% discount was not as high as Co-Fares for other municipal transit agencies (typically between 70-80% depending on the system), the Co-Fare was seen as a step forward in addressing the requirement to pay a full additional fare at the City of Toronto boundary, which was a disincentive for transit use. The three year agreement was based on the provincial government covering the loss in revenue for TTC and GO through a subsidy of $18.5 million per year. The program exceeded the subsidy in 2018-2019 by $2.5 million and is projected to exceed the subsidy in 2019-2020 by $10 million, effectively using up the subsidy amount much earlier than anticipated.

As the province has not committed to an increase in the annual subsidy amount of paying to cover the excess, the program would run out of money by October 2019. The CEO of Metrolinx has proposed that Metrolinx and the TTC come to an agreement to fund the remainder of the initial three years of the program, but this would create additional pressure on the TTC & Metrolinx budgets.

9.3 FARE INCREASES

Fare increases are usually expressed as an increase on the token/PRESTO cost, currently $3, and are traditionally levied in round numbers 5, 10, 25 corresponding to coin values, though this may change in the future with PRESTO cards. A 5-cent fare increase would generate around $18 million (a 10-cent increase, $35 million in new revenue) for the TTC if applied to tokens, Metropasses and to concession (students and seniors) fares in a pro-rata fashion. At 5 cents, Metropasses would likely rise to $148.50 or $148.75, or at 10 cents to $151.

The Impact of Fare Increases

Traditionally surveys reveal that riders tolerate slightly higher fares if these come with new service. It is also preferable to have more small fare increases than a larger one every few years because it affects ridership in a less dramatic fashion.

If revenue generated by a 5 or 10 cent hike is dedicated to adding more service, instead of just off-setting the City's contribution increases there is likely to be an increase in ridership with the new service that more than compensates for the loss of ridership due to the fare increase.

A 5 or 10 cent fare increase is unlikely to significantly reduce ridership as small increases have been shown to have negligible impacts on ridership. In this sense transit fare elasticities can be said to be negative and inelastic, in that while there is some drop in ridership with small increases in fares, the ridership does not drop as much, percentage-wise, as the fare increase. So, increasing fares will generally create more revenue for a transit agency.

However, as fare increases grow, there is a ridership response. Above 10 cents per ride and certainly above 15 cents, there is often a fairly large ridership loss due to the elasticity of fares, as people take fewer trips when prices rise and find other ways to get around.

With the introduction of a low-income Metropass (Fair Pass Discount Program), some of the impact on vulnerable populations has been mitigated. Nonetheless, many low-income workers are not currently eligible for the pass, which requires enrollment in Ontario Disability Support Program (ODSP) and Ontario Works (OW) assistance, and would therefore not be affected based on the criteria for use and a staged rollout.

The Challenge with Fare Freezes

Conversely, a fare freeze requires either an increase in City subsidy dollars or a cut in service. Over the long-term fare freezes compound, so if over a Council term 10 cent per year fare increases were not implemented, annual subsidy requirements would increase to around $150 million (by the end of the Council term) more than would be the case with moderate fare increases.

By the end of a four-year Council term with no fare increase, service cuts of over $500 million would be required, given that, 70% of the cost of service is paid by fares. This means that for every dollar of cuts, only 30 cents is saved making the order of magnitude of the required cuts much greater.

9.4 Other Forms of Revenue

Non-Fare Revenue: Little Room to Grow

Given the ongoing funding shortfall for the TTC, there have been many discussions over the years about raising non-fare revenue, now mostly from charters, rental space in stations, parking fees and advertising. Today this source represents only around 3% of revenue.

This form of revenue has remained flat in the most recent years (after a bump from a new advertising contract), and is mostly constrained by long-term structured contracts. Parking revenue is now based on market rates and will continue to decline (without large price increases) as the number of spots available is slowly reduced as land with the parking is sold for other uses.

Advertising revenues are on par proportionally with other transit agencies relative to the number of passengers and has limited room to grow based on market trends.

While this is always a topic of discussion, none of the ideas on offer to date has proven capable of delivering large revenue increases.

While the Commission should continue to consider new funding opportunities, past experience from Canada, the U.S. and internationally tells us that there is no easy way to dramatically increase non-fare revenue, equal to around $55 million in total.

a) Advertising and naming rights

An option floated from time to time to generate non-fare revenue is name rights for stations. However, with the exception of a few examples in much pricier markets like New York City where the Barclay's Center-Atlantic Avenue renaming brought in tens of millions of dollars, naming rates have not been proven to deliver large sums of money for transit agencies. Also station names are an important navigational aid for customers and should not be sacrificed for one-time revenues in most cases.

b) Parking Revenue

The Commission has over 12,000 parking spots in 23 lots. This is down from a high of more than 14,000 spots since lots were closed for transit-oriented development and revenue generation through land sales. The Commission has been charging for their use for just under a decade and collects around $11 million per year that, after expenses that leave a small net revenue stream. Today the spots are run by the Toronto Parking Authority on a fee for service basis. While 12,000 sounds like a lot, even if all of the spots are filled during workdays, which most are, the number of riders that park represents less than 1% of the total ridership or under 7 million rides a year, indicating that park and ride is not a solution for large transit ridership growth.

Over time, the total number of parking spots that the Commission oversees will further diminish as more parking lots that are capable of it, become developed. However, in the new developments, the ridership from transit-oriented residents living so close to a subway will likely in most cases equal or exceed ridership from the parking lots, and at $50,000 a spot for the construction of multi-level parking facilities, large scale new parking facilities are not a prudent way to grow ridership and are not cost effective.

9.5 Wheel-Trans Budget

No discussion about the TTC budget would be complete without a discussion about the budget impacts of Wheel-Trans. Up until the 1990's, Wheel-Trans received provincial subsidies for most of the cost of providing the service as subsidies recognized that the service is not only a part of Toronto's transportation mix, but that it also plays a social support role for those with mobility challenges. It can be viewed in some ways as an extension of the healthcare network since a large percentage of Wheel-Trans trips are for medical reasons and is critical to

keeping a large percentage of the population physically and socially active and ensuring access to society and opportunity.

2019 WHEEL-TRANS OPERATING BUDGET
($000s)

	2018 BUDGET	2019 BUDGET	BUDGET CHANGE
PASSENGER REVENUE	8,631	8,111	(520)
EXPENSES			
SERVICE COSTS			
CONTRACTED TAXI SERVICE	**71,319**	**58,994**	**(12,325)**
BUS SERVICE			
Operators	27,202	31,492	4,290
Divisional Staff	590	591	1
Mobile Supervision	1,309	1,214	(95)
Dispatch	4,208	4,517	309
Equipment Maintenance	14,830	14,445	(385)
Vehicle Fuel	2,966	3,487	521
TOTAL BUS SERVICE	**51,105**	**55,746**	**4,641**
TOTAL SERVICE COSTS	**122,424**	**114,740**	**(7,684)**
ADMINISTRATION			
Senior Manager's Office	1,211	1,207	(4)
Reservations	2,840	3,116	276
Taxi Administration	250	293	43
Customer Service	3,697	4,839	1,142
TOTAL ADMINISTRATION	**7,998**	**9,455**	**1,457**
ACCIDENT CLAIM PAYMENTS/RESERVE CONTRIBUTION	850	350	(500)
NON-DEPARTMENTAL COSTS	4,788	5,109	321
LAKESHORE GARAGE COSTS	1,285	1,282	(3)
EMPLOYEE BENEFITS	14,710	16,150	1,440
COLLECTIVE BARGAINING AGREEMENT	800	1,933	1,133
TOTAL EXPENDITURES	**152,855**	**149,019**	**(3,836)**
OPERATING SUBSIDY REQUIRED	**144,224**	**140,908**	**(3,316)**
2018 NET OPERATING SUBSIDY AVAILABLE	**144,224**	**144,224**	
WHEEL-TRANS SUBSIDY REDUCTION	-	**3,316**	**3,316**

2019 Wheel-Trans Operating Budget (Source: TTC)

Fares paid by Wheel-Trans customers represent less than 5% of the cost of providing the service, compared to the almost 70% of costs covered by riders and other revenue on the conventional system.

Over the last few years, there have been a number of efficiencies brought about through streamlining the process for Wheel-Trans applications, changing the criteria for use of the service, and using new technology to better deploy services. In addition, a shift to contracted services, away from the traditional Wheel-Trans buses, has also cut down on cost increases and increased efficiency.

Key Cost Drivers 2019 Wheel-Trans Base Operating Budget	
($Millions)	Wheel-Trans Net
Prior Year Impacts	
Workforce: ESA 48 (July 10, 2018 Board report)	2.2
PRESTO Transition	0.1
Subtotal: Prior Year Impacts	**2.3**
Economic Factors	
Collective Bargaining	1.4
Employee Benefits	0.6
Fuel: Diesel and Gasoline	1.0
Subtotal: Economic Factors	**3.0**
Base Changes	
Other	0.5
Subtotal: Base Changes	**0.5**
Total Wheel-Trans Budget Key Cost Drivers	**5.8**

Key cost drivers for Wheel-Trans in 2019 (Source: TTC)

However, increasingly major possible efficiencies (based on broader industry trends) and further cost containment, while possible, are unlikely to generate the same level of savings and budgets are likely to rise, particularly as demographics will continue to drive overall numbers up. The 2018 budget is already $142 million, with about half of the budget allocated to contracted services; this is set against only $8.5 million in revenue.

Wheel-Trans subsidy – Around $30 cost per ride

The TTC projects that in 2018 there will be an increase of 300,000 rides yearly on Wheel-Trans due to population growth, demographic shifts and changes in provincial legislation, bringing the total number of rides carried to 4.8 million.

Over the last 5 years annual ridership on Wheel-Trans has increased by around by over 1.3 million new riders – and while this is a small increase compared to passenger numbers on the wider network, the average subsidy per ride is close to around $30 versus the 95 cents on the conventional system.

In the past few years ridership growth has slowed, but it is expected that ridership growth will return to the expected average increases of 10% per year and this will result in annual expenditures reaching $210 million per year by 2022. This is an increase of over $60 million over the 2018 budget year, though for 2019, staff proposed a $4 million reduction in expenses.

2019 Recommended Operating Budget										
($ Millions)		TTC Conventional			Wheel-Trans			Combined		
Description		Expense	Revenue	Net	Expense	Revenue	Net	Expense	Revenue	Net
2018 Approved Budget		1,844	1,247	597	153	9	144	1,997	1,256	741
2019 Proposed Budget		1,910	1,288	622	149	8	141	2,059	1,296	763
Total 2019 Pressure	$	66	41	25	(4)	(1)	(3)	62	40	22
	%	3.6%	3.3%	4.1%	-2.5%	-6.0%	-2.3%	3.1%	3.2%	3.0%

2019 Recommended Operating Budget from TTC Staff. (Source: TTC)

One of the last remaining areas for cost-cutting may be a change to the way Wheel-Trans structures contracts with accessible taxis and there might be an opportunity for allowing true price competition, as well as a chance for out of the box thinking on how services are provided, especially in the context of new technology associated with ride-sharing.

To illustrate, New York City's experimentation in contracted e-hailing program for its paratransit services has succeeded in not only lowering the operational paratransit costs by almost one-half, but also in increasing ridership due to its superior routing and scheduling flexibility.

10. CAPITAL BUDGET

The Capital budget of the TTC covers major repairs and rehabilitation projects for major infrastructure, as well as, the purchase of vehicles. Provincial law determines what is or is not a capital expense. The Capital budget is financed by contributions from all three levels of government, with some of that funding coming with very specific requirements.

The largest portion of base capital budget funding comes from the City, and is mostly debt financed with the financing costs showing up on the City's balance sheet. Most of the base capital budget is dedicated to maintaining existing infrastructure, but the capital budget also contains money for expansion programs, which are mostly financed by the Federal and Provincial governments with each major project being financed differently.

Further details on the Wheel-Trans capital budget will be discussed in a later section of the report.

The TTC tracks both a yearly capital budget, and a 10-year budget of critical and funded capital projects. In addition, there are billions of dollars in unfunded or "Below the Line" capital projects, like new LRTs, station modernization, new subway construction and other important improvements projects. 2019 will be the beginning of a major series of cost increases for the TTC, which will see the requested annual capital budget increase significantly, going as high as $3.549 billion in 2024.

Highlights: 2019 Capital Budget: $1.674 Billion

- **$770.9** million for vehicles (new and overhaul)
  - $377.7 million for buses
  - $335.4 million for streetcars
  - $57.8 million to subway and other non-revenue vehicles
- **$78.4** million signal maintenance and new installation
- **$75.6** million track upgrades and repairs

Another way to break down the budget shows **$13** million for health & safety, **$85** million for accessibility, **$122** million for growth, **$193** million for service improvement, and **$1077** million for state-of-good-repair. There is also a funding shortfall of **$185** million.

10.1 Ten-Year Capital Budget $23.95 Billion

The 10 year capital budget is estimated at $23.95 billion. The 15 year capital plan (including a five year period, 2028-2033 for the Capital Investment Program), is a projected $33.5 billion. $5.7 billion or about 89% of the Funded 10-Year Capital Budget and Plan is committed to State-of-Good-Repair (76%), Legislated (11%), and Health and Safety (2%) projects. This budget reflects the funding needed to keep the TTC`s assets in a state of good repair (and keep Toronto moving) and ensure the orderly replacement of assets at the end of life.

Capital Plan only Partially Funded

The $23.95 billion is somewhat of an illusion as only $6.453 billion is actually funded. Of the $6.453 billion amount, $1.952 billion or 30% is funded by the federal government and $1.543 million by the Province, equal to 23.6% of the total. The remainder comes from municipal sources such as development charges (10% or $646.1 million), or city debt (with interest and capital covered in the City's operating budget) that fund $1.736 billion (or 27%) of the program. The remainder comes from a series of other smaller sources, equal to 8.8% of the total or $575.6 million.

2019 - 2028 Capital Budget and Plan											
($Millions)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	10-Year Total
2019 - 2028 Proposed Capital Plan Request	1,673.6	1,883.5	1,907.7	2,003.2	2,889.7	3,548.8	3,399.3	2,797.6	1,962.0	1,880.7	23,946.1
Funding Sources											
Provincial Funding	215.0	214.8	206.8	222.1	177.7	105.9	75.2	75.2	175.2	75.2	1,543.2
Federal Funding (Including PTIF)	344.0	169.1	174.1	174.1	181.7	181.7	181.7	181.7	181.7	181.7	1,951.6
Debt Funding	309.1	572.0	261.8	146.2	14.9	97.7	87.5	121.7	20.2	105.5	1,736.7
2017 Carry Forward Funding (Debt portion)	224.4										224.4
Capital Financing Reserve	146.8	37.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	184.4
TTC Internal (Depreciation)	25.7	25.3	23.0	9.9	10.5	7.1	8.0	13.2	13.2	13.3	149.2
Development Charges	223.2	178.6	137.6	45.0	24.9	21.9	5.4	3.4	3.5	2.6	646.1
TTC Other	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	17.6
Total Funding Sources	1,490.0	1,199.2	805.1	599.1	411.5	416.1	359.5	397.0	395.6	380.1	6,453.2
Funding Shortfall	183.6	684.3	1,102.6	1,404.1	2,478.2	3,132.8	3,039.7	2,400.5	1,566.4	1,500.6	17,492.9
Reductions to address shortfall:											
Capacity to Spend (CTS) Adjustments	47.8	81.7	81.7	74.0	65.5	72.6	74.3	80.4	88.3	88.8	755.1
Existing Unfunded Projects	135.8	602.6	1,020.9	1,330.0	2,412.8	3,060.2	2,965.4	2,320.2	1,478.0	1,411.9	16,737.8
Total CTS Adjustments and Unfunded Projects	183.6	684.3	1,102.6	1,404.1	2,478.3	3,132.8	3,039.7	2,400.5	1,566.3	1,500.7	17,492.9

The TTC`s 10-year capital budget. (Source: TTC)

This budget may be large, but it does not provide sufficient resources to keep the system in a "State-of-Good-Repair" where all the assets, from vehicles to stations to maintenance facilities are prevented from deteriorating.

59% of the capital budget goes to structures and 41% to vehicles

Over the long haul, if resources are not found to repair or replace assets in a timely manner, their reliability diminishes, and in the end repairing them will likely cost more. Buses, for example, become very expensive to fix after they reach 15 years old, and if worn-out ones are not replaced, more money will be spent over time repairing them than the prorated cost of replacement. Another example is tunnel maintenance where for example if leaks in TTC structures are not quickly repaired, tend to grow in size, costing much more to fix in the long run when maintenance cannot be delayed for safety reasons.

76% of the Budget Goes to Future State-of-Good-Repair

The TTC maintains assets for which the replacement value would be in the tens of billions of dollars. But, at the same time, it is also responsible for complying with laws on accessibility, and responding to the pressure to expand and update the system, from providing new buses to building new transit lines.

Of the total proposed $23.95 billion 10-year capital budget, only $6.453 billion is funded, and of that, 76% is allocated to State-of-Good-Repair (SOGR) and legislatively required work, leaving only 24% for projects to improve service and increase capacity to meet growing ridership. While this appears to be a major improvement over the 2018-2027 capital budget (where 92% was allocated to state-of-good-repair and only 8% to service improvements), there are still significant challenges ahead. More importantly, it shows how quickly things can change when decisions affecting capital planning and funding are made, often unexpectedly.

For example, the Province in their April 2019 budget announced that they would forego the planned for hike in gas tax revenue. This reduced the capacity for the City to enhance allocation towards SOGR by $1 billion (over the 10 year plan). Meanwhile, the Federal Government announced a one-time doubling of the gas tax revenue in March 2019. In another example, the provincial decisions to build the Line 2 extension instead of the Scarborough LRT, and the Ontario Line instead of the Relief Line has also had major impacts on the TTC`s capital plans, especially the need for subway vehicles and yards and maintenance facilities.

10.2 Large Components of the 10-Year Capital Plan

Fire Ventilation

The original subway ventilation system was designed to provide general humidity and temperature control for customer comfort, as well as to relieve the effect of air pressure generated by train movements.

Fire ventilation system upgrades. (Source: TTC)

This program for new fire ventilation involves installing large 2-3-metre-wide fans with large vent shafts at 100 locations to meet newer fire code standards and provide emergency ventilation to push air in the direction of evacuating passengers to help people exit the system in an event of an emergency.

It also includes refurbishing or replacing a similar number of vent shaft dampers (that close in the event of a fire to prevent the spread of flames and the installation of upwards of 40 portal doors and other associated system upgrades at 51 stations, including remote fan control from the Transit Control Centre. This program is part of the US National Fire Association's 130 Standard that unofficially is the design guideline for the subway.

The total allocated cost is $112 million, although completing the entire project will end up costing over a billion dollars and likely take decades.

Elevators and Other Accessibility Projects

Elevator installation in individual stations typically cost $10M to $15M and two are budgeted per year, although past history suggests the Commission only manages to open an average of 1.25 accessible stations per year. Most stations require 3 elevators to reach the mezzanine level (where fare gates are located) and the platforms. The current rate of installation will not meet the 2025 legislative deadlines for full accessibility.

The total for this is $473 million, grouped together under "Easier Access III"

McNicoll Garage (Kennedy and McNicoll)

McNicoll garage is being built in Scarborough to hold an additional 250 buses. The current bus capacity (across all garages) is around 1700, and the new garage will bring the capacity to 1950 buses, although the actual number of buses system-wide is projected by the time the garage is finished to be 1975 buses.

This means operations may remain inefficient (due to lack of space for easy bus movement between maintenance stations) and constrained by overcrowding at certain garages.

Rendering of McNicoll Garage (Source: TTC)

The TTC fleet is officially set to grow to over 2020 by 2027, but slightly higher service levels or ridership growth could push the fleet need over 2100 to as high as 2150. This could occur despite the new LRTs planned to start operations during this time, and slated to replace bus service on these routes. Even with the completion of the McNicoll garage a new one will need to be started in the early 2020's to keep up with fleet growth.

$157 million is allocated to the project with total cost over $200 million.

Rail Yard Upgrades

Ongoing upgrades to rail yards are required to make TTC subway facilities able to handle the new Toronto Rocket subway cars, and automate the yards for better efficiency. The new TR trains are single unit (there are no interior barriers) or "open gangway" as opposed to being made up of multiple cars as traditional subway trains in Toronto are, and this creates new maintenance challenges as the yards were designed for "married pairs," i.e. two of the old-style cars coupled together in one unit.

In addition, there is no room at the existing rail yards for the new fleet to co-exist with the old one during a multi-year delivery and phase-in period or to add any new trains that may be required for added service or line extensions.

The total cost is $120 million within the 10-year window for rail yard upgrades.

With new Automatic Train Control, more trains will be able to be run on the Yonge-University-Spadina line, but current subway facilities (mainly Wilson and

Greenwood and the smaller Keele and Davisville) are at capacity. In addition, the Relief Line South would require additional trains, more than can be housed currently.

A large property southwest of Kipling Station, formerly a CPR freight yard, was being acquired by the TTC for a new subway yard, but not projected to be available before until 2031. This would have meant that the TTC, already suffering a shortage of yard space for Line 2, would not be able to store the new trains needed to provide full service to the Line 2 extension and Relief Line. However, the provincial decision to replace the Relief Line with the Ontario Line, and the TTC decision to undertake a life extension of the older T1 trains used on Line 2 (rather than replacing them), means that future fleet and yard needs are not entirely known at this time.

IT Systems

Like any large organization, the TTC has a large number of complex computer systems for everything from inventory control and SAP (systems applications, and products), to payroll, to programs that track and run the various transit vehicles the TTC operates. Many of these systems are decades old and require updating.

$298 million is allocated to several large IT refurbishments at various phases of development.

Automatic Train Control

Automatic Train Control (ATC) allows trains to be run by computer, making the operator position redundant, although for safety reasons; staff may still be deployed on the train. By 2019/2020 the entire Yonge-University Line will be able to be run by computers allowing closer spacing of trains, and enabling additional trains to be run.

Preliminary design for the automation of the Bloor Danforth line is in process and the TTC is expected to start procurement of the project in the coming years. The total current estimate for the program is currently $430 million, although if experience from the Yonge-University line is any guide, that number is likely to grow.

Only $251 million has been allocated to date, and completion is not expected until at least 2028. However, the Bloor-Danforth line trains running on the Bloor-

Danforth line (called T1's) are too expensive to retrofit for ATC. New trains were not expected to be available until around 2030, which would have slowed implementation of the signal system so new trains and the new system will be available at the same time. This also affects timing (along with the need to build another subway yard) of the Scarborough Subway extension, since the single control system has to be synchronized along the Bloor Danforth line. However, with the decision by TTC staff to undertake a life extension of the Bloor-Danforth Line trains, the future of the ATC plan is not known.

10. 3 State of Good Repair Shortfall

Discussion about the State-of-Good-Repair (SOGR) backlog is always a hot topic in transit planning in Toronto. Currently the backlog is between $2.6 billion and $3 billion depending on the exact definition, which means that it would take over $300 million more annually (a 25% to 30% increase over current spending) for over a decade to make all the repairs and replacements necessary, a funding commitment that is unlikely to occur any time soon. A current re-evaluation the SOGR is underway and is expected to double or triple the backlog after a thorough review is conducted of all the assets.

This isn't to say that everything is broken or unsafe; indeed, that is not the case, but it does mean that there are parts of the infrastructure that are past their design life and should be replaced. Keeping out-dated infrastructure operating safely generally costs more in the operating budgets (simple repairs are an operating and not capital expense), as it requires more checks and fixes. If items are not overhauled on schedule, the result is major repairs that are inevitably more costly.

SOGR can also have an impact on customer service. Older vehicles kept running past their useful life, for example, would likely suffer more breakdowns even if well maintained. So too, the ongoing use of a more than 50-year-old signal system on the Bloor-Danforth Line means that there is a limit to how much can be done to add more trains; the current block signal system only allows a train every two minutes and 10 seconds, or practically a maximum of 28 trains per hour. As well, the system breaks down more often than a modern signal system, like the one being installed currently on the Yonge Line, which could also theoretically support trains every 90 seconds.

Managed Under Spending – The 10% Rule

There is one associated issue that comes into the debate around the TTC's budget, and that is the "Capacity to Spend" reduction that City finance applies to funding of the TTC's capital budget. Every year, circumstances under the control of the Commission and those beyond, mean it rarely spends all the money it plans to and is theoretically allocated.

There are various reasons for this. It could be because vehicle deliveries are delayed, or a project takes longer than expected, thus postponing the arrival of the final bills. It could also be because a project takes longer to start due to design or procurement delays. The City finance department therefore applies an approximate 10% reduction in the approved budget of the TTC, and further limits the Commission from applying funding from one project to another, without prior approval.

In the past the TTC could have reallocated funding from one project in the capital budget to another, to take advantage of a delay in another, especially if the new project was one that could be scaled up fairly quickly, like paving or roofing. Currently, this isn't currently possible without specific City approval.

The aim of the "Capacity to Spend Policy" is to prevent the Commission from reallocating spending without the nod of the City. This has the benefit, from a City budget perspective, of reducing the total TTC capital spending and lessening the budget impact by making in year changes in spending very difficult. As a result, it is rare, that the TTC spends its full budget any year, meaning that the needed work is left uncompleted, as money can no longer be easily moved around.

So while the TTC may be allocated $6.5 billion over the 10 year capital window (with needs of over $9 billion), it is likely, thanks to the City's 10% cut, to get less than the $6 billion.

10.4 Off The Table But on The List

In addition to the official state-of-good repair backlog, there is an unofficial one, referred to as "below-the-line". It works like this: there is an understanding that certain capital projects are necessary or desirable, but the need has not become absolutely acute or a funding source identified. So, because of the backlog, and the need to contain capital budget forecasts for debt-rating agencies that evaluate the City's liabilities, and other constituencies, these items are not added to the capital budget.

Three high profile "below the line" examples are: a new signal system for the

Bloor-Danforth line, a new Wheel-Trans garage and an additional bus garage beyond the McNicoll garage currently under construction. In addition, “nice-to-haves” like station renovations are perpetually “below the line”, unless political pressure pushes them into the capital budget.

The Need for More Maintenance & Storage Facilities

In addition to the new bus facilities discussed elsewhere in this report, the TTC requires new rail storage facilities.

One large example of a major “below the line” item is the need for a new subway maintenance and storage facility. When the Yonge-North subway project was picking up support over a decade old, it was thought that the $700 million to $1 billion carhouse project could be tacked on to the expansion project. With the downgrading of this project, whatever new extension is built next will need to carry the cost of a new subway carhouse.

Existing subway carhouses (Wilson and Greenwood) are near capacity and Greenwood is not well suited to the new “open gangway” trains as it was designed for the “married pairs” – two of the older style subway cars coupled together. This is particularly an issue with the recent opening of the Spadina Extension which expands the fleet, but also puts the maintenance window under pressure, largely because of travel times for the first few morning trains to the north part of the Yonge line from Wilson station. A new subway yard in the north part of the City would help with this, although land constraints are an issue and the instead the TTC is currently in discussions to acquire a former CPR yard near Kipling station.

11. CURRENT TRENDS AND ISSUES

11.1 Fare Collection, Presto, and the Future

Over the years the TTC fare system has evolved, adding tokens in the 1950’s with the opening of the Yonge subway, and in the 1980s, magnetic Metropasses. Essentially much of the system was not automated until recently, and everything from fare boxes to turnstiles was mechanical and did not need communication or extensive electrical connections, making them easy and inexpensive to maintain. The system was viewed by many as antiquated, and not as customer-friendly as the new automated fare payment technology.

In 2011, TTC elected to move forward with the automated fare system called PRESTO. The PRESTO solution, which involves replacing fare gates and fareboxes with automated ticket vending machines, is based on contactless smart card technology. It is replacing the use of tokens, tickets, passes with magnetic stripes, and paper passes and transfers with a card that acts like a digital, electronic version of tokens and tickets. These smart cards contain a computer chip that stores information about the fares that riders have purchased. They rely on imbedded antennae to receive and send information "contactlessly" by bringing cards in proximity to card readers on buses and fare gates to confirm payment.

Maintenance window

The time between when the last train leaves the line and enters the carhouse to when the first train enters the line to be spaced to offer service throughout the line starting at around 6am, or 8am on Sunday.

Sunday night to Friday night, it is usually around 2,15am to 2.30am when the last trains come in from service to the yards to 5.15am when the first trains are going back onto the line to be in place for the start of regular service at 6am. This leaves just under 3 hours a night or just under 5 hours on Saturday night for a long list of maintenance items to be completed.

It usually takes some time for maintenance crews to get into place and start work and they must leave time at the end to pack-up and exit the tunnels before trains start running, which means that there is usually only around 1.5 to 2 hours to do actually work or 3.5 to 4 hours on Saturday night.

The result of these restricted hours is that projects take a long time to complete which is why the TTC has been moving to extended weekend closures to extend the work period available for more complex and time consuming projects.

This technology, first pioneered in the 1990s in Hong Kong, requires the creation of a large and expensive "back-office" to act like a bank and accept the loading of fare information on the cards, the verification of each transaction, and the recording of transactions in the back office. The price tag for these systems is high because they are custom-built for transit agencies. They use proprietary software to set-up a unique financial and customer support back-office for accepting money from riders for payment of fares, issuing PRESTO cards with paid fare information on them to riders, and processing and reporting rides taken and fares used.

The TTC had initially resisted moving to an electronic fare system, not because it believed that the existing system was better, but because typical transit automated fare collection system (AFC) alternatives were more costly both in terms of initial capital investment, and in ongoing higher operating costs. An analysis of TTC legacy fare system costs – tokens and various paper tickets – showed that it cost five to seven cents to collect a dollar of fare revenue when including staff labor costs, maintenance of equipment cash handling, and fraud losses due to the inefficiency of the system, half the average of typical smartcard systems.

Automated Fare Systems

A review by the TTC of proprietary AFC systems (prior to Presto adoption) in operation showed that their operating costs ranged from a low of 12 cents to a high of 21 cents to collect a dollar of revenue. Experience with PRESTO – which has so far cost the Province over $1 billion (for province wide implementation) has not been well managed – with ongoing challenges associated with the performance of the fare collection equipment, like card readers and gates as well as issues in the back office.

The current rate charged by PRESTO is 5.25 cents per dollar of fares collected, a rate negotiated to match a competing fare collection opportunity the TTC had with an Open Standards Payment RFP (Xerox won the bid) ready for award in 2011, the award of which was cancelled with pressure from the Province to adopt PRESTO.

An even greater challenge with PRESTO and other proprietary systems is that the transit agency alone has to bear the costs of fare system upgrades and the introduction of innovations.

The pace of innovation, as well as its expansive scope, has created new needs for upgrades to keep pace with how riders can conduct personal mobile commerce generally. At the same time there is still more work needed to complete the initial planned installation of PRESTO by 2019, a full 15 years since the project was first announced.

Innovative Fare Collection

Taking a cue from the financial services industry, other transit agencies across North America and around the World have realized the advantages of mobile commerce, especially as it relates to paying fares. Several major cities – London

(England), Chicago, Philadelphia, and others – have transitioned to accepting mobile payments. The most advanced of these have taken the step to accept "open standards," or bank card technology for payment of fares, without having to issue their own transit cards, or maintain an expensive back office.

Open standards is the same technology used by retail merchants throughout the world when they accept bank cards, gift cards, payment apps like Apple or Google Pay, or any other card for payment. It involves a set of technology standards and business protocols that are accepted by merchants globally and, more importantly, understood universally by anyone who has a bank card or some other form of payment card. In Canada, virtually all adults have some form of bank-issued card, and increasingly those under 18 have cards as well, either as physical cards or virtual cards on in their mobile wallets.

London, England is perhaps the best example of this practice on a large scale, with over two million trips daily paid with a smart phone containing a bank technology card in its digital wallet. While not the only way to pay (London still issues a version of its non-bank Oyster card), use of digitized banking cards is popular with customers because it's the same card that can be used in general retail.

Transport for London benefits as well, since it avoids the high cost of issuing its own cards, and leverages banks' systems and technologies in processing payments, in providing customer support and issue resolution, and in introducing advanced security and leading-edge innovations to riders' fare payment experience.

Fare Capping – An Effective Way to Drive Ridership and Low Income Users

An even more important benefit to both riders and transit agencies is that fare policy can be simplified with new electronic fare payment. Again, London took the lead (following on practices well-established in Australia and expanding in the US) by introducing full fare capping. With open standards (or with smartcards), the back office can be simplified and programmed to "cap" fares at the price equivalent of a daily, weekly, or monthly pass. So in effect, riders need not worry about receiving the best fare: they just ride and automatically have their fares capped and ride "free" thereafter, once the price of a discounted multi-trip fare is reached. This reduces the "barrier to entry" for low-income riders who often find it difficult to come up with the money for the full months pass in advance.

More Ways to Pay – Lower Cost Infrastructure

The technology used to accept Open Standards payment also allows payment through cell phone apps (like Apple Pay and Google Pay), and as it is based on universal systems, it is very adaptive (with the entire world financial system working to improve it continuously) at little cost to the agency since costs are amortized on a larger base than just one system. Plus, it is much more secure as large financial companies invest more in security systems and protocols than any one transit agency ever could.

In addition, the technology acts no differently for the transit agency, in this case the TTC, than it does for Tim Horton's or any other retail establishment. No complex and expensive back-office is needed, updates are cheap, and all the equipment is commercially available and non-proprietary. It's the same method used all around the world – and it's cheaper.

Perhaps most important, Open Standards technology is the basis for future innovations, such as a new process that uses longer-range "contactless" technology called "beacons" to interact with apps that customers have loaded on their smart phones is becoming commercially viable. This technology is being used to assist disabled persons with limited use of limbs, to be able to pay fares without concern for holding and presenting a ticket to a reader. This "hands-free" or "walk-on" payment method will likely be applied for general use in the near future so that all riders can pay fares without having to reach into pockets for cell phones or cards if they choose.

The effect will be to increase throughput at fare gates and reduce dwell times for streetcars and buses. This and other technological advances come faster and easier when tapping into the worldwide trends with Open Standards Payments.

Too costly to adapt PRESTO

PRESTO can be adapted to use Open Payments, but the contract structure does not encourage this, and the TTC or Province must pay high fees to adapt the back-office for each new technology, and pay for proprietary systems. And even if TTC were to move forward in this way, the process would require continuous TTC involvement in tracking innovations in riders' payment and mobile commerce preferences, and adapting its infrastructure to them rather than simply following practices of other "merchants" in general retail.

This involvement would tie TTC to a program of investment that would draw funds away from its primary mission to provide transit services – more subways, streetcars, and buses – at a time of increasing demand and the need for investment in urban mobility alternatives.

11.2 The New Two-Hour Transfer

One of the biggest arguments in favour of the private car is often that it allows drivers to do several errands with quick stops and little incremental cost, while transit involves the paying of separate fares for each destination. The Time-based Transfer, recently implemented, allows two-hour travel privileges for one fare, and changes how transit service will be viewed by those who have, to this point, not found purchasing passes to be cost effective.

Today, around 225 million of the 540 million TTC trips annually are made by riders who do not have a pass offering unlimited travel. Allowing riders two hours of TTC travel on a single fare, regardless of the number of stops and boardings, will provide more mobility freedom and enhance the value of fares.

The Time-based Transfer is also easier to understand, and TTC workers will benefit because the current transfer policy generates fare disputes, which often puts them in difficult and sometimes dangerous situations.

The new transfer policy will also likely mitigate some degree of fare evasion as it will regularize the “hop on – hop off” that occurs currently (riders hopping off to do errands and re-boarding another vehicle on the same transfer) but is not official. This is difficult to patrol if the stops are quick and the transfer is within the time window.

The Time-Based transfers comes at a net operational cost of around $21 million per year, but TTC estimates suggest that it will increase ridership by 0.4% annually, or two to 2.5 million new rides a year. The PRESTO rollout made this new policy much easier to implement than it would have otherwise been but also forced its adoption. This is because the directional transfer that the TTC had used decades was easy to understand (as long a trip as needed was allowed, i.e. no time limits, as long as the trip was continuous with no “stop-overs” and uni-directional with no backtracking) for users, but hard for a computer to analyze it in real-time (in order to confirm any theoretically transfer is acceptable) to quickly decide whether or not to accept the transfer.

11.3 Fare Policy and Fare Integration

Toronto is part of a growing city-region: over 150,000 people ride across the 416/905 border every day. So while the TTC is designed to serve the needs of Toronto-residents, it also provides service for thousands of 905 residents who pour into the city every day.

With the arrival of the PRESTO card, it is now possible for passengers to pay different fares on one card. However, it could also make it possible to integrate inter-and intra-municipal fare structures themselves. Today a transit rider can travel from Scarborough to Etobicoke on a single fare, but has to pay two fares to cross the border from Mississauga to Etobicoke, even if only travelling for only several blocks.

Traditionally the TTC has refused to budge on reducing its fare as part of fare integration as due to the revenue loss, especially since 905 transit riders do not pay through the property tax to support the TTC network like City of Toronto residents currently do. Toronto taxpayers pay close to $150,000 every day, or close to $5 million a year, to subsidize cross border trips for non-Toronto residents.

In addition to integrating fares, there are a range of possible other fare policy options, from zone- or distance-based fares, to express service and time-of-day pricing. All of these create winners and losers in every scenario.

Eliminating the possibility that some would "lose" would likely cost hundreds of millions of dollars in ongoing subsidies (to keep fares down) and that money could be better spent improving service.

The Challenge with Fare-by-Distance

There has long been a conversation at the TTC, Metrolinx and the Province on how to rationalize the fare system so that short trips across the municipal boundaries are not twice the cost of trips within Toronto, trips that could be up to 35km on the same fare.

This could be accomplished by moving to a “fare-by-distance” but the main reason to switch fare systems should not be the relatively small number of cross municipal

boundary passengers, but rather other broader issues like equity, speeding up boarding and encouraging transit use.

Without new subsidies, a new “fare-by-distance” system would make shorter trips typically taken by those living downtown or in the centre part of the City, cheaper at the expense of longer trips, typically taken by those coming from the former inner suburbs, many on crowded, long, bus trips and standing-room-only subway rides.

A fare system based on “fare by distance” would generally tend to decrease fares for downtown residents who, on the average, have access to overall faster and more reliable service than their fellow riders from places like Scarborough, Etobicoke and North York, and increase fares or these coming from the same inner suburbs.

In addition, as rental and property costs push more middle- and lower-income residents out of the central city, fare by distance would create a higher transportation cost burden for many, while cutting transit costs for downtown and on average higher income travellers. It would also work against the objectives of cutting emissions from vehicle use and reducing overall traffic volumes since the average trip on the TTC is about 6km, whereas the average trip many from the inner suburbs can be 25km plus.

As a result, any regional changes to the fare system need to come with new and ongoing permanent subsidies from the Province.

The GO-TTC discounted fare, introduced in January 2018 is expected to be used, and to benefit, less than 1,000 people per day. (Riders who use PRESTO and transfer between the TTC and GO Transit or UP Express, or vice versa, pay $1.50 on the TTC, as opposed to the full fare). This will only generate 350,000 new rides, so while it is an interesting option for a few riders, it is not a panacea to regional fare integration.

Moving more riders onto GO services will require that the GO expansions which will increase capacity will go ahead or there will not be sufficient space on GO services to accommodate the new 416 ridership as many GO services into/out of Toronto are already well used.

In addition, “fare-by-distance” will be harder to implement on the TTC than on some metro-only systems as most TTC riders use a surface route for part of their

trip, where “tapping” on and off is much more difficult (think of crowded buses and streetcars and the need to find a terminal to tap off!) and will likely result in the surface system being classified as all one zone. It will also require that passengers “tap” off or on at a subway station which will require new fare gates to be implemented separating surface transit from subways. The other problem is that “tapping” on/off will slow down the exiting from stations which may introduce passenger flow issues at crowded downtown stations in the rush hour and will certainly not be customer friendly.

Time-of-day Pricing

Time-of-day pricing is often discussed in the context of new fare systems, as it is hard to do without electronic fare payment. It can be used to drive behaviour and push some riders to use the system outside of the peak period when it is overcrowded, which allows the system to better utilize its assets. It also can be used to offer discounts to groups like seniors and to a lesser extent the student population who may not need to always travel in the peak period.

However, experience in other large systems (in Europe or Asia) have shown a minimum ability to shift a large number of users outside of the broader peak period with the biggest movement occurring from the peak hour to the periods on either side of the peak hour called the “shoulder” periods. While this helpful to some degree, shifts of more than 1% of peak hour riders have never been realised, despite some systems (like Hong Kong and Singapore) even offering free transit in some cases. This is because most peak users are tied to larger societal trends around work hours that are fairly standardized. In the future if flexible working arrangements take hold across a large section of the economy, there may be more opportunities to take advantage of incentivised none-peak travel.

11.4 Electrification of The Bus System

The Toronto Transit Commission with its need to power the traction for subways and streetcars is already the second largest user of electric energy in the city.

Electric-powered motors are simpler and easier to maintain than diesel ones, operate better in cold weather, (certainly important for Toronto), are more energy efficient, and allow for faster acceleration.

Technology advances are making electrical buses more efficient and therefore cheaper and more practical. New advances like regenerative braking, which recoups energy from vehicle braking and returns power back to the grid, along with more efficient onboard systems are improving the overall operation of electric buses. In addition, battery technology has come a long way. While battery powered buses still have a range of 120km or less (when AC or heating is in use as is often the case in Toronto), the technology is advancing quickly and will soon be cost-effective for large scale deployment, if the networks can support the power requirements.

TTC Once had a Large Electrically Powered Fleet

An older Trolley bus in Toronto (left) and a modern Trolley bus in Vancouver (right). (Source: Wikimedia Commons)

For many years, the TTC operated a large number of fully electric buses, in the form of its trolley bus network, built out using the streetcar electrical system as the base. In the 1950s and 1960s these were seen as a permanent replacement for all the streetcar routes.

The last trolley buses were phased out by 1993 as a result of the large capital cost (compared to replacing the system with diesel buses) associated with upgrading the dilapidated system competing with other funding priorities. Given the current development of electric bus technology, the next generation of electric buses will not be tethered by overhead wires.

The TTC is in the process of testing new generation electric buses as the technology is evolving quickly, with countries like China in the process of converting entire urban transit bus fleets to electric operations. This scaling up of the technology is likely to address many of the current problems with electric buses. These problems include durability and insufficient battery strength, that have been an issue for electric buses since battery-powered buses came on the

market, as well as creating economies of scale to push down prices and make the lifecycle costs comparable or cheaper than conventional diesel buses.

TTC began testing battery electric buses in June 2019. (Source: Humber News)

Currently a battery electric bus is still hundreds of thousands of dollars more than the cost of a conventional diesel bus and fuel savings do not yet offset the high purchase price.

Electric Powered Vehicles reduce Local Emissions

Beyond being quieter and offering smoother rides, electric buses offer the opportunity to reduce local particulate matter ($PM_{2.5}$) that is harmful to human health and the emissions of GHG coming from the transit fleet operations.

The TTC uses around 90 million liters of diesel to move the over 500 million rides taken on buses every year and moving to electric buses would make for a quieter and more ecologically friendly ride assuming energy comes from a clean source.

Potential for zero emissions

Electric buses are the only truly green propulsion technology with the potential for zero emissions from generation through to operations for the bus fleet. They have no local tailpipe emissions, and in Ontario, generation of electricity for overnight charging is mostly 100% nuclear or hydro-based and therefore completely free of GHG emissions, although buses that require charging during the day (using quick charge systems at bus stops) may well end up using power generated by natural gas used to meet peak energy use.

Full adoption of electric vehicles is still some time off in North America as there have been no large-scale fleets in long-term operation anywhere in North America. This means vehicle reliability, battery longevity, operating and

maintenance costs are not truly known or proven in a local context. Of the 63,000 buses in operation throughout North America, fewer than 220 are either Battery Electric or Hydrogen Fuel Cell Electric.

While it would be premature to purchase electric buses in large numbers for TTC's bus replacement program, the experience of other transit authorities over the past few years with battery electric buses (BEBs) has been very positive. Montreal is the closest peer city that is also moving towards a fully electric fleet in the coming decades, with the support of Hydro Quebec, the world's largest generator of cheap hydropower.

The TTC issued a Request for Information (RFI) in early September 2017 to survey the industry on currently available BEBs. There are three manufacturers of long-range BEBs operating in the mainstream Canadian transit market, and the TTC initially decided to procure ten buses from each manufacturer for a long-term, head-to-head comparison. This was changed to 20 buses from each manufacturer in January 2018

The first buses arrived in April 2019 and all of them are expected to arrive by the end of 2019. This procurement of 60 all-electric buses will be used to confirm bus performance, including examining metrics for: vehicle reliably and service availability, customer satisfaction, battery charging times and range, maintainability, and the total cost of ownership. The results will assist the TTC and the transit industry at large with the development of bus specifications for future green bus procurements.

To this point electric buses have had ranges of only 100km to 150km with the AC/heat functioning, which is not enough for a full day of operations. However, battery technology is evolving quickly so this range will improve.

In addition to the base cost of the buses, there will be a need to change existing maintenance facilities to accommodate the new type of buses. This will include upgrades to the electricity network to support higher demand generally and specifically at bus depots that will require additional electrical capacity to charge upwards of 250 buses at a time.

a) Other Bus Propulsion Methods

Condensed Natural Gas

Over the last two decades, research has been done to attempt to find cost-effective alternative fuels for buses that have lower emissions. In the 1990's the TTC experimented with an earlier generation of natural gas (known as CNG or Condensed Natural Gas) buses. Special facilities had to be installed for the 100 buses in the trial including new fuelling facilities and special ventilation for the storage and maintenance area of bus depots.

While CNG technology has advanced, it has been mostly adopted in places without cold winters where outdoor storage (where no specialized ventilation upgrades are needed) is possible, and in jurisdictions like the United States were specific tax subsidies have been available.

Without the subsidies CNG does not represent a cost-effective approach within a Toronto context. Likewise, with the ongoing developments in cleaner diesel, the environmental benefits and lower carbon emissions relative to diesel buses are less pronounced.

Hydrogen Fuel Cell Electric Bus (FCEB)

With an operational range of 450km between refuelling, these buses have significantly longer range than the current Battery Electric Bus at 100km to 150km per charge. While FCEB technology is promising, there are only 20 buses in service in North America and the production of hydrogen is not yet cost effective or particularly sustainable.

The lack of in-service experience has led transit staff at most large agencies to consider this technology not commercially viable at this stage.

Bio-Diesel and Ethanol

Ethanol-blended fuel is widely used and most cars on the road today can run on blends of up to 10% ethanol, with standard equipment.

Bioethanol is a form of renewable energy that can be produced from agricultural by-products or crops such as hemp, sugarcane, potato, or corn. There has been considerable debate about how useful bioethanol is in replacing gasoline and cutting emissions.

Concerns about its production and use relate to increased food prices due to the large amount of arable land required for crops – especially corn which is the source of most North American biodiesel – as well as the energy and pollution balance of the whole cycle of ethanol production.

Biodiesel from agricultural waste products has a much-reduced environmental footprint, and if it can be produced relatively close to the point of use (to avoid the shipping costs and environmental impacts of transportation) the benefits of this fuel source may improve.

The TTC used bio-diesel from 2006 to 2009, but the project was cancelled due to concerns around food security and the poor environmental footprint of the biodiesel available to the TTC, along with the additional multimillion-dollar cost of the fuel over conventional diesel.

11.5 Balancing Local Parking Needs And Active Transport

Many business owners oppose parking limitations, believing that a large percentage of their business is derived from customers arriving by private car. In most cases, however, this does not paint the full picture of local commerce.

A 2014 study on the Danforth by Ryerson University's Planning and Consulting Group (Danforth Study - Bike Lanes, On-Street Parking and Business) presents evidence suggesting there is a big disconnect between the perceptions of merchants about who their customers are, and the reality. With a large percentage of purchases being made electronically, it is now possible to measure the economic impact of changes in parking regulations through the monitoring of electronic sales and comparing them to past sales periods.

Only 19% arrived by car

The Ryerson report notes that only 19% of visitors arrived at the Danforth by private car, while 32% arrived by public transit, and 49% either walked or cycled. It also noted that even in peak shopping periods, 20% of spots remained empty and that 86% of non-drivers spent more than $100 compared to 69% of drivers, indicating non-drivers, were bigger spenders on average.

Similarly, the recent City of Toronto study of the King Street Pilot Project showed that sales along the stretch of King affected by the pilot projects increased after it was implemented. This suggests that changes to parking regulations that improve transit or cycling will not severely hurt local business and may in fact improve sales as backed up in other studies.

More recently, data from the study of 2.4km of permanent bike lanes on Bloor Street show that they had nearly1 million users between February 2018 and February 2019, a 56% increase with separated bike lanes. 90% of patrons of businesses in the Bloor-Annex area arrived at their destinations by walking, cycling or transit, and with bike lanes there was a 44% decrease in conflicts between road users.

More Data Available

The ability to examine card transactions by specific areas allows for more thorough examination of the claim that parking restrictions drive down sales. City of Toronto analyses of the volume of business sales along King Street before and after the pilot confirm earlier studies from Toronto and elsewhere that show that new transit or bike lanes that reduce access and parking for cars tends to improve street level commerce as opposed to hurting it as claimed by some local businesses.

In the case of the King Street pilot, retail receipts recently compiled (August 2018), using Moneris (a company that processes credit and debit transactions), demonstrated that the volume and value of sales continued to increase. The report said, specifically that “Customer spending climbed 0.3% beyond the yearly growth average in May and June”, which demonstrates that improving transit in dense urban neighborhoods, even at the expense of the private car, is good for business as well as transit riders.

11.6 Ride-Hailing's Effect on Ridership

Breaking down the Terms

The traditional split of private and public vehicles are breaking down with the arrival of electronic vehicle hailing technology. A blurring of distinctions between the types of services may create confusion.

Ride Hailing – hailing a ride from a private vehicle that is operating as a taxi or quasi-taxi service using an application (Uber, Lyft, Beck). This may involve sharing a vehicle (UberPool).

Ride-Sharing – sharing a private vehicle with a person or persons traveling to a destination, either for all or part of the trip, usually arranged through an Application

Carpooling – a more traditional form of ride-sharing, but limited to groups of people familiar with each other (work colleagues, neighbourhood children, sports team members, neighbours)

Transit on-demand – a publicly organized local area transit service (e.g. Dial-a-Van, RideCo) that serves customers as needed /requested

Flexible route transit – a publicly organized local area transit service that serves a standardized route but is able to deviate from the route based on customer demand (either directly to the bus driver, or through an application

Studies across North America have put the impact of ride-hailing and ride-sharing (mostly ride-hailing) on public transit at 1% to 2% of total ridership in cities with developed transportation systems, with much of that ridership loss outside of rush hour. Cumulative effects over 8 years in San Francisco showed a staggering 12.7% loss. In New York City, daily Uber and Lyft trips increased ten times between 2015 and 2018. The total decline in transit boardings, 580,000, was only slightly less than the increase in Uber and Lyft trips.

In a TTC context, this represents potentially around 5 to 10 million lost riders, and likely around $5 to $15 million in lost revenue depending on how the ridership changes affects Metropasses (where slight increases or decreases in rides taken do not affect revenue as long as the economies of the pass still make sense for the rider) sales.

Keeping in mind that providing additional rides in the peak is expensive, any rides shifted to ride-sharing would help the TTC cope with overcrowding during

the peak, in one sense, although increased traffic discussed below would likely offset any savings. Outside of rush hour when most of the ride-sharing trips occur, ride sharing-may eventually reduce demand and lead to the calls for service cuts to less-used transit lines.

Ride Hailing – Adding to Already Congested Streets

Previous studies have shown that between 20 to 30% of traffic in dense urban areas is attributable to ride-hailing apps. By slowing traffic down, ride-sharing may actually lead to poorer surface transit service and therefore reduced usage. It is unclear how the entire ride-share situation globally affects transit, as it is still too new a phenomenon.

Likewise, there is a serious equity issue with ride-hailing. This is especially true if it leads to reduced public transit for those who are unable to pay the higher ride-sharing costs that may end up on transit of reduced quality due to lower ridership and more traffic, both potentially caused by ride-hailing.

11.7 Low Income Pass

The City's Fair Fare Pass, originally approved in December 2016 is now in effect. It is currently open to those on Ontario Works (OW) and Ontario Disability Support Program (ODSP). The discounts include $1 off single rides (with PRESTO), ($2 cost instead of $3) and $30.75 off the $146.25 for a monthly pass (offered at $115.50), at a cost to the City of $46 million.

In the second phase of the plan, the Fair Fare Pass will be extended to those who receive child-care subsidies, and housing supports, and in the third, will include all residents whose household incomes are less than 115% of Toronto's Low-Income Cut-Off (LICO) as reported officially on income tax returns. The measure relies on Statistics Canada's LICO - 24,949 ($28,691 is 115% of LICO) income for one person, escalating up (there are rates for all family sizes) to $66,027 ($76,138 is 115% of LICO) for households of seven with additional sums for larger families.

Fair Fare Pass

Ultimately, the cost of fully implementing a pass for low-income Torontonians is expected to be around $48 million and affect up to 193,000 people by 2021, if fully implemented. However, it is unlikely that the program will enroll the full

number of people eligible. However, the $2 fare is likely to be used by a large number of eligible users.

Census data from 2016 indicates that 20% of Torontonians live on low incomes based on the Statistics Canada 2015 Low-Income Measure, after-tax definition.

Previous studies on the working poor in the Toronto Region have estimated the number of working poor in Toronto at 71,000 in 2006, or likely closer to 90,000 today. In addition, over the last decade an approximate average of 8.5% of the population has been on Ontario Works or ODSP; together these two groups make up close to 240,000 people. While this is a large number, the Ministry of Community and Social Service estimates that only 11% (or close to 27,000) of those on social assistance work and most of this is part-time employment.

The Metropass is currently calculated at just under 49 trips (at the $3 PRESTO fare), which means that most Metropass users have jobs working four to five days a week as there is an average of 21 work days a month and this equals 42 trips needed to get to/from work. With this math, those who do not hold a job requiring 4/five days a week travel would, in most cases, find the pass not to be cost-effective. This suggests that the likely population able to benefit from the reduced-cost Metropass is closer to 120,000, although a higher number of people with low-incomes may take advantage of the reduced-price single-use PRESTO fares.

It's not just the employment status that will determine the pass uptake level, but also the percentage of those eligible who would actually take advantage of the pass, as many people walk, cycle, work from home, share rides or are unable to provide the upfront cost even at the reduced price. Likewise, many people may choose to only use the reduction of the price of single rides to $2, as it requires less money upfront. TTC reports on the Post-Secondary Pass suggest that less than 50% of those eligible are taking advantage of it, despite the fact that it does not require income verification the way the low-income pass does.

While the same 50% rate noted above might apply to the low-income pass, (although this needs more post-implementation analysis) another way to make transit more affordable is to switch the PRESTO unlimited Metropass or weekly pass to a fare-capping system (combined with the reduced $2 fare), used on many systems where the person pays trip by trip until a maximum is reached. This eliminates the need to have the money in advance, which would likely increase ridership across the board, but would be especially attractive to low-income residents.

11.8 Mobility as a Service (MaaS)

Mobility as a Service (MaaS) is the integration of various forms of transport services into a single mobility service accessible on demand, usually on a mobile device through an app. The first city to pioneer this concept in a complete way on-line was Helsinki, which has seen the concept lead to a larger use of transit.

While a MaaS-like service is not yet functional in Toronto (the TTC has committed to studying it), it points the way to the transit future, where public transit remains the key player, with other transportation modes on offer for specialized circumstances.

The concept allows customers to pay one monthly (or other time period) price to access a suite of transportation options to meet their particular needs. The menu of transport options usually includes public transport, rideshare (like Uber/Lyft), carshare (like Zipcar, or Enterprise Carshare), bike-sharing (like Bixi) and sometimes taxi or car rental.

	Whim to Go	Whim Everyday	Whim Unlimited
Monthly payment	£0	£99	£349
Public transport	Pay per ride	Unlimited	Unlimited
Taxi	Pay per ride	Pay per ride	Unlimited
Car	Pay per ride	Max £49/day	Unlimited
Bike share	Coming soon!	Coming soon!	Coming soon!
Cancel anytime	✓	✓	✓
Signup possible	Now	April 5th	April 5th

Mobility-as-a-Service subscription options on the Whim (App. Source: Whim)

The service recognizes that while public transit, biking or walking may work for a large proportion of trips, most people need some access to other forms of transportation for longer trips, out of town travel, shopping excursions, the movement of larger goods, or multiple people travelling together.

For the user, MaaS offers the added value of making organizing transportation easier with a single payment and planning/booking platform, instead of multiple ticketing and payment operations and the need to go to various sites to compare modes and plan trips.

The Mobility-as-a-Service ecosystem of available trips and modes is usually linked to the user through a personal portable/mobile device. (Source: MaaS Global)

A successful MaaS service would also generate new business models for operating the various transport options. It would allow transport operators access to improved user and demand information, and provide new opportunities to serve unmet needs. The aim of the integrated platform of MaaS is to provide an alternative to the use of the private car that is just as convenient, cheaper, more sustainable, and as a result more likely to attract new users to more sustainable transportation options.

https://whimapp.com/

Mobility-as-a-Service and Personal Mobility Devices

Battery-electric buses may not yet be capable of meeting the operating needs of a transit agency like the TTC, but advances in battery technology have made it possible to build cheaper, lighter batteries which can be used to power light, electric bicycles and motorcycles, as well as electric versions of personal mobility devices like scooters and skateboards.

The increasing number of services offering electric bicycle sharing and scooter sharing (either alone or as part of a MaaS ecosystem) has created challenges for

municipal governments, because of issues like storage, reckless use, vandalism, and public safety.

11.9 Autonomous Vehicles

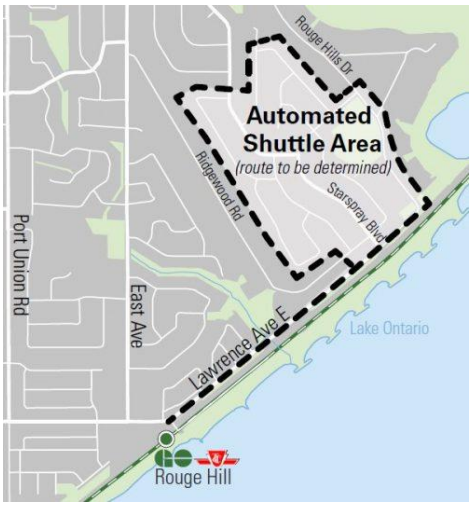
Autonomous buses and streetcars will have a transformational effect on transit and transportation, as we know it. Fully autonomous metros have been in operation since the 1980s, and have been shown to be safe and have the advantage of being able to offer more service because the lack of the need for operators keeps operating costs low.

While autonomous vehicles could make driving (or being driven in a car) more appealing (and as a result add to vehicle kilometres travelled, traffic volumes, and overall congestion), they will also lower the operating cost of transit, making it possible to increase service levels without large operating budget increases. Autonomous vehicles may also herald the merging of on-demand ride-sharing and traditional public transportation, raising many questions about oversight and who operates future mobility options.

The last decade has seen great advances in autonomous vehicle technology, and yet we are still close to ten years from cost-effective and widespread deployment of these “autonomous” vehicles, which at the first stages will still require a driver to be theoretically available to step in. Fully autonomous vehicles in standard service, with no driver on board, are still perhaps 15 to 20 years away, if not more.

Toronto`s first Autonomous Road Vehicle Trial

The City of Toronto, TTC, and Metrolinx are working together to study autonomous vehicles. Beginning in late 2020 there will be a 6-12 month pilot project which will see a zero-emissions electric autonomous shuttle service in the West Rouge community (at the east end of Toronto), connecting to the Rouge Hill GO station and TTC bus loop.



The proposed service area for Toronto`s first autonomous road vehicle trial. (Source: TTC)

Autonomous Vehicle Technology and Pending Changes to Mobility Patterns

Computer “vision” (using laser beams known as LiDar and optical scanners) has evolved to the point where it can assemble accurate 3-D maps of streetscapes; distinguish people, cars, and other objects on and near roadways. Using these 3-D maps, computers can and successfully quickly process this information to safely travel to destinations along public roadways. But weather and unpredictable urban situations are still posing challenges to full automation (no driver on board) that will limit its use for public transit in the foreseeable future.

Automation – A Continuum

There are five tiers of automation generally accepted by the industry, with many current car models possessing options like cruise control, parking assistance, collision detection, and automatic braking representing levels one and two on the five-point autonomous vehicle level scale. Today testing is occurring around the world on levels three and four, but these still legally require a driver on board.

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* (“system”) monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

The Five stages of Autonomous Vehicles. (Source: SAE International)

The transfer from primarily human to preliminary computer control begins at level three. Here, the vehicle's automatic system monitors the environment and drives according to the conditions, but it still requires human intervention in certain circumstances. It allows for consistent braking and acceleration, and collision anticipation and future bus purchases will likely incorporate elements of level three automation in the coming years.

It is only at level four (drone like operation of vehicles) or level five where a major transformation of transit service will occur, and buses and other fully autonomous vehicles will be capable of operating entirely without drivers. As wages represent over 85% of the Commission's operating budget, and the agency employs over 7,000 operators, level five autonomous vehicles could dramatically change the economics, by lowering costs and allowing for more service. It would also lead to the reduction in the need for operators, although a higher number of skilled technicians would be required.

Implications for the TTC

For the TTC, fully automated vehicles (level five) will bring big change…eventually. New technology (levels two and three) will improve the safety of transit operations in the short term and allow a greater focus on customer service, but according to most industry analysts, it will likely be 20 to 25 years before the technology cost-effectiveness and regulation (one without the other won't allow full roll out of autonomous vehicles) to advance to a point where there are driverless buses and streetcars with no TTC personnel onboard. Even then, the Commission may decide to make it policy that TTC personnel always staff TTC vehicles, especially larger vehicles.

While 20 to 25 years seems like a long time, it is within one and a half to two bus lifecycles (12 to 15 years), making the need to reconsider the progress of the technology every few years necessary as new vehicle orders are considered. This is especially true, since level four autonomous vehicles will likely be available sooner (likely in about half the time), and offer the opportunity to offer more service, likely more safely with less staff and fewer costs.

An Interim Step to Full Automation and more Service for the TTC

Level Four Automation assumes that while vehicles would no longer require human intervention in most situations, bad weather, challenging areas like construction zones or difficult roads may require remote driving by a person.

At this level of automation, drivers are replaced by fleet operators who remotely monitor a number of vehicles at the same time and take control as needed, similar to how drones are flown remotely by humans. In the event of multiple vehicles needing help at the same time (in excess of the number of available remote drivers), fail-safe “stop and stay” provisions are incorporated.

Predictions for level four buses and streetcars being commercially available and economically affordable are in the 2030 to 2035 window, so a bus purchased in 2019 may be operated into the timeframe when remotely driven buses are also commercially available. However, the Commission would likely move slowly in the transition to a major shift in how service is provided to make the change as smooth as possible for budgets, staff and passengers.

Fewer operators will reduce costs, but there may not be much overall savings since there will be a need for more skilled and therefore higher paid employees. As well, other priorities such as increases in customer service may reduce savings from possible staff reductions.

A good example of this is the current PRESTO rollout where automation reduced the need for Collectors and staff to do manual tasks (like transporting tokens), but it created a requirement for more technicians at higher wages. Despite the fact that PRESTO required fewer collectors, the public facing staff count did not decrease significantly because station attendants were deemed to be needed in their place, resulting in roughly the same number of positions and cost.

Compared to other systems the TTC has low numbers of staff per station and it felt that at least some TTC staff should be maintained at all stations for customer service and security purposes.

Likewise, the higher capital costs (and debt servicing costs associated with borrowing) of automated vehicles may offset a lot of the savings of level four vehicles at least initially. Over the last few decades as buses have included more complex technological components, their purchase price has risen at over double the cost of inflation, and maintenance costs have risen as more components (GPS, AC, etc.) need to be maintained. Likewise, substantial amounts of capital will be required for new IT systems and renovations to existing facilities in the event of the addition of level four (or higher) vehicles.

Autonomous Vehicles will Reshape Travel Spending

Where the TTC allocates spending will also change with autonomous vehicles. For example, with more autonomous vehicles on the street, safety will likely increase and accidents and injuries will diminish, leading to fewer collision claims. This will save the TTC money in one area, but more will have to be spent (at least initially) on training and changing the layout and configuration of all the transit facilities, both public ones and the maintenance facilities to accommodate the new operating realities of autonomous vehicles.

Changing Mobility Patterns, Changing Cities

The rise of new transportation technology in the public sphere is unlikely to undercut the need for transit along core lines, but may dramatically change the service delivery system and model in lower-density neighbourhoods. New electric bicycles and motorcycles are becoming competitive with cars for trips fewer than 4km in length, which could change demand patterns in neighbourhoods and transit station areas which traditionally catered to automobile traffic.

Questions about accessibility, design and public safety will increasingly arise as mobility patterns shift and vehicle autonomy increases.

Accessibility for an aging population, accessibility for people using medical mobility devices, and the ability of those with mobility difficulties to board vehicles without operators will become important issues. So will concerns about the public's sense of safety in a multi-passenger vehicle with no staff on board, and the need to ensure fare payment. Still, the ability to refocus operators on customer service activities is an exciting opportunity that needs to be explored and embraced by transit agencies and civic planners.

Implications for Transit from Autonomous Vehicles effects on Street Design, Parking and Road Capacity

Currently up to 30% of travel lane capacity is often lost due to design, different vehicle types (with different acceleration and braking patterns, visual sightlines, and safety expectations) and poor driving habits (reckless, careless, and aggressive driving, mismatched speeds, different vehicle sizes, inefficient breaking and acceleration, distraction, and poor driving skills).

When all or most cars are fully autonomous, driving and parking realities will change and street design may also see changes as a result of changing needs and users. As the vehicles will all be (presumably) linked and connected through data systems, and operate more predictably and consistently, road space can be more efficiently used. Less parking overall is expected to be needed, with the possibility of personal vehicles being sent `home` when not in use. Another possibility is the use of circling “pool” cars that are available for hire which would circle in between trips to avoid the need for parking.

As a result it may be theoretically possible to accommodate more vehicles and/or speed-up trip times. However improved efficiency could be offset by more overall traffic, as autonomous vehicles travel more kilometres instead of being parked..

Naturally, how the market evolves will shape how we embrace the future. If most autonomous cars are privately owned and service mostly only one person or family, parking will remain at similar levels, although the pressure to have the vehicle close at hand may diminish as the autonomous car will be able to drop off the passengers and go away to park. This could continue to cause traffic problems, since approximately a quarter of all traffic in busy downtown areas is currently a result of drivers looking for a parking spot.

Already, the reduced cost and ease of use of app-based ride-sharing services in major urban centers has led to more traffic, which has already further diminished the efficiency of surface transit.

Regardless of how the market for autonomous cars evolves, be it “shared use” or privately owned, there will likely be negative effects on traffic, and as a result surface transit operation. If the majority of people buy an autonomous car for private use and the current average of 1.1 people per car continues, combined with the possibility that people will respond to a less stressful drive (as they are not actually driving) by commuting more over longer distances or periods of time, we will likely see more overall traffic.

It is possible that this growth may be offset by the growing number of electric bicycles and motorcycles as well as personal mobility devices, which may allow people in urban areas to make local trips, and allow people in suburban areas to make local trips or access transit stations. However, this growth may come at the expense of transit services to these locations, as these vehicles may be able to replace transit trips for many people.

Conclusions

Overall, autonomous vehicles will offer transit agencies new opportunities and challenges to adapt to. While they will likely allow for more transit service to be offered and more efficient use of road space (less space taken up with on-street parking and better driving patterns) they will not necessarily reduce vehicle miles driven.

Any efficiencies from carpooling will likely be offset by latent demand for more travel given the attractiveness of being transported door-to-door without driving. As a result, autonomous vehicles are unlikely to reduce traffic volumes, meaning surface transit will continue to suffer whenever it is not separated from traffic in dedicated lanes.

11.10 Fare Evasion

Fare evasion is a sensitive issue in a city as Torontonians are equity-minded, there are many working poor and marginalized communities in the city, and the monthly transit costs can be a burden for those on limited incomes. Nonetheless, the failure to collect fares from all riders may be costing the TTC in the range of $40 to $60 million every year in lost revenue.

Traditionally fare evasion has been reported at 2%, but recently more detailed reviews, have put it in the 4% to 5% range, nearly double historical levels.

And while it is important to control fare evasion, the Commission took action several years ago to reduce operator assault, which averages two per day; one initiative was to encourage operators not to get into fair disputes.

Evading fares includes everything from paying with counterfeit tickets, tokens and Metropasses, expired transfers, or not paying the full fare – either by putting in less than required or by using a student or senior fare when it does not apply – or simply not paying a fare at all. The recently introduced free children fares (under 12) have increased fare evasion (there was always some use of cheaper children's tickets by youth, but the increased incentive of free transit has exacerbated the problem) among students as it is hard to determine and enforce the 12 year old limit as children are not required to carry ID and no one wants

heavy-handed enforcement. It has also shifted the subsidy from the school boards and other organizations (who used to pay for children's' tickets) to the TTC.

The fare evasion rate is calculated by auditing the fare box and comparing it to manual and automatic machine counts, as well as visual observations. Typically the rate of fare avoidance differs according to the time of day – rush hour has a lower rate – and route. The Presto system will make it easier to track ridership and get better data as well as mostly eliminate counterfeiting and short-changing of the fare box, but it will not eliminate other forms of fare evasion.

"Closed" systems where people must pass an operator or go through a turnstile generally have lower rates than ''open'' systems or "open" modes like "all-door loading", as would be expected.

An accurate fare evasion analysis must consider that not all of these riders who get on without paying or using an expired transfer would have paid. Some would simply not have boarded if they were unable to avoid paying a fare, therefore no revenue would have been collected.

In the past, counterfeit tickets, tokens and even Metropasses were an issue, and although it was possible to physically replicate the look of the Metropass or Presto card, the magnetic strip or chip have never been copied. As tickets, tokens and Metropasses are being phased out, there will be less counterfeiting, and soon this type of fare evasion will mostly be eliminated, with the exception of the use of counterfeit money and credit cards to buy passes.

As a higher percentage of fares are purchased with electronic media, the responsibility for detecting fraud will shift to financial institutions and credit card companies who oversee security for payment card.

Full electronic payment will stop most counterfeiting, but the other forms of fare evasion will continue, and recent moves towards all-door loading and new fare gates (which are easier to get around), will result in this continuing to be an issue.

Maintaining Integrity of Proof-of-Payment (POP) Systems

In systems (like GO) that have Proof-of-Payments along with all door-loading, efficient and effective inspections are needed to ensure that those considering fare evasion realize the risk of a $250-$450-plus fine far outweighs the

opportunity to save the cost of a fare. In order to maintain public confidence enforcement must take into consideration specific situations and avoid criminalizing poverty.

Full implementation of all-door loading on a large percentage of routes will require a significant force of Fare Enforcement officers to maintain the transit industry standard of inspecting one in 20 passengers. With over 500 million passenger trips on buses and streetcars a year, this would require around 25 million fare checks, and a great number of staff if fully implemented on all routes. This is why it is only likely to be instituted on heavily utilized routes where all-door boarding can significantly increase service quality.

Fare Evasion May Cost Upwards of $40 to $60 million yearly

It was estimated that 100 fare inspectors would be required to service streetcar routes when the move to all-door loading on streetcars is fully implemented. Streetcars carry about 15% of all trips on TTC or slightly over 250,000 trips per day.

These enforcement officers would have a cost in the order of $10 million, but if they are able to hold the line on fare evasion at the current 4% to 5% rate, they will pay for themselves in likely reductions in fare evasion. The difference in lost fare revenue between 4%-5% and 8%-9% (the rate that was observed on “all-door” loading in programs like POP on the Queen Street streetcar when no enforcement was in place that might be an indicator of a wider non-enforced all-door boarding) is around $35-45 million per year.

As noted, fare enforcement officers currently have a total incremental cost of around $100,000 per year. With current fare evasion estimated at 4%-5% and previous experience of all-door loading indicating that no enforcement leads to fare evasion rates of around double that, it’s clear a strategy needs to be in place when moving to all door loading.

Shifting fare enforcement to trained and equipped personnel is the right thing to do to stem loses to the Commission, protect workers, and ensure that rules are applied fairly and appropriately.

The new low-income pass if fully implemented would eliminate some of the concerns around affordability, and the problem that some people may attempt to avoid fares due to the financial burden the fare represents. In all cases, fare enforcement officers must have discretion in the issuing of fines, and a non-

criminal process should be prioritized to ensure that fare enforcement does not criminalize marginalized people, but allows the TTC to protect its fare revenue.

11.11 The U-Pass

A U-Pass program provides all full-time students in a school with a Metropass for the school year; at a discounted rate with the cost being included in the post-secondary fees a student pays each semester.

In Toronto's case the U-Pass is designed to be mostly revenue and cost neutral to the TTC. The plan makes participation mandatory for the student population on campuses where the U-Pass is supported by a referendum, and only a small number of exceptions are allowed for non-participation.

The discount is generated by making the U-Pass non-discretionary for students, guaranteeing a revenue stream for the TTC by way of students who pay for the pass but mainly use other means of transportation. These non-riders end up effectively subsidizing the cost of the pass and this is where the point of friction is sometimes created. The cost of new service (due to higher ridership) is also factored into the economic equation.

Most students would obviously benefit from the plan since approximately 760,000 monthly Metropasses were sold to post-secondary students in 2017, ranging from as high as 70,000 a month in the winter to 55,000 in the summer. The discount value of the current Post-Secondary Metropass is equal to around $17 million.

The proposed current cost of a U-Pass in Toronto is $70 per month (it would go up as general fares do) per eligible student.

The calculations that arrived at this price-tag are based on a number of factors, starting with the number of transit trips students actually take at particular school or groups of schools to determine what the current amount of fare revenue. This profile can be very different from campus to campus since in suburban campuses, more students may get to class by car, while in the downtown students are more likely to walk or cycle to school, or live on campus.

How students travel to school is important because if they don't depend on transit as much, the U-PASS may not be valued and therefore represent an unwanted cost.

The Transportation Tomorrow Survey (TTS) is a comprehensive travel survey conducted in the Greater Golden Horseshoe every 5 years through a partnership with the Provincial government and the University of Toronto. It surveys around 2% of the population with a detailed questionnaire and travel log. The information collected is used to create predictive travel models and help make informed decisions around transportation planning.

The models allow the TTC to accurately predict how ridership on proposed new routes or changes to existing routes will perform.

Calculation of the U-Pass Price

The Transportation Tomorrow Survey and the 2015 StudentMoveTO report estimated that the 110,000 full-time students at the University of Toronto – St. George, Ryerson University, OCAD University and George Brown College make approximately an average of 30 trips per student per month.

Today according to TTC reports, full-time students, without a U-Pass at the above-mentioned universities generate an estimated $7.3 million in revenues for the TTC per month during the fall and winter semesters – annually approximately $61.7 million. A U-Pass price of $65 monthly (the price at the time) would generate the same revenues as are currently generated by post-secondary students now riding the TTC and paying individually.

Trips by students to increase by 12% with a U-Pass

The experience of other Canadian transit agencies such as Ottawa, Victoria, St. Catherine's and Waterloo has shown around a 10-20% increase in ridership from U-Pass customers. Based on the above and experience from the introduction of other new pass models, the TTC estimated that transit trips by post-secondary students would likely increase by up to 15% with the introduction of the U-Pass.

That 15% spike, an estimated additional 4.5 trips per student per month, would mean an additional $4.7 million in fares collected annually if each ride was paid for. While the $4.7 million in new fares is also new revenue, it would require additional service and each new trip costs an average of about $1 in subsidies, although subsides for all riders are paid for from the City's budget.

The current cost of $70 includes $5 for additional service to cover the need for more service for the increase in ridership, bringing the total U-Pass price to $70

monthly. This would bring total revenue if all 110,000 students receive the pass to $66.4M.

It seems unusual for the added cost of new service to be borne by only students (as it isn't for other ridership growth) and generally service is increased as needed to accommodate ridership growth.

U-Pass: Mandatory Participation Becomes an Issue

The U-Pass policy does make some exceptions for students to opt-out of mandatory participation in a U-Pass program. This particularly relates to students for whom the program potentially imposes a burden due to personal circumstances or needs, such as their inability to utilize transit, either the conventional system or Wheel-Trans. The compulsory nature of the program could well violate protections under the Ontario Human Rights Code in such cases. In order to eliminate this potential burden, an opt-out provision was proposed to accommodate these students.

The mandatory nature of the pass has been controversial on campuses, with students voting to reject the pass twice in the last decade. While the number of students who would save money at each institution was enough to win a referendum in theory, the concern for fairness resulted in referendums going down to defeat by wide margins. Typically, students have been reluctant to force their fellow students to pay higher fees for transit they may not use, so despite a majority of students benefiting from the money-saving pass, referendums have in the past lost by substantial margins.

In November of 2018 students at Ryerson University voted 62% in favour of adopting a U-Pass (with a 43% voter turnout) for all undergraduate students, making them the first University to take advantage of this program.

In January 2019, the Ontario Government allowed students at colleges and universities to opt-out of paying fees for programs like the U-Pass, which would potentially have a significant impact on the funding available for programs like the U-Pass to continue.

11.12 Security

In customer surveys, security is always listed as one of the major issues for riders, although far from the top. Toronto police are officially responsible for security on the TTC, although the TTC has a small force of Special Constables

authorized by the Toronto Police Services Board with the powers of a “Peace Officer”.

Peace Officer status gives special constables many powers similar to a police officer on, or immediately adjacent to TTC property, and certainly more than security guards have. They can apprehend people on TTC property suspected of having committed a crime (whereas security guards must witness the crime directly to make an arrest) and may take someone into custody for their own protection under the Mental Health Act.

Crime on the TTC remains at levels similar or lower than across the city. All the entrances, and most of the public spaces in subway stations and TTC vehicles (with the exception of Bloor Danforth Trains), are covered by high definition security cameras that record events, but are mostly not monitored, except those on station platforms.

The TTC also has an internal investigations unit that works with Toronto Police and other law enforcement entities on larger investigations into internal fraud or counterfeit fare media. The TTC’s security leadership also regularly interacts with local, provincial and national police and security organizations around the prevention of terrorist acts. As a whole, there is less crime per capita on the TTC than there is generally in the city, meaning that while people are always concerned about security, the TTC is a very safe system.

12.TRANSIT’S IMPACT ON THE ECONOMY

Transit is not just a sustainable way of getting around town; it’s also a way of reorganizing a city so that it’s able to foster enterprise, dynamism, and the generation of higher living standards for all. All transit dollars are doing double shift, both providing mobility, and adding clear value to communities. This occurs on many levels, direct and tangible or subtle and sometimes unrecognized.

For starters, well-planned and executed transit, particularly higher capacity transit, encourages densification, the key to generating retail, street life, and sociability, and the kind of quality of life that attracts creative people from elsewhere, and fosters new ways of thinking, doing commerce, and ultimately creating wealth.

Further, it lessens the use of the private car, which clogs streets to the detriment

of the free movement of inputs to production and finished goods to market. It also allows residents to seek job possibilities far from their own neighborhoods, and employers to recruit from a larger geographic pool. Good transit, on top of all that, is an instrument for inclusivity, allowing seniors to age in their communities, and making the City more welcoming to those with mobility challenges, or low incomes.

Public transit is wealth-creating

Beyond the basic benefits of transit, there is also the hard-core contribution of big-dollar transit spending to Toronto's economic life. Besides the operation of the system itself, which requires thousands of permanent jobs – all of which contribute to tax revenues – there is the enormous value of spin-offs and in-direct employment generated by expenditures on transit infrastructure. The bottom line is that every dollar spent by transit agencies results in four times the economic value, as the calculations discussed below demonstrate.

There is certainly a consensus regarding the positive economic benefits of more infrastructure spending, and the case for investing in this way has never been more powerful. In the short term, these expenditures support jobs and business, feed economic growth, increase business competitiveness and wealth-creation, and generate higher living standards in the long-term.

12.1 Economic Impact of Transit Spending

A recent study by the American Public Transportation Association (APTA), called the Economic *Impact of Public Transportation Investment*, estimated that a total

The APTA study divided the jobs created into three distinct subcategories:

Direct Jobs: account for all jobs generated directly from the project's spending and construction. Such roles include contractors, utilities, and other roles specifically created due to the project

Indirect Jobs: accounts for all jobs that are deemed "supporting" to the project. Such roles include the creation of inputs (steelworkers, car manufactures, etc.) and other associated jobs.

Induced Jobs: accounts for all jobs that are produced due to the economic activity surrounding the project. Roles such as jobs at cafes surrounding the construction site or jobs that are supported by the wages of those directly and indirectly involved in the project are included

of 11,710 job years would be created for every $1 billion (2018$) in capital spending, and 17,789 jobs for every $1 billion (2018$) in operational spending.

The table below shows the estimated breakdown of these roles:

Job Creation Impacts Per $1 billion in Public Transit Spending (2018$)					
Capital Spending			**Operational Spending**		
APTA Study Escalated to	**2018**	**$1,000,000,000**	APTA Study Escalated To	**2018**	**$1,000,000,000**
Direct	4,278		Direct	9,602	
Indirect	3,109		Indirect	1,574	
Induced	4,324		Induced	6,613	
Total Jobs	**11,710**		**Total Jobs**	**17,789**	

Similarly, a Conference Board of Canada report undertook a detailed examination of the impacts of infrastructure spending on job creation in the country, and found that every $1 billion (2018$) in spending resulted in around 14,720 job years of employment. The difference with the APTA numbers is that the Conference Board report averages operational and capital spending, whereas the APTA models breaks them out separately.

Spending on transit operations results in higher job-creation numbers, especially locally, because it encompasses all aspects of the running and functioning of a public transit system including management, maintenance, operating vehicles, etc. These roles – many of which are labor intensive and 100% local - are also ongoing, as compared to capital spending-based jobs that have a wider geographic base, and don't necessarily benefit just a city, but also a province or even the country as a whole.

Job Years
As there are a myriad of skills involved in a transit construction project, the number of jobs is expressed as full-time equivalent years or job years since few people are likely to work on the project from inception to completion. The number of hours of the various required tasks are added up and divided by the number of hours in a work year – about 1840 – to give the number of "years" worth of employment.

Specifically, investments that are attached to the inputs of production (rails, pipes, specialized machinery), for example, would not likely be produced locally.

GDP Growth – Fueled by Transit Investments

Smart investments in transit infrastructure have been found to have a very strong correlation with positive GDP growth. Depending on the exact nature of the investment, the multiplier effect (as money moves through the economy is "spent" multiply times, therefore creating more impact than the initial sum) ranges from 1.14 to a high of 1.78, while the Government of Canada, estimates the average at 1.6. This means that every dollar spent on public infrastructure increases GDP by dramatically more than the investment made through such means as the purchase of goods and services by those employed in the transit sector, which keeps the economic wheel turning, generating more jobs. Overall, the construction of public infrastructure has an immense social dividend, more so than for most other capital investments, if the projects are well planned and well implemented.

Looked at it from the negative, inadequate infrastructure results in increased costs for business, leading to lower returns on investment and reduced profit. This means less capital for reinvestment in machinery and technology, and reduced job creation, production, economic output and growth in personal incomes. Without ongoing sustained investment in transit infrastructure, the arguments are strong that economic development slows and general prosperity declines.

Infrastructure makes the economy competitive

While there is often substantial discussion about the use of infrastructure as an economic stimulus tool, the most important economic benefit of public infrastructure is its long-term effect on Canadian labour productivity and business competiveness, important elements of a modern, growing economy.

The higher tax revenue that investment in public infrastructure brings with it allows the government to recoup part of the investment almost right away, and to finance debt associated with infrastructure on a long-term basis. Indeed, the Conference Board estimates that governments recover between 30-35% of their investments through higher tax revenue.

Using Government Accounting to Get Infrastructure Built

If the provincial government owns the asset directly it can often account for it over as many as 30-40 years (or the life of the asset, i.e. a bus has a typical 12-year lifespan, so only 1/12th of the value of the bus appears in the budget every year. This can have a big impact, if for example the government commits to spend a billion dollars on a subway (for example) only $25 million would appear in the financial statements per year.

1% of the Capital Construction Cost is Needed to Maintain Assets

Although Canada has acceptable public infrastructure in place, it is aging, while our population and cities are growing, and the global economy becomes more competitive. To respond to these challenges, our governments and municipalities must maintain, renew and replace their existing infrastructure, while also building new infrastructure needed for a growing population and economy.

Typically maintaining a piece of infrastructure costs an average of 1% per year of its cost of construction (or “Book Value”) to maintain, such that a $1 billion subway would cost an average $10 million a year to maintain over its 40-year lifespan. However most of that money will need to be spent in the second half of the 40 years as the asset ages and less at the beginning when it is relatively new.

Applying Standard Economic Models to Toronto’s Situation

While there are slight differences between the U.S. and Canadian labour markets, they are not so different that a comparison cannot be made. Using the job-creation formulas the $700 million plus subsidy the City gives to the TTC can be calculated to produce around 12,600 jobs directly and indirectly. Further, the entire TTC operating budget supports around 32,300 jobs using the same calculation method, and total Toronto area transit spending in general would produce much more once the other transit agencies like GO were factored in.

Using other multipliers in the APTA (American Public Transit Association) report (“Economic Impact of Public Transportation Investment”), each billion invested in transit operations is estimated to produce $1.8 billion in salaries, and $2 billion in GDP.

Applying these numbers to a Toronto context the TTC budget generates around $3.25 billion directly and indirectly in salaries to the economy, and approximately

$3.6 billion in GDP growth. And this is apart from the jobs generated by surplus personal savings accrued through transit use, and the forgoing of car ownership, or from the benefits of transit's easy movement of people and goods around the region.

With billions being promised by the provincial government for further transit capital investments in the GTA to build subways as well as buying new transit vehicles, LRT, BRT and GO transit capacity, transit investment is slated to create and sustain upwards of 60,000 jobs per year. More than two thirds of them will be created locally, generating over $7 billion in wages, hundreds of millions in tax revenue, and $8 billion in added GDP.

By putting this all together, one can grasp the immensity of the transit premium. If one factors in direct investment, the indirect spin-offs and associated benefits like reduced commuting costs, and the higher local spending capacity, it turns out that for every $1 communities invest in public transportation, approximately $4 is generated in economic returns (following the APTA model). This means that the combined TTC capital and operating budgets of $3.2 billion create $12.8 billion worth of economic rewards a year.

12.2 Government Tax Revenue from Public Transit Investments

The *Economic Impact of Public Transportation Investment* study by APTA (American Public Transit Association) estimated the income tax revenue for governments per $1 billion spent on transit capital projects and operations in various jurisdictions to be around 4% of the total or $40 million, excluding the additional economic activity that generates added tax revenue. When the report examined total tax, revenues generated per billion expended on transit capital projects, including spin-offs, the estimates were around 40%-45%, meaning the government directly recouped about $400 to $450 million on every billion spent on transit.

While the income tax levels are different in Ontario and Canada than they are in the US generally, they are broadly comparable to those in the higher tax jurisdictions of California and New York, examined in the study. With this measure, the $3.2 billion in annual TTC spending generated around $1.4 billion million in income tax revenue, alone, for the provincial and federal governments.

12.3. Freeing Up Money Spent on Personal Vehicles

Reliable public transit works wonders for local economic development. Importantly, transit provides an alternative to car ownership and frees up money spent on car purchase, ownership, and operation that can then be diverted to other more stimulating sections of the local economy. The Montreal Board of Trade's 2010 report, *Public Transit: At the Heart of Montreal's Economic Development*, noted that even though half of households owned cars, using transit saved residents of that city $826 million a year (close to $950 million in 2018 dollars) – money they mostly invested back into the local economy through purchases of goods and services.

Using the Montreal Board of Trade model for Toronto, but factoring in inflation, and the fact that our city has 60% more people than Montreal, as well as a higher per capita GDP ($59,779 for Toronto verses $50,762 for Montreal), one can estimate that transit saved Toronto residents $1.7 billion in 2018. The more Torontonians that use our transit vehicles as opposed to making those trips in private cars, the more money gets pumped into the local economy via shopping, investing in a bigger house/condo, eating out, or buying services, all of which create local jobs.

Giving up the Car Pumps the Economy

The Montreal report notes that the extra cash liberated for personal expenditures through avoiding car ownership or reduced car use has an impact on job creation that is about 20% greater than expenditures on cars. So while a small amount of expenditures on cars goes to local car dealers, local car-servicing centres and gas stations, most of the money spent on cars leaves the city.

Unlike Montreal, Toronto, or rather its outskirts, has an active auto sector – but the fact remains that a large percentage of cars purchased in the GTA are not made in Ontario (even partially), and are currently run on non-Ontario produced fuel.

The average transportation cost for a car-less family of two working adults with one to two children is approximately $5,000 per year. This accounts for the cost of two yearly TTC passes ($1600 a year) plus another $150 a month on taxis, car sharing, youth transit charges and cycling/bike-share costs.

The Canadian Automobile Association puts the average cost of a compact car at around $9,500, meaning that relying on public transit combined with other mobility options represents a family cost saving of well over $4,000-$5,000 per year after tax, or over $5,000 to $6,000 on pre-tax income.

Here's another way of thinking about the cost differential: the average cost of traveling one person-kilometre by car in Canada is 46¢, and only 12¢ for transit. This, according to Canadian Urban Transit Association calculations, puts the annual savings at $2,495 for every transit-riding Torontonian.

12.4 Transit's Effect on Real Estate And Housing

Real estate sales confirm what homeowners have long known – proximity to transit is one of many factors that make houses more valuable in the marketplace. The construction of new rapid transit routes in a neighborhood will increase home values, and by the same logic, transit construction encourages additional housing to be built along impacted routes, generating new taxes for the city.

Studies have looked at the number of jobs created by housing construction and while there are differences in methodology, there seems to be a consensus that each unit can be credited with the creation of 1.5 to 2 job years of employment in the construction of the average condo, apartment, or 500 square feet of commercial space. On top of that, 0.25 to 0.50 permanent ongoing jobs are created post-construction in the servicing of each unit or employee for commercial spaces.

While not all construction can be tied to transit, the fact that most of the new housing and commercial development in Toronto is close to rapid transit lines is no coincidence, based on public statements from developers about where the demand is highest.

The new transit investments in Toronto over the past decades and today help to ensure that the tens of thousands of residential units and millions of square feet of commercial development built each year will continue. It's clear that transit is key to helping sustain a construction industry that employees upwards of 100,000 people in the City of Toronto alone, and as many as 250,000 more across the GTA. These numbers do not factor in the additional indirect and

induced jobs created by the economic activity generated by new residents' spending money in the local area.

In this way, transit expansion generates a higher tax base for the city and more investment income for the residents.

12.5 Downtown – Density Created by Transit

Transit is responsible for driving residential and commercial development in the downtown core and creating one of the continent's largest areas of wealth creation.

According to the City of Toronto, the population of the downtown is growing at a rate of 10,000 people a year, and the population is expected to reach 475,000 residents in 2041 up from just over 250,000 today.

It is the expansion of public transit over the last 50 years that has allowed the numbers of jobs in the downtown core to increase by hundreds of thousands, despite there being fewer parking spots today than in the 1970's, and the fact that road capacity has essentially remained unchanged.

Each work day, just under 600,000 people come to the core to study, work or play and more than 60% of them are carried by transit, either by GO Transit (250,000-plus riders a day, 95% of which pass through Union Station) or by the TTC's network of buses, streetcars, and subways that bring hundreds of thousands to the city centre. In addition, of the hundreds of thousands of downtown residents, 47% walk or cycle to work, 32% take transit and only 22% use a car.

Without transit, Toronto's downtown would not exist, as we know it. Transit capacity replaces over 50 lanes of highways, and without it, there would be no way to bring workers into the city centre, or to provide parking for hundreds of thousands of cars that would be required

The core of Toronto is key both to the region and the province, and provides 25% of the City's tax base. Moreover, it generates 51% of the city's GDP, is the focus of more than a third of residential development applications, and is the seat of just less than half of the city's commercial development.

Without the core, built with the support of transit, Toronto would be a very different and less prosperous city.

13. TRANSIT: THE ENVIRONMENT AND HEALTH

While most of us think about the direct mobility and economic benefits of transit, public transportation usage offers a number of other tangible pluses to city dwellers, like improved health incomes, environmental supports, and fewer traffic accidents.

13.1 Greenhouse Gas Emissions

Transportation is responsible for around 40% of our carbon emissions in Toronto. With the average private car carrying just 1.1 people, transit emits far less GHGs per person and per kilometer traveled. Rail transit produces on average 60% fewer greenhouse gas emissions per passenger kilometres than the average car, while bus transit provides over 30% less GHGs (Transit's Role in Environmental Sustainability – www.transit.dot.gov) emissions.
With the average TTC transit trip in Toronto around 6 kilometres, most transit trips save over 4.5kg of greenhouse gas emissions relative to those made in a private vehicle.

When these numbers are scaled up and applied to the full TTC ridership, transit in Toronto can be credited with the saving of around 2.5 billion metric tons of GHG gas emissions every year.

13.2 Better Air, Better Health

There have been numerous studies showing that public transportation usage improves health outcomes. As previously discussed, increased use of transit leads to fewer greenhouse gas emissions; beyond that, it reduces car travel and hence the harmful, fine particulate matter (e.g. $PM_{2.5}$) in the air (generated by vehicle emissions and particles from tire wear) that causes and exacerbates breathing conditions such as bronchitis and asthma. Every year, according to government

studies, respiratory illnesses cost the government hundreds of millions in healthcare costs, and at least that much is lost to productivity due to missed days of work, not to mention hundreds of thousands of school days lost.

In 2012, the City released its Road to Health Report, which discussed the role of sustainable transit in cutting deaths in the city, and contributing to improved health for Toronto residents according to the report:

> ***"Increased levels of walking and cycling to work were estimated to prevent about 120 deaths each year. Public transit not only reduces vehicle emissions that contribute to a range of adverse health outcomes, but people using public transit also tend to walk more in order to get to and from the public transit network, and to transfer between routes.*** **"City of Toronto Public Health**

The 2012 report estimated the savings from the prevented deaths to range "from $130 million (close to $148 million in 2018$) to $478 million ($546 million in 2018$) depending on how deaths are valued. Savings in direct medical costs arising from residents staying active by walking and cycling are estimated to provide a further economic benefit of $110 to $160 million per year in savings.

Transit Helps to Tackle Obesity and Improve Health Outcomes

With 40% of Torontonians overweight (22% of children), getting people walking, even to and from transit, can help improve health outcomes.

A 2010 study led by Dr. Kristiann Heesch (Physical Activity, Walking, and Quality of Life in Women) found that every kilometre walked per day was associated with a 4.8% reduction in obesity and that walking was as effective as other forms of physical activity in reducing anxiety and depression, an important finding given the current focus on mental health.

With most transit riders walking at least 1 kilometre daily, there is a direct connection between public transit use and better personal fitness levels and as a result better health.

Across Canada, physical inactivity is estimated to cost $3.7 billion in economic productivity loss, due to its role in coronary artery disease, stroke, hypertension, colon cancer, breast cancer, type II diabetes and osteoporosis. Together, inactivity and obesity are estimated to account for $6.4 billion nationally (about $600 million for Toronto alone) in lost economic output due to short- and long-term disability

and premature death according to the 2004 study by Dr. Peter Katzmarzyk and Ian Janssen entitled The Economic Costs Associated with Physical Inactivity and Obesity in Canada.

Transit users have a more active commute, including simply walking to and from the transit stations, and that alone has been shown to reduce a rider's Body Mass Index (BMI).

13.3 Transit's Role in Improving Traffic Safety

Cities with higher per capita transit passenger kilometres have consistently seen lower levels of traffic fatalities. In Toronto, motor vehicle collisions resulted in over 18,000 injuries and upwards of 50 deaths a year, despite the efforts of the Vision Zero campaign.

Transit is safer for both passengers and pedestrians, to the point where transit riders have been shown to be 90% less likely to be involved in a crash when using public transportation.

Automobile accidents have large-scale economic impacts on a community. According to government studies car accidents may account for about 1% of the GDP of a city, according to insurance industry studies, which in Toronto's case would amount to a $1-$1.5 billion-dollar impact. When additional costs including loss of work productivity, disability payments, and other costs are included, total social costs are projected to be greater than $4 billion for the City's economy.

Put together, there is a strong case that increases in transit use would increase productivity and reduce the amount of resources required for our healthcare system, both due to encouraging healthy lifestyle and in preventing injuries from accidents.

While the large majority of these costs would be recovered by the local economy (local mechanics fixing cars, local hospitals tending to the injured, etc.), these expenses can be reduced or prevented, and the money diverted to other optimal areas – food, entertainment, and other services, through further dependence on public transit.

14. DELIVERING TORONTO'S TRANSIT CAPITAL PROJECTS

This section briefly discusses procurement methods and delivery methods the new lines that are under construction or have advanced to the procurement stage.

Breaking down the Terms

Many different types of Public-Private Partnerships exist. Some of the descriptive terms are shown below:

Build-Operate-Transfer – The public entity or private entity is responsible for the design of the project. The private entity is responsible for building and operating the infrastructure while the public entity owns the infrastructure. When the concession agreement ends, the operating contract will be transferred back to the public entity.

Build-Own-Operate-Transfer – The public or private entity is responsible for the design of the project. The private entity is responsible for building and operating the infrastructure and owns the infrastructure. At the end of the concession agreement, the operating contract and ownership will be transferred back to the public entity.

Design-Build-Finance-Operate-Maintain – The private entity is responsible for the majority of the design of the project, financing the project, and building, operating, and maintaining the infrastructure. The public agency owns the infrastructure. At the end of the concession agreement, the operating and maintenance contracts will be transferred back to the public entity. (Example: Hurontario LRT, Waterloo LRT)

Design-Build-Finance-Maintain – The private entity is responsible for the majority of the design of the project, financing the project, and building and maintaining the infrastructure. The public agency owns the infrastructure. At the end of the concession agreement, the maintenance contracts will be transferred back to the public entity. (Example: Crosstown LRT, Finch West LRT)

Design-Build-Finance – The private entity is responsible for the majority of the design of the project, financing the project, and building the infrastructure. The public agency owns, operates and maintains the infrastructure. (Example: TTC subway extensions)

14.1 Public-Private-Partnerships

Traditionally public infrastructure projects were delivered by a process called Design-Bid-Build (DBB) that involves the government entity designing (often by separate outside private consultants) the project and then bidding each component separately, coordinating the entire project and making sure that all the contractors' components came together at the right time and in the correct fashion. In this method the public sector takes full responsibility for all the budget and schedule risks.

Due to the complexity of large infrastructure projects, they have often not come in on budget or on-time, leading to public frustration and political pressure to find better ways of delivering projects and other solutions. Over the last few decades, new forms of project design, financing and delivery were defined under terms commonly described as Alternative Financing and Procurement (AFP), which include various forms of Public-Private-Partnerships (P3).

In a P3, government partners with a private entity to build a project and share the risks and responsibilities. In many cases the private entity operates, maintains and finances part of the construction.

The P3 Rationale

The rationale for using P3's are usually either that the government doesn't have the specific expertise or capacity to deliver the project and/or that the combining of design, construction and operations can help ensure a higher quality project as the designer and constructor must commit to operating what they build. Also by involving a large private sector consortium early on that is able to bring a large set of diverse resources to the project, more elements of innovation are typically generated.

P3s: Potential Financing Vehicle – Not a Funding Source

One thing P3s are not is a funding vehicle as the government usually pays all the costs of construction and covers any financing charges through ongoing "availability payments" which are payments made at scheduled intervals throughout the life of the project.

In a North American context, most of the construction costs are financed directly by government with payments being made at project mile-stones (for example, at

the start of the project, completion of various levels of design, start of construction, etc.) and the private entities take an equity stake (usually in the 5% to 15% range) which is paid back over the length of the contract with interest. In some cases, there are user fees (like tolls or payments for utilities) that help cover the operating costs, but only in rare cases in OECD countries (none exist in the transport sector in North America) do they cover all the operating costs (even rarer for them to recoup capital construction costs) and therefore ongoing government paid "availability payments" are required for P3s.

The level of equity contribution is usually set at a level that allows it to act as a sort of performance bond, but low enough to avoid significant additional interest costs to the government funders. In a North American context, the public sector can borrow more cheaply than the private sector partners and as such payments typically start during construction to limit the financing costs.

On Budget and On Time?

Governments have also warmed to P3s to guarantee "on-budget and on-time" performance. On this last point, "on-budget and on-time" doesn't mean that it will necessary cost less or take less time, but only that the amount and schedule bid by the private contractors will be more likely to be met due to penalties (or bonuses) that incentivize the private contractors (more so than in traditional procurements) to take specific actions to mitigate delays. Also by putting all the elements of the project to together in one contract, it is assumed that the individual entities will have specific incentives to work together to improve project delivery and cut costs as they stand to financially benefit from any savings, although they must also weigh the long term costs (if operations are included) of their decisions.

In an Ontario context, P3 have not, according to analysis by the Province's Auditor General, resulted in lower costs delivery. In fact, the Auditor General found that in the small number of LRTs being built with a P3 structure, that over $450 million in additional costs, over traditional construction methods, were incurred. Often these increased costs are associated with the inability of the public sector to make decisions at early design stages and stick to these decisions as projects evolve. Change orders are often very expensive in a P3 structure unless the agreement is specifically structured to allow this.

One challenge for governments wanting to move quickly to get "shovels in the ground" is the fact that P3s take longer to start as the procurement is longer and the legal negotiations are time-consuming. However, over the life of the project they tend to make up that time with more efficient implementation of the construction processes.

First Step: Value for Money Analysis

When considering whether a P3 is the appropriate delivery option for a transit project, a thorough "Value for Money" analysis should consider and analyze all the quantitative and qualitative factors that may recommend (or not) a P3 from a financial and organizational perspective.

P3 Experience in Ontario with Transit Projects

Infrastructure Ontario has an impressive record of delivering P3 projects "on-time and on-budget" with over 200 projects underway or completed. Most of these projects are standalone buildings like schools and hospitals that are a relatively easy construction process compared to longer projects like LRT or other rapid transit modes.

There are six active LRT projects that have used P3 procurement (with some additional extensions possible), shown below:

Project	Type	Contract Awarded	Construction Start	Anticipated Completion	Current Status
Eglinton-Crosstown LRT	DBFM	November 2015	2016	2020	Construction, complete in 2021
Waterloo Region LRT	DBFOM	March 2014	2014	2018	Operating as of June 21, 2019
Ottawa Confederation Line LRT	DBFOM	December 2012	2013	2018	Operating as of September 14, 2019
Finch West LRT	DBFM	May 2018	2019	2023	Construction beginning in 2019

Hurontario LRT	DBFOM	August 2019	2019	2023	Construction beginning in 2019
Hamilton LRT	DBFOM	In RFP	2020 (anticipated)	2024	In RFP

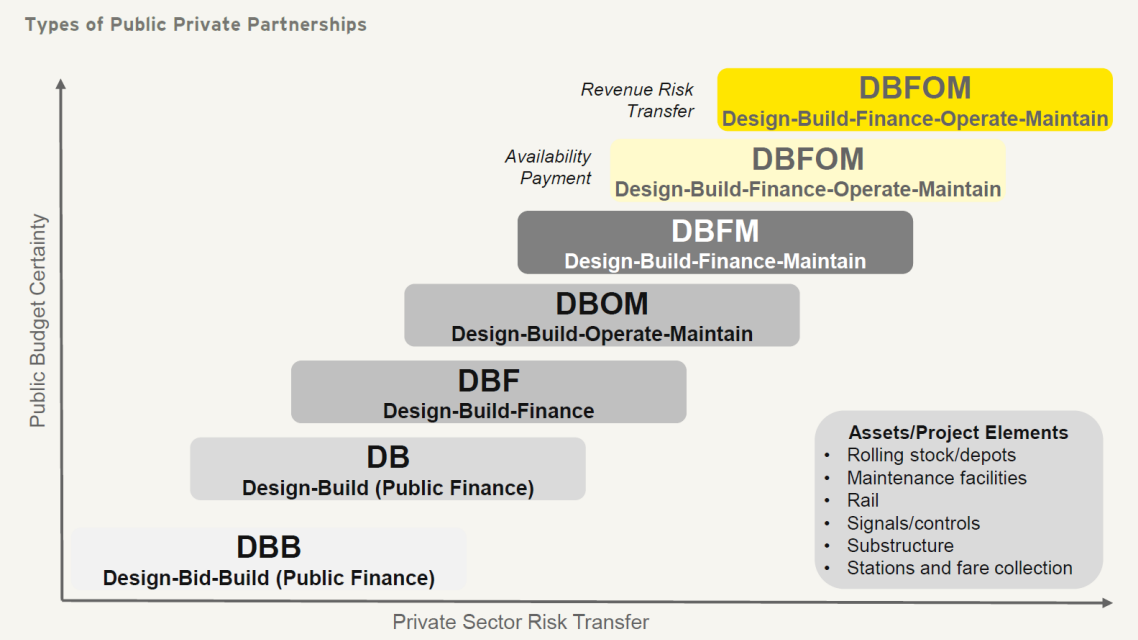
Other LRT lines envisioned for Toronto (Waterfront LRT, Jane LRT, Don Mills LRT) will likely involve P3 agreements. Meanwhile the Bus Rapid Transit projects currently operating in the Greater Toronto Area (Mississauga Transitway and York Region viva rapidways) were built in more traditional design-bid-build agreements.

The Waterloo LRT, Ottawa's LRT and the Eglinton LRT will each be delayed by 1-2 years, meaning they were not delivered on-time. Recently announced litigation between the Crossrail consortium building the Eglinton LRT and the Government of Ontario over costs suggests (along with other claims against the government for controllable delays coming from the Ottawa and Waterloo LRT projects) that transit P3s may struggle to come in on budget due to many extenuating circumstances.

With only two of these projects in operation, a final evaluation is hard to do at this point. Even on completion, a full evaluation might take upwards of 10 years as they all contain various operating and/or maintenance provisions that can in many cases have very large multi-billion values as the terms stretch over many years. With so much of the total value of the contracts tied to operations, a full operation and financial evaluation will need to wait.

One of the big advantages of the use of P3s is transferring risk, but if not done right, it can lead to court cases and higher costs for the project sponsors, as is happening in Ontario currently. The cost of risk, often represented by contingency funds in projects is evaluated based on likelihood to occur and in the case of P3s are priced with a risk premium. The risk of a particular element in a project should rest with the entity (public or private) that actually controls the factor. The less control or understanding a private entity has over controlling a factor (say like utility relocation of public utilities) the more it will set aside in contingency funds, which will drive up the cost of the project, especially if the public entity is better able to manage the risk. While projects are bid competitively, most large consortiums will have a common understanding of the risk, meaning that competitive factors won't solve poorly assigned risk. This is often one of the keys to good P3 design. Lessons learned from these first wave

P3s in Ontario and others in the US will hopefully allow the process to be improved.



Types of Public Private Partnerships, showing the different levels of public certainty and risk transfer. (Source: Wikimedia Commons)

Many common concerns that lead to opposition to privatization may be addressed by choosing a delivery method that maintains public oversight, ownership and in some cases operations.

The traditional assumed trade-off of reduced public control, potential less design excellence in exchange for “on-time”/” on-budget” accepts the principle that there may in fact be higher overall costs once efficiencies are balanced against profit margins and higher borrowing costs of P3 consortiums. In Ontario none of the transit projects have been completed and the operations portions of the contracts tested, so the value of P3s in Ontario remains an open question.

While P3 structures may in certain circumstances be a prudent delivery model, their use for extending an existing line is much more difficult as the interactions between the new and old infrastructure make the contract more complex.

14.2 Community Benefit Agreements (CBA) and Project Labour Agreements (PLA)

Community Benefits Agreements (CBA)

Most large capital projects in the GTA now develop a Community Benefits Agreement (CBA) to ensure that local communities are able to benefit from the direct capital investments through employment opportunities with contractors building components of the line as well as employment in the operations of the line. Likewise, CBAs might also include investments in local infrastructure like upgrades to parks and schools or other pieces of community infrastructure, especially in a case where a piece of transportation goes through a community (like commuter rail) but does not necessarily stop or service the area.

CBAs set out the specific contributions that a transit project must make to the communities it will run through. They can include targets for local hiring or targets for other marginalized groups. They often include target training programs and investments for new community infrastructure. Over the last decade these have become standard for many large transit projects in the Toronto area, although they have been used elsewhere for a long time.

Many of the jobs require specific training and journeyman licenses for skilled professions. Successful community benefit agreements also create a pipeline for residents from training directly into apprenticeships and jobs. In some cases, the entities administering the Community Benefit Agreement work with local groups to help ensure that local residents have the educational attainment necessary to be accepted into training programs that also helps to further engage marginalized communities.

Project Labor Agreement (PLA)

Large public and private infrastructure projects typically use Project Labour Agreements that guarantee wage rates and the use of unionized labour in exchange for “No Strike” clauses.

A Project Labor Agreement is a contract that is signed by the project owner with the unions whose members will be integral to building any large capital project in Ontario. It sets the prevailing wages for workers on the project, typically, at around industry standards in exchange for a no-strike agreement.

Due to the nature of large public transit projects, many skilled trades will be involved and typically these skilled trades require specific journeyman licenses who are represented in almost all cases by specific unions and governed by different sectorial labour agreements.

Large public and privately funded projects use these agreements because work stoppages among any of the skilled trade groups involved can bring the entire project to a stop and inflict large cost increase and schedule risk that PLAs avoid.

14.3 New Transit Lines - Procured and Underway

The following section briefly outlines some of the major transit expansion projects taking place in Toronto. Other capital expansion projects (like new signalling systems) are discussed in other chapters.

It should be noted that the lines identified in section 14.3 and 14.4 are based on plans and proposals approved by Toronto City Council, but currently, only two lines are under construction and there are ongoing discussions about the other projects.

This report aims to provide information that is as up-to-date as possible, but the authors acknowledge that decisions may be made which will change proposals and plans.

A. Eglinton Crosstown LRT

The Eglinton Crosstown LRT line will run across northern Toronto. Originally a City of Toronto proposal, it is now an Infrastructure Ontario+Metrolinx P3 project. **Metrolinx has contracted with a private consortium called Crosslinx in a (DBFM - Design Build Finance Maintain) P3 delivery model.**

The Eglinton Crosstown LRT project map. (Source: Crosslinx)

Construction is currently well underway on the 19-kilometre light rail line across Toronto's midtown, which will run from Kennedy station in the east to Jane Street in the west. The central 10-kilometre portion will run underground similar to a subway, while the eastern portion will run at street level, with tunnel sections at Don Mills station and Kennedy Station. Construction of the central tunnel started in 2016 and construction of the surface section in 2019.

There has recently been a reassessment of the timelines and the line is now expected to open one to two years late, in 2021 or 2022.

Project Cost	$9.1 billion
Length	19km
Stops/Stations	25
Ridership per hour (AM peak hour per direction)	6,000 per hour
Per day/Per Year	200,000 per day or 59 million riders/year
Completion Date	2021 (more likely 2022)

B. Finch West LRT

The Finch West LRT line will run across northern Toronto. Originally a City of Toronto proposal, it is now an Infrastructure Ontario+Metrolinx P3 project. **Metrolinx has contracted with a private consortium called Mosaic Transit Group in a (DBFM - Design Build Finance Maintain) P3 delivery model.**

The Finch LRT line will run down the centre of Finch Avenue in a dedicated right-of-way, with an underground section at Keele Street as it enters Finch West subway station at the eastern terminus. The line will tunnel under the intersection of Finch Avenue and Highway 27, and emerge to an open cut section along Highway 27 to its western terminus just south of Humber College Boulevard.

There have been discussions about future extensions south to Pearson Airport, (with a connection to the extended Eglinton Crosstown) and east to Yonge Street, (with a connection to Finch subway station), but these projects are not currently in the planning or design stages.

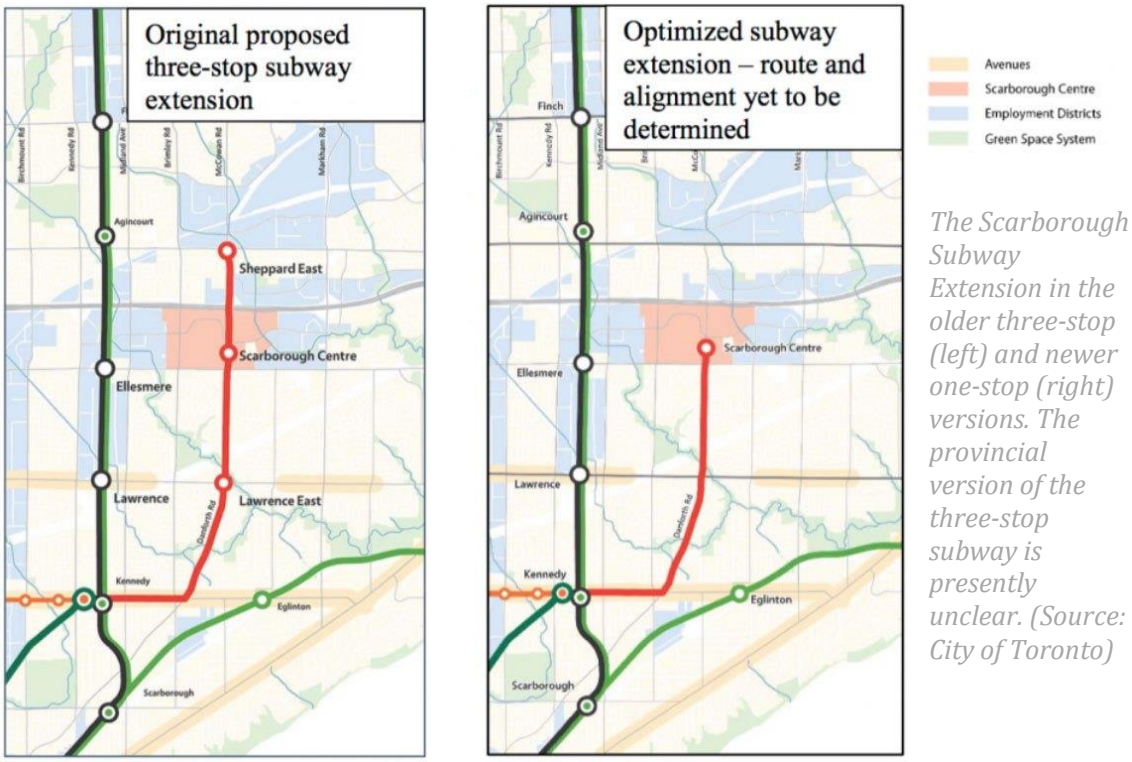
Project Cost	$1.2 billion
Length	11km
Stops/Stations	18
Ridership per hour (AM peak hour per direction)	2,800 per hour
Per day/Per Year	40,000 per day/15 million riders/year
Completion Date	2023/2024

C. Scarborough Subway Extension

The proposed Scarborough Subway Extension (SSE) is an extension of the Bloor-Danforth subway line to the Scarborough Town Centre from Kennedy Station. It would replace the aging Scarborough RT (SRT) that is now close to 35 years old. The City of Toronto and Metrolinx had planned to replace the SRT with a LRT running in the fully grade separated path of the SRT until McCowan Station, where it would have moved to an on-street operation and continued to

Sheppard and eventually north to Malvern. However, plans changed and a subway extension was approved in principle by Council in Mid-2013. The SSE is currently undergoing the Transit Project Assessment Process (TPAP), a specialized version of the regular Environmental Assessment process.

Originally estimated at $3.5 billion in 2013, early design estimates for a three or four stop line suggested costs would increase significantly. In 2016, a proposal was made to eliminate the intermediate stops to create a a one-stop "express subway" line from Kennedy to Scarborough Centre. In 2017 Council approved an alignment along McCowan Avenue.



The Scarborough Subway Extension in the older three-stop (left) and newer one-stop (right) versions. The provincial version of the three-stop subway is presently unclear. (Source: City of Toronto)

Costs for the "express subway" extension are expected to continue to grow with further engineering and inflation, to an amount near $4.5 billion. This budget does not include the cost of new trains and a new rail maintenance facility, which would be needed to house any new trains as existing facilities are at capacity.

More recently, the provincial government elected in the June 2018 election has its own vision for the Scarborough Subway Extension, a three-stop line, which means that delays to the project are likely to continue as final determination of the project takes place.

Project data shown below represent the currently approved 1-stop "express subway" proposal. Additional intermediate stops, as proposed by some councillors, as well as the three stop version proposed by the provincial government (which includes an extension to Sheppard Avenue), would lead to vastly different cost estimates.

Project Cost	$4+ billion (estimated)
Length	6.2km
Stops/Stations	1
Ridership per hour (AM peak hour per direction)	7,400
Per day/Per Year	64,000 per day or 19 million riders/year
Completion Date	2028+

SSE Project Financing and Funding

The project has funding of $660 million from the Federal Government, a $1.5 billion commitment from the Provincial Government in 2010 dollars (the cost of renewing the SRT) which was committed to for either a retrofitted SRT, an LRT or a subway and $910 million commitment from the City's 1.6% transit tax levy and Development Charges.

Other Costs

As the new line (and the new trains) will be designed to run on modern Automatic Train Control (ATC), the cost of converting the rest of the Bloor Danforth line to ATC will also need to be factored in (just under $500 million) as well as a new fleet of trains for the Bloor Danforth line at a cost of around $1.4 billion. This is because the existing trains would not be able to run on the Scarborough extension if it was built with ATC as its base signal system without very expensive retrofits to the existing T1 fleet. The new signal system and new trains and maintenance facility will likely add another close to $2 billion to the cost of the project, bringing the total capital needs for the Scarborough Subway extension to close to $6.5 billion.

In addition, any decision to "add back" a few station would boost the budget by upwards of $300 to $400 million per station.

SSE Ridership and Service Planning

With the current City plan to have a 6.2 kilometre tunnel ending in one new station, most Scarborough Transit users will still need to take a bus to a subway station, therefore limiting the time savings.

While 47,000 people would have lived next to the revamped RT stations and future stations along the Scarborough LRT line, only 24,000 will live within walking distance of the new subway stop. According to a study done by Ryerson University, riders would "spend on average of 6.8 minutes more on the bus to get to the subway stop compared to the closest LRT station, and 3.6 minutes longer than they do now to get to an existing SRT station", meaning any speed related savings of a subway over an LRT will be lost.

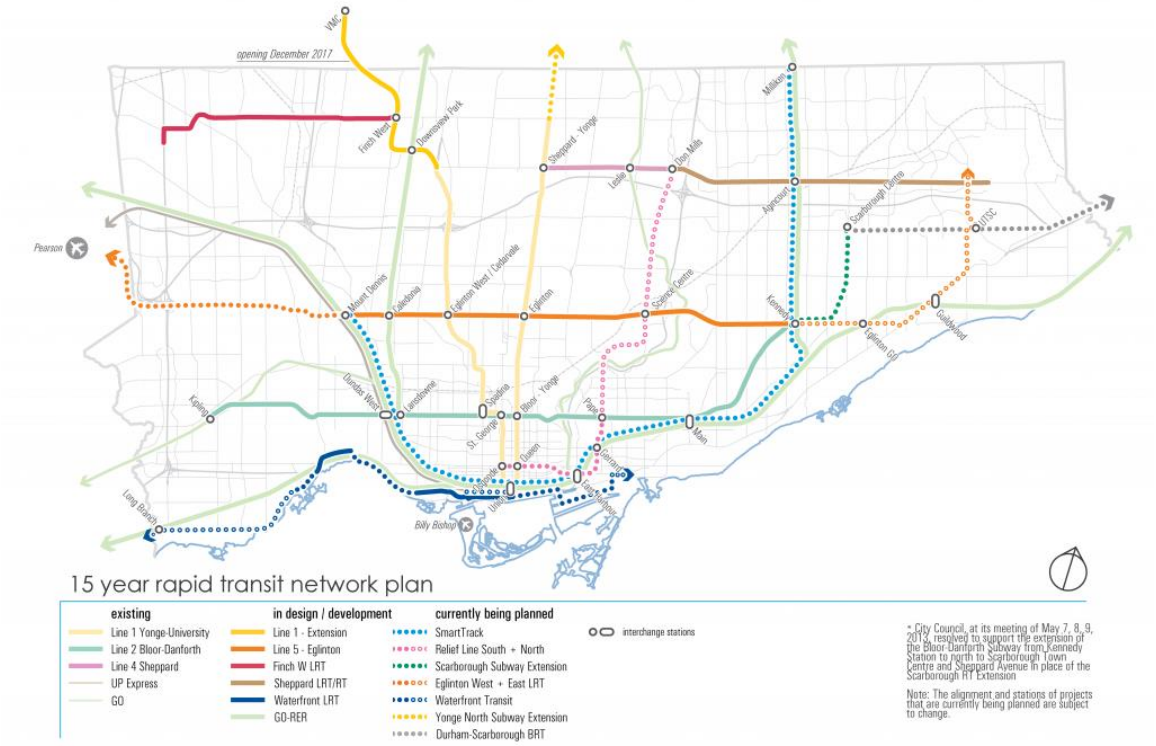
The subway extension would carry 64,000 people per day, with 7,300 riding in the peak hour, although only 2,300 of the daily total riders would be new riders.

The previous LRT with eight stops was expected to cost in the range of $1.5 to $2 billion and carry about the same number of people. Operating costs would likely add $10 to $15 million per year against less than $5 million in new revenue.

In summary, the Scarborough subway needs careful consideration as there are many elements of the budget that need to be fully understood by decision makers before the final decision on its feasibility is made.

14.4 Proposed Lines – In Planning

Toronto is very good at dreaming about new proposed transit lines, although the City's and region's track record is somewhat spotty on following through to construction of the lines. This section outlines major transit capital projects that are under active planning and consideration, but may not have identified funding or full approvals.



The City of Toronto's Fifteen Year Rapid Transit Network Plan. (Source: City of Toronto)

A. SmartTrack

SmartTrack was introduced in the 2014 mayoral campaign. The concept of a "surface subway at TTC fares" using the existing railway corridors was a distillation of proposals from a variety of sources including the City of Toronto's Official Plan. Since 2014, SmartTrack has been modified through planning and design discussions, and is now a set of six new stations along existing GO rail corridors, plus an extension of the Crosstown LRT or a new line along Eglinton West to Pearson Airport.

The six "SmartTrack" stations on the modified "SmartTrack" proposal are shown with existing and future GO rail stations (Source: City of Toronto)

B. Extensions to the Eglinton Crosstown LRT

The Eglinton Crosstown was originally planned to continue to Pearson Airport providing a direct TTC rail link to the airport and surrounding community. The Airport Employment Zone, which includes parts of Toronto, Mississauga, and Brampton, has one of the largest job clusters in the Toronto area, with around 75,000 jobs at or around the airport.

The Western end of the Crosstown was delayed in 2008 and has now been broken off as a separate project, and has been included in the modified SmartTrack proposal. The proposed western extension is officially referred to as the Eglinton West LRT.

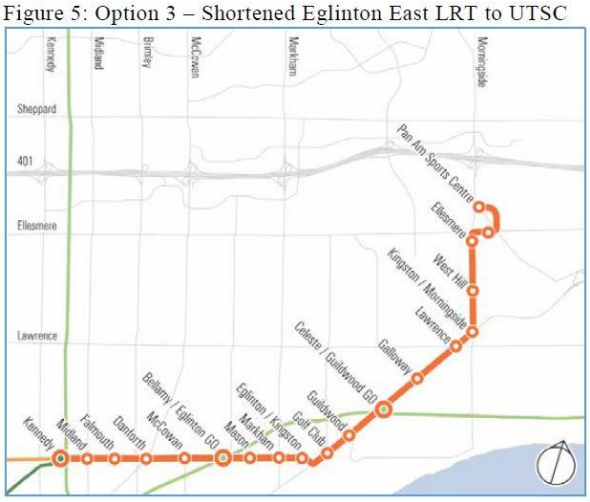
As proposed, it would run along Eglinton Avenue West to Renforth, at the City of Toronto boundary with Mississauga, then cross over the 401 and enter the Pearson airport lands from the south. The alignment within the bounds of the airport will be challenging to design and construct due to existing airport infrastructure, but the intent is to have the Eglinton West Line and the Finch West Line meet at the proposed Pearson Transit Centre, which is currently undergoing detailed design.

November 2017

The Eglinton West line is currently undergoing the Transit Project Assessment Project (TPAP), and there have been different proposals regarding the number of stations and whether the line would run on-street or entirely or partially above or underground. Recommendations from City of Toronto planning staff will be going to City Council in Late 2019, so this means that specific details of the project are not yet known at the time of this writing. The line is expected to cost around $1.5 billion and have around 12 stations.

The second extension would run east from Kennedy subway station along Eglinton Avenue East to Morningside Avenue and then would run north to the University of Toronto Scarborough Campus.

Figure 5: Option 3 – Shortened Eglinton East LRT to UTSC



Phase 1 of the Eglinton East LRT Line, which would eventually run to Malvern Town Centre. (Source: City of Toronto)

The line would then be extended further north, to connect with Sheppard Avenue and the Malvern Town Centre. The Eglinton East line is also currently undergoing the Transit Project Assessment Project (TPAP), and there have been different proposals regarding the number of stations and other details. Recommendations from City of Toronto planning staff will be going to City Council in Late 2019, so this means that specific details of the project are not yet known at the time of this writing. As with the western extension, the cost estimate is around $1.5 billion.

C. Relief Line

A Long History

A subway relief line has been on the table since the 1980's, although earlier plans for a streetcar subway go back to 1910. There were further discussions later around a Queen streetcar subway line that essentially followed a similar routing. In fact, in 1968 while the Bloor Danforth line was being extended to Warden and Islington, and the Yonge line north to Finch, the TTC's next priority was a 12km line along Queen Street from Roncesvalles to Donlands station.

In the 1980's as the issue of overcrowding on the Yonge line first surfaced a relief line was proposed as a way to offload some downtown-bound passengers coming from the east part of the city. It was included in in the province's 1985 "Network 2011" as one of 3 proposed lines. The focus on the east end evolved as the University line provided additional north/south capacity into the downtown for riders coming from the northwest of the city or from the Bloor/Danforth line.

The first of more "recent" studies of the line started around 2009 when the idea came back into discussion due to growing ridership on the Yonge line, and the recognition that other capacity-increasing methods (like open gang-way subway trains and a new signal system) would not provide sufficient capacity to accommodate future growth.

Project Cost	$7 to $13+ billion
Length	7.5km to 14km
Stops/Stations	8 to 14
Ridership per hour (AM peak hour per direction)	21,500 per hour
Per day/Per Year	~280,000+ per day/85 million riders/year
Completion Date	2030+

The current relief line proposal is divided into two pieces, and has been renamed for accuracy, as its primary focus is to create more capacity or "relief" to accommodate riders coming to the downtown from other parts of Toronto. Today it is referred to as the Relief Line and the studies break it into two parts: the Relief Line North and the Relief Line South. There is also mention of a western extension in Metrolinx's Big Move, perhaps all the way to the Bloor Line in the High Park area, but this has dropped off the table in the current discussions about construction of a first phase.

The highest priority section of the line from a pure transit perspective is the section south of Danforth in the east end, and in 2016 City Council approved a Pape Avenue-Eastern Avenue-Queen Street routing which would connect with Queen and Osgoode Stations on the Yonge-University-Spadina subway line, although the exact routing along a band of the Don River to Greenwood is still open to further review during the design phase.

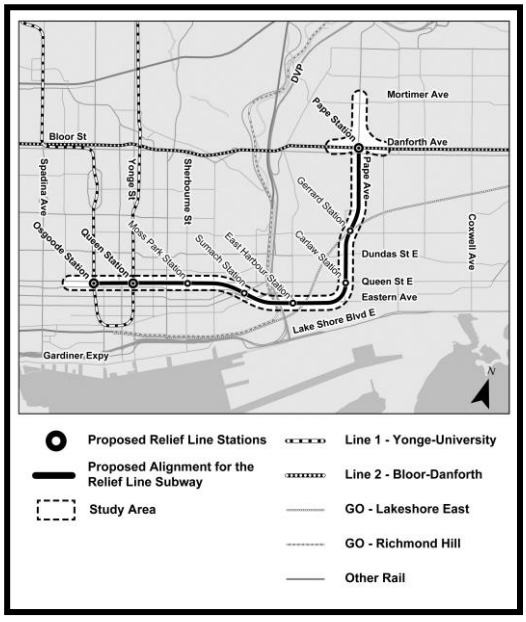
The current thinking around the routing is for the line to run south from Pape Station along Pape Ave., turning west south of Queen Street East, running approximately along Eastern Avenue to Sumach Street and King Street East. Here the line would veer northwest until about Parliament Street and Queen Street. The line would then continue westward under Queen Street to terminate at Osgoode Station.

The proposal aims to relieve the overcrowding on the Yonge line south of Bloor, and connect downtown Toronto to the Bloor-Danforth Subway east of the Don River.

Current Status

In 2016, $150 million was provided to plan and do preliminary design. In April of 2018, it was announced that an Environmental Assessment process would be started. In late 2018, the Provincial government announced approval of the EA, meaning the design and construction of the line could proceed at any time.

Future extension of the Relief Line could extend the line up to Sheppard in the East end and perhaps use the Georgetown Corridor in the West End, although, it is more likely to connect with the Eglinton Crosstown in a theoretical first phase, due to cost and rider ship considerations.



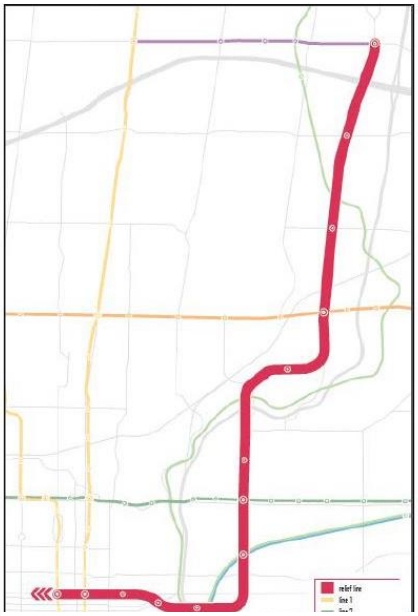
The proposed Relief Line (South) corridor and stations. Source: TTC

Complex Construction

This line will be more complex to design and construct than most of the other lines being discussed, as it will need to likely be built deeper to avoid some of the issues arising from the basements of tall buildings and other infrastructure in the downtown core including the existing subway line, And it will have to cross under the Don River, potentially more than once, depending how far north it goes.

The Relief line is expected to reduce demands for streetcar service along the Queen and King streetcar lines, but it is predominately designed to reduce demand on the Yonge Line. Specifically, it is designed to help reduce the 12,500 people transferring at Bloor and Yonge Station in the peak of the morning commute, a connecting point that has trouble accommodating the current number of transfers.

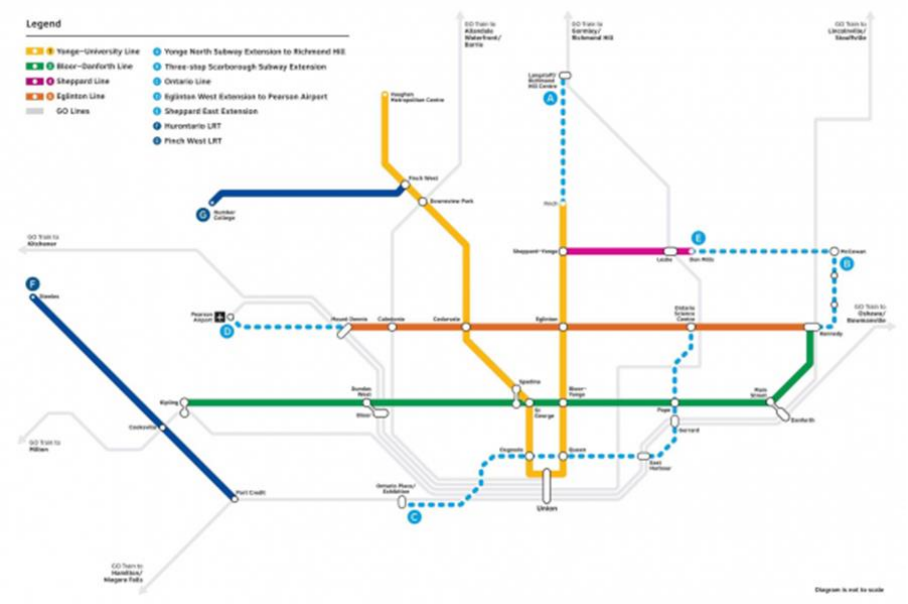
Without the Relief line, the Yonge line will face a demand of close to 40,000 passengers in the peak hour (peak direction) in 2031, which is more than the line can accommodate, even with automatic train control and new trains.



Conceptual image of the Relief Line showing both the South and North sections completed. (Source: City of Toronto)

Provincial Planning for Transit

Differences in priorities between the TTC, City of Toronto and the Provincial Government of the day have been an ongoing issue. In the 2019 budget, the Provincial Government announced their vision for transit in the Greater Toronto Area, which contrasted in many ways with the City of Toronto's proposals. The provincial government plan omits the LRT lines proposed by the City of Toronto, and replaces the Relief Line South (a subway from Pape Station to Osgoode Station via Pape, Carlaw, and Queen) with the Ontario Line, a line from Don Mills & Eglinton to the Exhibition/Ontario Place, (running via Don Mills, Pape, and Queen).

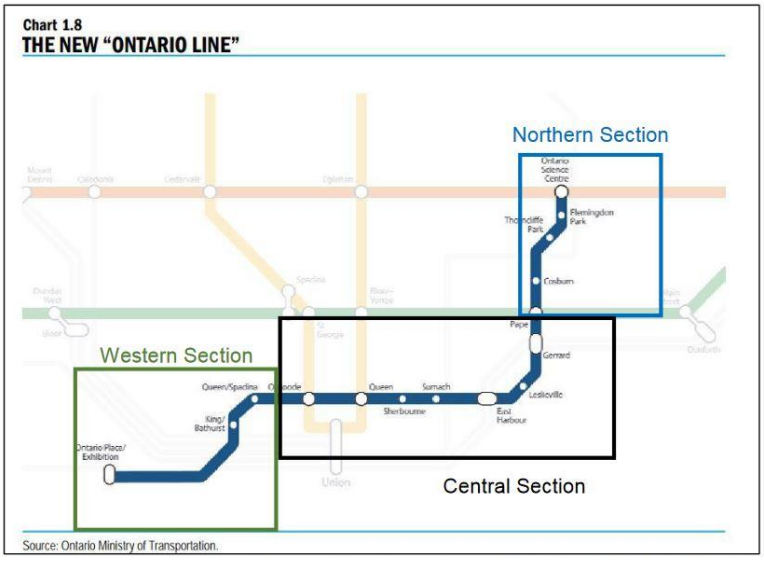


The Ontario Government's 2019 vision for rapid transit in Toronto and Mississauga by 2021. Lines under construction (navy) and proposed (blue dots) are shown. (Source: Government of Ontario)

The Ontario Line

The proposed Ontario Line would be longer than the proposed Relief Line South, and use an alternative transit technology from subways, which the government argued would allow the line to make tighter turns and climb/descend higher grades. The smaller trains and stations would allow a faster construction period, allowing the line to be completed by 2027, as compared to the projected 2031 completion of the Relief Line South.

The Ontario Line is the signature project in the Provincial Government's rapid transit plan for Toronto. (Source: Ontario Ministry of Transportation)



The Ontario Line (as shown in the Initial Business Case produced by Metrolinx) is compared with the Relief Line South. (Source: Metrolinx)

In Late July 2019, the Initial Business Case for the Ontario Line was published, detailing some proposed modifications to the route including elevation through Thorncliffe Park & Flemingdon Park, running along the outside of the railway corridor in Leslieville and the West Done Lands, following a different alignment between Queen and the railway corridor in the West end, and terminating at Exhibition GO station rather than Ontario Place. It is proposed that the gap between Exhibition GO and Ontario Place would be covered by a cable car system.

While it is not known how the Ontario Line may further change as it goes through the (accelerated) public consultation and design process, the anticipated design differences will have significant planning, capital and operational implications for the TTC. The shift to the Ontario Line will affect the TTC's anticipated plans for new yard facilities near Kipling station, upgrades to the Greenwood Yard to handle a Relief Line fleet, and even plans for surface transit along the portions of the Ontario Line route which run beyond the Relief Line South.

D. Yonge Subway Extension (YSE)

Since the Yonge subway opened to Eglinton in 1954 from Union Station, the continued push for rapid transit north on Yonge Street has been envisioned.

Over the last 15 years, residents and politicians in York Region have pushed hard for the subway to be extended north from Finch to Richmond Hill Centre with a four to five station subway extension

An Environmental Assessment was approved in 2009 and was linked to the work with the Relief Line. The extension is expected to attract around 2,400 new passengers, with the bulk of the total ridership of 40,000 a day coming from transit riders currently travelling on buses to Finch Station.

The Yonge North Subway Extension. (Source: TTC)

The ride from Richmond Hill Centre to Union Station is expected to take around an hour by subway, versus the GO Transit travel time of around 35 minutes. In the future (still many years away), the full implementation of Regional Express Rail service (along with full GO/TTC fare integration) may reduce the passenger estimates, as some people would switch to faster GO service if there was room and the price was the same as the subway.

Project Cost	$2 billion
Length	4km
Stops/Stations	3-4
Ridership per hour (AM peak hour per direction)	3,800 per hour
Per day/Per Year	45,000 per day/14 million riders/year
Completion Date	2032+

Currently the Yonge Subway Extension project is being advanced with $55 million of funding provided by the Province at the same time as design and planning was provided for the Relief Line. York Region has also allocated $36 million of its share of Federal transit funding to the project. These two projects are tightly linked, because without the Relief line available to relieve pressure on

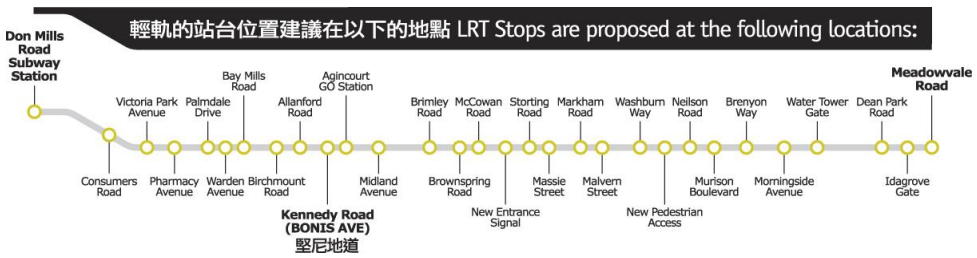
the Yonge line, which currently has no excess capacity, the new passengers on the Yonge line would simply create a situation where current passengers wishing to board further south would be unable to board the packed trains.

E. Sheppard East LRT

The Sheppard East LRT is a 13-kilometre light rail transit line, with a 1.1 km tunnel connection to Don Mills subway station. The 11.9 kilometres from the tunnel portal at Consumers Road will run along the surface of Sheppard Avenue from Consumers Road to Morningside Avenue. The surface line will operate in a dedicated lane in the centre of the street.

The Sheppard East LRT was originally the first line of the Transit City plan to start construction in December of 2009, and was later cancelled in 2010 with the City being responsible for upwards of $80 million in cancellation costs.

Project Cost	$4 to 8 billion
Length	7.5km to 14km
Stops/Stations	7 to
Ridership per hour (AM peak hour per direction)	2,800 per hour
Per day/Per Year	40,000 per day/15 million riders/year
Completion Date	2028+ (likely post 2030)



Map of the Sheppard East LRT line. (Source: TTC)

14.5 Heavy Rail Expansions

SmartTrack

SmartTrack was proposed as part of the 2010 election campaign of Mayor Tory and is linked to the capital expansion of the GO network as part of Metrolinx's large $13.5 billion Regional Express Rail (RER) program.

Originally SmartTrack was proposed in the Mayor's election platform to run 53km on Eglinton Avenue from the Matheson/Airport Corporate Centre in Mississauga to Mount Dennis before turning towards downtown on the Georgetown line towards Union Station before running east and north to Scarborough, Unionville and Markham. In total there was to be 22 stations and connections to the subway and other GO services. The platform estimated it would have a ridership of 200,000 passengers a day, would cost $8 billion and be in service by 2022.

After initial feasibilities studies, the SmartTrack was deemed to be very difficult to implement and unlikely to be able to be constructed within the stated budget and timeframe and as a result, the original concept was reframed.

Currently SmartTrack will lead to additional stations being installed at the City's cost on existing GO routes within the City of Toronto. The western extension of the Eglinton LRT has replaced the previously proposed heavy rail line, which would have been almost impossible to construct.

The current plan is to have six new Smart Track stations in Toronto on the Kitchener, Lakeshore East and Stouffville GO Corridors. The SmartTrack stations are at Finch East, Lawrence East, Gerrard Street East, and East Harbour (Unilever) on the Stouffville/Lakeshore East GO Corridor, and Liberty Village and St. Clair West on the Kitchener GO Corridor.

The current estimated project cost for SmartTrack is around $1.25 billion with $53.9 million having been committed in the City's 10-Year Capital plan, and an ultimate commitment by the City of around $800 million. Its successful implementation is tied to the increases in GO service and the associated additional track that is being electrified.

Regional Express Rail (RER)

Regional Express Rail (RER) is Metrolinx's program to significantly increase rail service across the GO rail network and includes two-way, all-day service on five GO rail corridors with electric trains running every 15 minutes or better, in both directions on the most heavily utilized parts of the network.

In order to have this level of service, full electrification of the Lakeshore East and Barrie GO lines along, with inner portions of the Lakeshore West, the Kitchener, and Stouffville GO lines will be required. The electrification of the Union-Pearson service is also included in the plan.

RER will allow for a quadrupling of the number of daily trips, taking the total number of trains per week from around 1,500 to 6,000 when fully complete. This is expected to take ridership from around 65 million today to close to 130 million, over 400,000 riders a day.

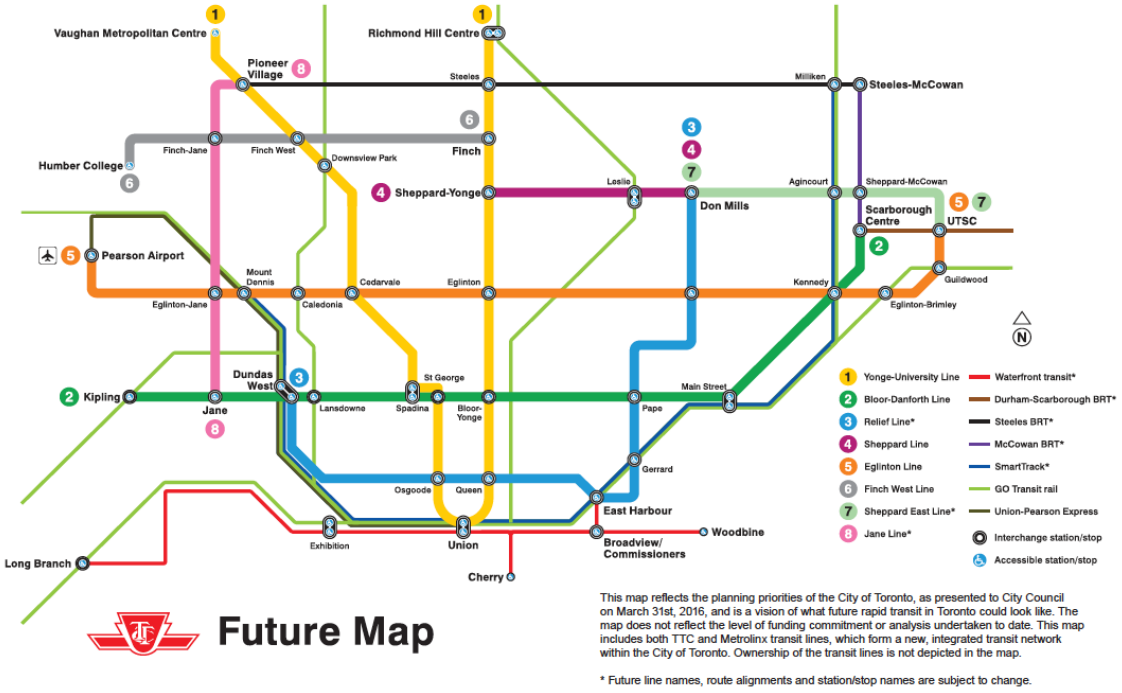
RER will transform the GO service from a predominately commuter type service into more of a metro type service, and could transform travel patterns in the GTA, which is why ridership numbers are so high. However, without additional scaling up of connecting transit to GO stations, it will be hard to attract so many riders because there are simply not enough people within walking distance of GO stations, or enough parking spots, to accommodate a doubling of ridership. Likewise, there is not enough space to build more parking spots and at a cost of $50,000 plus per spot for multi-deck parking, the cost of accommodating this ridership (if even physically possible or desirable) would be in the $4.5 billion - plus range, not to mention extensive annual maintenance costs for the parking facilities.

However, by 2018 only a fraction of the total work has been completed, suggesting that completion before 2030 is highly unlikely, with some experts suggesting that the volume of work will take until the mid to late 2030's.

Electric Operations Allows Higher Speed and Frequency

Electric operations allows for faster acceleration and hence the closer spacing of trains. The 10-year regional express rail plan was originally costed at $13.5 billion, and will require 150 kilometres of new track including new bridges and tunnels. The network will ultimately have 260km of electrified track. Trains of eight to 10 cars would be used in peak times, with smaller four-car trains running at other times when demand is lower.

However, after more work and market soundings, the construction costs are likely closer to $30 billion. Not only will this require extensive new funding, but also the volume of work will be very difficult to accomplish, and additional efforts may be needed to upgrade the broader power network along the route to support this level of electrically-powered transit. With the recent change in government, there is an opportunity to take a hard look at the economics and practically of full electrification and consider a revised program based on a pragmatic assessment of utility of electrify certain lines.



The City of Toronto's vision for rapid transit by 2035, based on the planning priorities presented to Council in March, 2018. (Source: TTC)

15. ACKNOWLEDGEMENTS

This report draws on information from public TTC reports and other government agencies and organizations both in the Toronto area and around the world. Analysis and commentary are provided by the author or other cited sources.

Where appropriate, reports are identified in the text either by title or website, or by reference to subject and time period to allow easy location of the original document.

I want to acknowledge the assistance of Mitch Stambler and Ellie Kirzner in the review of the contents of this report to help ensure the accuracy and completeness of the material. Any errors or omissions are the responsibility of the author.

Mitch Stambler is the former Head of Planning and Strategy for the Toronto Transit Commission. Over his career, he drove several initiatives including the TTC's Light Rail Plan, the Ridership Growth Strategy, the Plan for System-Wide Accessibility at the TTC, the (2014) Opportunities to Improve Transit in Toronto, and the Service Strategy for the 2015 Pan Am Games. He spent several years

in the planning and operations areas of the TTC, and previously worked in city and transportation planning.

Ellie Kirzner spent many years at NOW Magazine (including as Senior Editor) covering local issues including transit, and has a thorough understanding of the complex web of local municipal issues.

City of Toronto Archives.