

An Independent Study
Commissioned by



RESIDENTIAL AND
CIVIL
CONSTRUCTION
ALLIANCE OF
ONTARIO

Constructing Ontario's Future



STATION TO STATION

Why Subway-building Costs Have Soared in the Toronto Region

APRIL 2020



15 YEARS
OF
INFRASTRUCTURE
ADVOCACY **2005-2020**

STATION TO STATION

Why Subway-building Costs Have Soared in the Toronto Region

An investigative study commissioned by the
Residential and Civil Construction Alliance of Ontario (RCCAO)

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APRIL 2020



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The Residential and Civil Construction Alliance of Ontario (RCCAO) is composed of management and labour groups that represent a wide spectrum of the Ontario construction industry.

RCCAO's goal is to work in cooperation with governments and related stakeholders to offer realistic solutions to a variety of challenges facing the construction industry and which also have wider societal benefits.

RCCAO has independently commissioned 54 reports on planning, procuring, financing and building infrastructure, and we have submitted position papers to politicians and staff to help influence government decisions.

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RCCAO members include:

- Carpenters' District Council of Ontario
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- Heavy Construction Association of Toronto
- International Union of Operating Engineers, Local 793
- Joint Residential Construction Association
- LiUNA, Local 183
- Ontario Formwork Association
- Toronto and Area Road Builders Association

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The overall goal has been to jumpstart a constructive conversation on a subject crucial to the livability and economic health of Toronto, southern Ontario and Canada. Any unattributed opinions expressed are solely those of the author.

Unfortunately, this report was being finalized during the lockdown precipitated by the COVID-19 crisis. Although it is unknown how long the pandemic will last, or the extent of the impacts, the fundamental themes in this report remain.

Care has been taken to flag potential methodological concerns and maximize the fairness of comparisons in all cases. The Bank of Canada's online inflation calculator was used to measure costs for comparisons over time in real dollars. <https://www.bankofcanada.ca/rates/related/inflation-calculator/>

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EXECUTIVE SUMMARY

York University station, designed by Foster + Partners Architects, sees more daily ridership than any other stop on the Toronto-York-Spadina Subway Extension.



For nearly seven decades, the Toronto Transit Commission (TTC) managed delivery of rapid-transit projects in Canada’s most populous city. But in 2015, 2.5 years before the opening of the Toronto-York-Spadina Subway Extension (TYSSE), the TTC was effectively removed from the project in response to major cost overruns and delays.

So, what went wrong for the TYSSE? Two of the common theories that emerged were that its six stations were unnecessarily grandiose and that traditional public-sector procurement and delivery methods had become too inefficient to provide value for Ontarians.

One need not follow the money for long to determine the TYSSE was an unusually expensive project – costing nearly four times as much as the average per-kilometre cost of TTC-managed 20th-century subway projects – even after adjusting for inflation. It was, in real dollars per-km, about 90% more expensive than the Sheppard subway, which was also deemed extremely costly when it opened in 2002.

Yet those dubious records likely won’t last long. Even amid cancellation of an LRT project in Hamilton and decisions to seek cost efficiencies on the Ontario Line in Toronto and Mississauga’s Hurontario LRT, the transit-building price spiral is still accelerating at an alarming rate. If recent estimates hold for the planned subway extensions to Richmond Hill and deeper into Scarborough, the public will be asked to pay up to twice as much per kilometre as it did for the TYSSE. (For a per-km breakdown of transit projects since 1954, see Figure 1 on the following page.)

Figure 1: Toronto Transit Capital Cost History

Project	km	Stns	Stns/km	Cost	Open	In 2019 \$*	2019 \$/km**
Yonge***	7.4	12	1.6	\$67M	(1954)	\$648M	\$87.6M
Uni-BD***	16.0	25	1.6	\$206M	(1966)	\$1.6B	\$100.0M
BD exts.	9.9	9	0.9	\$77.8M	(1968)	\$565.7M	\$57.1M
YSNE	8.0	4	0.5	\$140M	(1974)	\$751.8M	\$94.0M
Spadina***	10.0	8	0.8	\$220M	(1978)	\$833.8M	\$83.4M
Kip. + Ken.	4.3	2	0.47	\$127M	(1980)	\$402.6M	\$93.6M
Downsview	1.6	1	0.63	\$117M	(1996)	\$179.0M	\$111.9M
Sheppard	6.4	5	0.78	\$934M	(2002)	\$1.3B	\$203.1M
TYSSE	8.6	6	0.70	\$3.2B	(2017)	\$3.3B	\$383.7M
Xtown***	19.0	25	1.31	\$5.3B	n.a.	\$6.2B	\$326.3M
Finch W****	11.0	18	1.63	\$2.5B	n.a.	\$2.6B	\$236.4M
XtownW	n.a.	n.a.	n.a.	\$4.7B*	n.a.	\$4.7B	n.a.
ON Line***	15.5	15	0.97	\$10.9B*	n.a.	\$10.9B	\$703.2M
SSE	7.6	3	0.39	\$5.5B*	n.a.	\$5.5B	\$723.7M
Yonge N	7.4	6	0.81	\$5.6B*	n.a.	\$5.6B	\$756.8M

LEGEND:

Yonge: The original Eglinton to Union line.

Uni-BD: University-Bloor-Danforth from Union to St. George and Keele to Woodbine.

BD exts.: Bloor-Danforth extensions, Keele to Islington and Woodbine to Warden.

YSNE: Yonge Subway Northern Extension, Eglinton to Finch.

Spadina: Extension from St. George to Wilson.

Kip. + Ken.: Bloor-Danforth extensions from Islington to Kipling and Warden to Kennedy.

Downsview: Spadina line extension, Wilson to Downsview, since renamed Sheppard West.

Sheppard: Sheppard subway, now known as Line 4, from Sheppard-Yonge to Don Mills.

TYSSE: Toronto-York Spadina Subway Extension from Sheppard West to Vaughan Metropolitan Centre.

Xtown: The under-construction Eglinton Crosstown LRT from Kennedy to Mount Dennis. (45 per cent above ground.)

Finch W: The above-ground, under-construction Finch West LRT, Finch West station to Humber College.

Xtown W: A proposed extension for the Eglinton Crosstown from Mount Dennis.

ON Line: The proposed Ontario Line/Relief Line subway from the Science Centre to Exhibition Place.

SSE: A proposed Line 2 subway extension from Kennedy to McCowan and Sheppard.

Yonge N: The proposed Yonge North extension from Finch to Richmond Hill.

* Numbers for the XtownW, ON Line, SSE and Yonge N are construction-cost estimates provided by the Ontario Ministry of Transportation in November 2019.

** Bank of Canada inflation calculator was used to adjust costs into 2019 dollars.

*** Projects include vehicle maintenance and storage facilities

**** Project includes vehicle facility and 30-year maintenance contract.

Subway-building costs in Toronto rose almost in lockstep with the inflation rate throughout the second half of the 20th century, before suddenly soaring at about twice that rate in the 21st. Subways cost far more now in real dollars than they did decades ago, even though the latest projects have had fewer stations per kilometre and traverse simpler, less-dense contexts. The new lines are projected to cost more despite being delivered during an extended period of record-low borrowing costs. Further, these projects will be delivered using the province's public-private-partnership (P3) program, which is supposed to offer better value for the money.

From a construction perspective, the biggest cost-increase factor appears to be station depths predetermined by tunnelling choices. Some TYSSE stations are seven-storey underground buildings whose only purpose is to move people between the surface and platform levels. Twentieth-century stations were much less expensive, largely because the TTC preferred to use shallow cut-and-cover tunnels, open trenches and above-grade alignments, methods that are messier, but usually faster and much less costly. The TYSSE stations were deeper and more costly than any previously built in the GTA, and plans for the Scarborough Subway Extension call for stations that will be deeper and far more expensive still.

In an attempt to understand Ontario's seeming inability to contain costs, the following report examines a variety of other potential cost-escalation drivers, including labour, materials and delays in the planning and approvals processes. It also tries to assess the effectiveness of current project planning and evaluation as well as the still-nascent public-private partnership (P3) procurement models.

Because soaring project costs threaten the GTA's and Ontario's economic competitiveness and quality of life, the report hopes to jumpstart an urgent debate on how to improve all aspects of delivery processes for complex transit-infrastructure projects.

The following 10 recommendations provide a starting point in that conversation. These include technical considerations and the financing of projects. Based on the report's findings, a cost-driver matrix was developed that breaks down the various factors involved and the level of risk they present to both project cost and project delivery timelines (Figure 2). Among the highest risk factors are tunnel depths and political interference.

Figure 2: Cost Drivers

	High risk	Medium risk	Lower risk	Undetermined
Tunnel depths	X			
Corridor clearance and maintenance		X		
Art, design aesthetics			X	
Political meddling in the planning process	X			
Approvals, study delays		X		
Labour costs		X		
Materials			X	
Construction productivity		X		
Soil removal			X	
Openness and accountability		X		
P3s and bidding processes				X

LEGEND

- **Undetermined risk:** P3s, bidding process.
- **High risk:** Tunnel depth and political interference in planning process.
- **Medium risk:** Corridor clearance (utilities), labour, productivity, approvals and study delays, accountability and transparency.
- **Low risk:** Art and aesthetics, materials, soil removal.

Figure 3: Deeper Tunnels, Longer Timelines

Original Yonge line (1949-1954)

Union to Eglinton (4.7 km cut + cover and 2.7 km open trench)
54 months (4.5 years) for 7.4 km and 12 stations (project was delayed significantly by post-war materials shortages)

1.6 km per year; 2.7 stations a year

University-Bloor-Danforth (1959-1966)

Union to St. George and Woodbine to Keele (13 km cut + cover, 3 km tunnel, 0.3 km open cut) 75 months (6.25 years) for 16 km and 25 stations

2.6 km per year; 4 stations a year

(Timelines for extensions to Warden and Islington, which opened in 1968, are hard to determine because work started concurrently with the core of the Bloor-Danforth line)

Yonge Subway Northern Extension (1968-1974)

Eglinton to Finch (4 km cut + cover, 4.6 km tunnelled)
66 months (5.5 years) for 8.6 km and 4 stations

1.6 km per year; 0.7 stations a year

Spadina (1974-1978)

St. George to Wilson (4.4 km cut + cover, 0.6 km tunnelled, 4.3 km open trench, 0.6 km bridge) 44 months (3.67 years) for 10 km and 8 stations

2.7 km per year; 2.2 stations a year

Sheppard, opened 2002

Unable to compare fairly because work was interrupted (by concerns about whether the job would be completed).

TYSSE (2009-2017)

(Sheppard West to Vaughan Metropolitan Centre) 97 months (8.1 years) for 8.6 km (all deep-bore tunnels) and 6 stations

1.1 km per year; 0.7 stations a year

KEY RECOMMENDATIONS

1 Expand the cost-crisis conversation beyond the usual transit experts.

Even people who never ride public transit benefit hugely from its existence and, with constraints on our ability to add more road space, the benefits of expanded transit will increasingly be more important than ever. The infrastructure cost crisis is growing, and without prompt and appropriate responses it will damage the long-term competitiveness of the GTA, with harmful knock-on effects for all of Canada. Cities that make wise transit planning decisions will have major competitive advantages in the 21st century.¹ Merely building will not be enough. If we spend foolishly, we undermine the public's willingness to fund future projects, no matter how urgent they might be.

2 Minimize the use of tunnels and keep tunnels as shallow as possible

when there is a need to go underground. Best practices from around the world include cut-and-cover tunnelling and, in less-dense suburban areas, at-grade and aboveground corridors. Toronto once accomplished a lot at good prices by relying on these construction methods. Digging deep is sometimes essential, especially in city cores and when connecting with existing subways from below. However, default acceptance of deep tunnels tends to result in prohibitive costs that often outweigh the benefits of reduced surface disruption. The record shows that rail projects have usually been built faster and much cheaper when the track-bed corridor is closer to the surface. Shallow stations are more accessible and cheaper to build, operate and maintain.

3 Plan for and protect transit corridors. As pointed out in the “Lost Scarborough Corridor” (Chapter 8 of this report), short-term thinking led to the loss of a disused but valuable corridor, eliminating the potential for a cost-effective subway option to link Kennedy station with Scarborough Centre. It is vital to create and protect a web of viable corridors in our official plans. All GTA municipalities should be planning for and taking steps to ensure that potential lines in their areas can be built quickly and cost-effectively with a minimal need for utility relocations, which drive up risk and cost. Discussions with a TTC manager in the 1980s indicated efforts were initiated to minimize utility concerns decades ago on Queen Street and on Yonge between Finch and Steeles, but it is unknown to what degree these corridors were maintained.²

KEY RECOMMENDATIONS (CONTINUED)

4 Increase the focus on openness and transparency. Detailed, open-access line-by-line accounts for every multibillion-dollar project are essential and should be publicly available to ensure decision-makers and their advisers can be informed well enough to comparison shop. Open accountability can go a long way toward reviving the public's faith in the process. Creation of an international database could improve bidding competitiveness and help jurisdictions globally get value for money. Confidentiality matters during bidding and land-acquisition processes, but there is merit in engaging and informing the public as fully and promptly as possible. It was discovered during research for this report that huge amounts of knowledge have been lost or hidden in places that are hard to access for the public, decision-makers and transit researchers.

5 Rethink factors that make stations special. Maximizing utility is paramount, but functionality doesn't have to come at the expense of architecture, art and aesthetics. Designs that aim to be uplifting, however, need not be monuments to architects' egos. We could seek out relatively unknown talents through design competitions, though we might also take another look at the benefits of standardized stations – and not just in terms of cost savings. Stand-alone stations with green roofs may be much less green than stations designed and developed as part of mixed-use buildings from the start. Bringing in natural light may be a stated guideline desire, but it's costly if stations are deep. Pillars need not be undesirable (see the refurbished Museum TTC station, or Moscow's system). If more subterranean space is desired, make it horizontal at platform level rather than great vertical distances that have to be conquered with stairs and long, costly escalators. Vast tiled walls can be gallery space for artists or archival photos from the station vicinity's local history. In short, pleasant stations don't have to be costly, but spartan ones will be if they're unnecessarily deep.

KEY RECOMMENDATIONS (CONTINUED)

6 Reuse excess soil beneficially. If Ontario follows through and builds all the transit lines promised, we will remove vast amounts of soil and could end up paying a lot of money to have it transported around the province. It is estimated that excavations for the Eglinton Crosstown tunnels and stations will have generated 1.5 million cubic metres of excess soil and 150,000 truck trips.³ Some cities in Europe faced with a similar situation have created soil-matching programs that facilitate beneficial reuse, delivering economic and environmental benefits. Perhaps clean soil could be used to replace land that has eroded at the Toronto Islands or create new islands near Ontario Place. In the 1960s, excavation for the University-Bloor-Danforth subway project yielded soil that kick-started what is now the Leslie Street Spit. Lots of cities around the world have used similarly sourced fill to create new, valuable real estate. Let's think creatively about potential reuse within the GTA.

7 Proactively address the skilled-trades shortage. We couldn't find evidence that wage increases were a particularly large factor in the soaring cost of subway building, but labour costs have risen faster than the rate of inflation amid our prolonged building boom – and it has happened while lots of Ontarians and Canadians are unemployed or underemployed. There's a win-win opportunity here. Part of the solution likely lies in the Red Seal program,⁴ which aims to improve interprovincial mobility for workers in a variety of trades. Attention to this issue should allow our investments in local infrastructure to strengthen national unity while boosting local competitiveness. We might even consider building low-cost housing for the use of apprentices while they're getting their careers established.

8 Increase efforts to make P3s work for transit projects. Some would have us abort the P3 experiment now. Others seem as interested in promoting the P3 concept as they are about getting it right. Linear multi-billion-dollar infrastructure is more complex than the standalone public real estate projects that Infrastructure Ontario (IO) has delivered so far. Delays and cost overruns on IO's first transit projects should not be reason to hastily abandon the P3 model. However, government, opposition parties, auditors, media and academics need better access to information required to vigorously assess P3 effectiveness. At some point, IO must be able to show it has saved the public real money while expediting the delivery of projects. For now, it is important to remember that the proposed transit projects are carrying per-kilometre cost estimates far higher than what was paid for the TYSSE, a project so expensive it resulted in the TTC being excluded from future subway work. IO has to prove it can deliver more reliably and at better prices than the TTC once did.

KEY RECOMMENDATIONS (CONTINUED)

9 Approve long-term transit plans based on real evidence. Politicians have hugely important roles to play in ensuring contracts are fulfilled and in choosing service-policies (ridership growth versus broader network coverage for example). They should also retain the best and most powerful role in the process: choosing which projects get approved and funded, but only from a menu of options prepared by transit experts who have been freed to exercise professional independence and publicly speak truth to power. The GTA’s multi-decade descent into a transit crisis is rooted at least partly in an ethical breach that needs to be sealed off immediately. When politicians can interfere in preparing the menus of options, we inevitably waste and misuse experts by having them engage in “decision-based evidence making.” Planners and consultants need to be able to safely raise and study good options even if those options are seen as threats to projects promised by politicians in power, or seeking office. Often, the only options that make it to the table are unnecessarily costly and of questionable worth, while more practical solutions receive little or no consideration.

10 Create designs, processes and incentives that allow stations and their catchment areas to pay dividends. Tunnels and tracks will always be costly, but stations and their catchment zones can and should be yielding bigger returns on investments. Talk of transit-oriented development (TOD) has become increasingly mainstream, but action in this part of the world has been lacking, timid and unfocused for more than half a century. TOD proponents often have simplistic notions of the potential, while too much of what we hear from detractors ignores real-world successes or serves as excuse-making for people unwilling to accept that we must change how we do things to stay competitive globally. The province might need to emulate the big pension funds and create a Crown developer and real estate manager largely free to operate as if it were a private-sector firm. But the full worth of catchment zones will rely on more than station-related properties and residential density. Richer land-use mixes and pedestrian-friendly design can go a long way toward creating bidirectional all-day transit demand that’s more economic for transit operators, whether they’re running subways, commuter rail or local bus networks.

NOTES FROM KEY RECOMMENDATIONS

- 1 “Canada’s cities are about to add millions more people. They can’t all drive to work,” The Globe and Mail editorial, January 3, 2020. <https://www.theglobeandmail.com/opinion/editorials/article-canadas-cities-are-about-to-add-millions-of-new-residents-they-cant/>
- 2 The report’s author had a series of off-the-record conversations in the mid-1980s with the TTC’s then manager of engineering and construction.
- 3 Information from the Environmental Assessment, quoted in a March 6, 2020 presentation by the Construction and Design Alliance of Ontario to Metrolinx and Infrastructure Ontario.
- 4 Red Seal program: The Real Trades program. http://www.red-seal.ca/trades/tr.1d.2s_1.3st-eng.html

1.0 INTRODUCTION

The following report began with a discussion in 2019 about whether the stations on Toronto's latest subway extension, to Vaughan, were too grand and to what degree designs may have added to cost overruns. Initially, the discussion revolved around how to deliver stations more cost effectively, but it expanded significantly.

Even after accounting for inflation, the public pays far more for transit infrastructure in the 21st century than previous generations did, and it has paid far more even though the latest subway projects have fewer stations, traverse simpler and less-dense contexts and were built during an extended period of record-low borrowing costs. Of much greater concern, however, is that estimates for future projects indicate the 21st-century cost-escalation spiral is accelerating still.

Capital-cost concerns are a significant part of the reason Toronto has steadily fallen further behind in addressing transit needs, even as the city and regional population keeps growing at continent-leading rates. The issue itself is nothing new: Cost overruns on two 1970s subway projects sped up the push to develop intermediate-capacity rapid-transit technology, introduced in Scarborough in 1985 on a line now slated for replacement.¹ In 2007, the Transit City light-rail plan was unveiled less than two weeks after the Toronto-York-Spadina Subway Extension (TYSSE) was announced as fully funded, largely because many decision-makers had determined that subways were becoming too expensive (and they reached that conclusion before TYSSE costs soared past approved estimates by more than 50%).²

Now, however, the issue of costs should be of much greater concern. Subway-building cost increases held closely to the rate of inflation throughout the second half of the 20th century, before suddenly soaring in the 21st (Figure 1, right-hand column). Now, even surface light-rail lines are carrying higher price tags than subways did as late as the mid-1990s, and that's after adjusting for inflation and making use of public-private-partnership (P3) financing and procurement business models that are supposed to deliver better value for the public.

The Eglinton Crosstown, an only half-underground line, is expected to cost 3.8 times as much on a per-kilometre basis as the inflation-adjusted average of Toronto's first six subway projects (and that's not including at least one cost overrun so far). Cost-estimate increases were blamed when the Province recently cancelled an LRT project in Hamilton, although accounting details underlying that decision were not made public in time for this report.

More alarming still is that – even with Metrolinx and Infrastructure Ontario employing a public-private-partnership (P3) model as they take over responsibility for subway building from the Toronto Transit Commission – per-km estimates provided by the Ministry of Transportation for planned extensions deeper into Scarborough and under Yonge Street to Richmond Hill are nearly twice as much as the final tab for the TYSSE.³ It was, after all, those shocking final TYSSE construction-cost figures that prompted the TTC's removal as Toronto's subway-delivery agency.

It is also important to note that, with a few exceptions,⁴ the seriousness of our transit-infrastructure cost crisis appears to be under the radar. Even influential experts on a panel at a recent Toronto Region Board of Trade conference devoted to the subject of megaproject delivery seemed unaware there might be a problem. When asked why we were more efficient at delivering

transit infrastructure in the 1950s and '60s, the president and chief executive of Canada's Infrastructure Bank, Pierre Lavallée, smiled and asked: "Is that actually true?" Moments later, SNC-Lavalin executive vice-president, Dale Clarke, responded with: "I think that [greater efficiencies in an earlier era] may be more of a perception than a reality."⁵

The inability to get projects built was clearly apparent to the authors of an October 2019 University of Toronto report titled "Transit in the Greater Toronto Area: How to Get Back on the Rails."⁶ That report calls for reduced political influence in planning studies and cost-benefit analyses, as well as more emphasis on co-ordinating transit and land-use, but it barely touches the issue of rising capital costs.

Not only do the increased costs mean the public pays more for less when new infrastructure actually gets built, but high prices and cost overruns damage the electorate's faith that such projects are worthy investments rather than wasteful public spending. The problem is especially acute for the Greater Toronto Area (GTA) because the region has long suffered from an infrastructure deficit while global cities that Toronto has to compete with on the world stage keep expanding their transit systems.

It's hoped this report will spur readers from many walks of life to ask why, in such a wealthy and entrepreneurial country, we lost the ability to continually develop high-quality rapid-transit infrastructure at reasonable prices. Toronto was once such a model of accomplishment in this area that experts from other countries came to study how it was done. Toronto was a smaller and poorer city when it built the now-overloaded core parts of its subway system, and it did so with very little funding assistance from senior governments.⁷

NOTES FROM THE INTRODUCTION

- 1 "Subways Are Nearing the End of the Line," Michael Best, *Toronto Star*, August 16, 1975, page C1. Article's subway-building cost estimates are misleading because they don't account for inflation.
- 2 "TTC Reveals Multi-Billion-Dollar Light-Rail Plan," *CTV News*, March 16, 2007. <https://toronto.ctvnews.ca/ttc-reveals-multi-billion-dollar-light-rail-plan-1.233517>
- 3 Construction cost estimates provided by Bob Nichols, senior media liaison officer with the Ontario Ministry of Transportation, by email on November 6, 2019.
- 4 "Canada's soaring subway construction costs need to get back on track," Jonathan English and Alon Levy, *The Globe and Mail*, August 9, 2019. <https://www.theglobeandmail.com/opinion/article-canadas-soaring-subway-construction-costs-need-to-get-back-on-track/>
- 5 Toronto Region Board of Trade's fifth annual Transportation Summit, titled "Delivering Megaprojects", November 27, 2019. <https://transportationsummit2019.trbot.ca/>
- 6 "Transit in the Greater Toronto Area: How to Get Back on the Rails," by Matti Siemiatycki and Drew Fagan, published in October, 2019, for the Institute on Municipal Finance and Governance, which is based in the Munk School of Global Affairs and Public Policy at the University of Toronto. <https://tspace.library.utoronto.ca/bitstream/1807/96710/1/Perspectives-26-Siemiatycki-Fagan-Transit-GTA-October-2019.pdf>
- 7 "Seminal Lessons From the Toronto Transit Time Tunnel" Stephen Wickens. Story first appeared in the *Toronto Star* on Feb. 3, 2012. Retrieved on January 29, 2020, from the *WorldWideWickens.com* blog. <http://worldwidewickens.com/?p=406>

2.0 THE JOURNEY

Based upon decades of reading (books, reports, archival sources) as well as interviews with professionals and academics about how transit-infrastructure costs have evolved in Toronto and other developed-world cities, this report aims to:

- a) Identify assumptions, approaches and other factors that have led governments and their agencies to the current designs, methods and business models. The report has aimed to discover whether the approaches to rapid-transit design and building in the GTA are outdated or, possibly, just not as good as they once were;
- b) Identify proven best-practice examples from other parts of Canada and the world, as well as from our own past. The report will look for methods and business models that can be adopted or adapted to serve long- and medium-term goals and needs;
- c) Provide guidelines for better stations and rapid-transit lines, project-evaluation methods and delivery models, while keeping in mind that there is a significant difference between cost and value.

3.0 HOW MUCH DO RAPID TRANSIT STATIONS COST?

Photo: Stephen Wickens



How much do rapid-transit stations cost? It's a basic question for which no simple answers can suffice. But for anyone committed to ensuring the public receives optimum or even adequate returns on major transit-infrastructure investments, it's a good starting point.

In the wake of concerns the public may have overpaid for stations on the recently opened Toronto-York-Spadina Subway Extension (TYSSE), it is probably an urgent question now that governments plan to fast-track four projects in Toronto:

- The proposed Scarborough Subway Extension (SSE);
- A “relief line” through the city’s core, now branded the ‘Ontario Line’;
- A Line 1 extension from Finch station under Yonge Street to Richmond Hill;
- And a tunnelled western extension of the still-under-construction Eglinton Crosstown light-rail line.

Two of those projects could reach a point of no return in 2020, with the launching of a request-for-proposals process in March. Metrolinx CEO Phil Verster is on the record saying, “This year alone on the subways we’ll be taking two of the subway projects into tunnelling contracts which we’d like to have concluded and awarded.” (He later clarified that he means the SSE and Eglinton West).¹

As we will learn through the first half of this report, decisions about whether to tunnel or not, what types of tunnels are chosen and how deep tunnels sit, go a long way toward determining whether stations can be built cost effectively at all.

While design considerations are different for surface GO and SmartTrack stations, Metrolinx’s GO Expansion project (formerly known as Regional Express Rail) and SmartTrack-station funding promises announced during the 2019 federal election campaign should make discussion of those stations timely as well.²

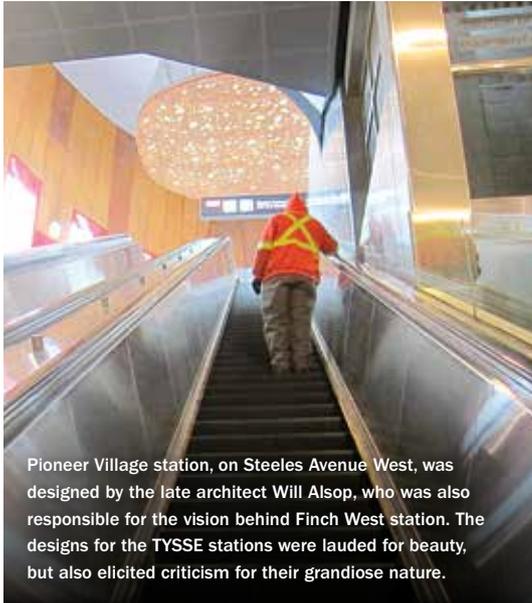
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4.0 20/20 HINDSIGHT ON THE TYSSE

Photo: Stephen Wickens



Pioneer Village station, on Steeles Avenue West, was designed by the late architect Will Alsop, who was also responsible for the vision behind Finch West station. The designs for the TYSSE stations were lauded for beauty, but also elicited criticism for their grandiose nature.



Prime Minister Justin Trudeau joins then-Premier of Ontario Kathleen Wynne and Toronto Mayor John Tory, among others, for the ribbon-cutting of the TYSSE.

Photo: Jenna Muirhead



Photo: Stephen Wickens

There was both praise and criticism when the TTC's Toronto-York-Spadina Subway Extension (TYSSE) opened in December 2017.

Praise from officials at the various levels of government that supported the 8.6-kilometre, six-station TYSSE project was a given, just as it was from York University students and employees (past and present) who had reason to feel quality rapid transit was overdue to a major university campus that began life on largely rural real estate north of the Toronto Bypass (as Highway 401 was known in the late 1950s, when much of the local transportation-planning focus was largely on private vehicles and the TTC's subway "system" was a single 7.4-kilometre line from Eglinton Avenue to Union Station).

Some York Region officials, residents and property developers were also quick to highlight TYSSE benefits to the areas "above Toronto" and noted that much of the worth and payback to that largely car-dependent part of the Greater Toronto Area would be well in the future.

Pundits and transit users who praised the TYSSE seemed impressed by the new stations, six structures designed by world-renowned architects, including Norman Foster's firm (York University station) and Will Alsop (Pioneer Village and Finch West). "Though as utilitarian as anything in this degraded landscape, they are also unabashedly beautiful," wrote Toronto Star architecture and urban affairs columnist Christopher Hume.¹

Ian Trites, the TYSSE's supervisor of architectural design put it this way in a piece by Chris Bateman for the U.S.-based CityLab website. "Each of the six new stations is a unique creative expression that blurs the line between public art and architecture; a philosophical continuation of the original Spadina line that opened in 1978, and was the first Toronto subway line to feature stations designed by multiple architects. We've found that when you do good urban design, good architecture, the local communities take ownership of the stations. Kids are less likely to vandalize them, there's lower maintenance as a result, and people actually enjoy being in the stations."²

The TYSSE station-design philosophy was set out in a September 2009 report and approved by TTC commissioners that month.³ Emphasis was to be on “architectural excellence” employing (among other points):

- Integrated design of all elements with strong aesthetics, high-quality urban design, and public artwork;
- Column-free structures when possible, high ceilings and simple flow of space;
- Bright, open spaces with daylight penetrating deep into stations where possible;
- Barrier-free with at least one fully accessible entrance;
- Use of TTC standard elements; and sustainable design to meet the Toronto Green Standard;
- A project focus on public buildings that are expected to remain standalone for the foreseeable future, until such time as they are integrated into development. Protection for future connections is a key goal.

To what degree those priorities drove costs higher is tough to estimate; researchers who have compared subway-building costs internationally have concluded that station depths necessitated by tunnelling choices were a much bigger factor (a topic we will get to later).

Criticism of the TYSSE project in the days surrounding the opening was found in the same pieces by Hume and Bateman, as well as by *Globe and Mail* architecture writer Alex Bozikovic, who referred to the stations as “secular cathedrals,” in part because of the size of the spaces created (including at some stations unlikely to generate even modest ridership numbers in the foreseeable future).⁴

One major criticism hinged on arguments about whether a suburban subway extension – or at least a suburban extension of such length – was an appropriate priority when parts of the subway system in older areas of the city have been overloaded for decades. That discussion is not a part of this report, which will focus primarily on whether the designs and methods employed in building rapid transit give the taxpayers of Toronto, York Region, Ontario and Canada the best infrastructure at the best price.

NOTES FROM 4.0

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- 2 “The ambitious design and low density of Toronto’s newest subway stations”: Chris Bateman, *CityLab*, December, 2017. <https://www.citylab.com/transportation/2017/12/the-ambitious-design-and-low-density-of-torontos-newest-subway-stations/548615/>
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5.0 THE TYSSE HISTORY



Dalton McGuinty and Stephen Harper reannounced the TYSSE subway project in March 2007, when it became official that Ottawa was in for one-third of the project's then estimated \$2.1-billion cost. McGuinty's finance minister Greg Sorbara, second from left, and his federal counterpart, Jim Flaherty, right, had cut a deal whereby Ottawa would help fund the subway to Vaughan that Sorbara wanted, in exchange for Queen's Park funding 400-series highway expansions in Durham, Flaherty's riding.

Photo: Jenna Muirhead



Photo: Stephen Wickens

York University and Pioneer Village are not just deep and costly stations, they're already showing signs of water damage. Some have questioned why we opted for costly tunnels through a low density area for the TYSSE project, while retired transit planner and engineer Ed Levy adds that going underground through an area with drainage issues could pose long-term problems.

A Spadina subway extension to serve York University had long been a priority of government officials and the TTC. When Greg Sorbara was a rookie MPP in 1986, he envisioned bringing the subway to the York campus. Two decades later, as provincial finance minister, Mr. Sorbara cut a deal with then-federal finance minister Jim Flaherty to secure funding from Ottawa for a subway extension all the way to Vaughan in exchange for Queen's Park's backing of the 407 East highway.¹

The TYSSE plan was unveiled in Ontario's 2006 budget, when "the Province announced the creation of 'Move Ontario,' for the purpose of investing in public transit, municipal roads and bridges, including allocation of \$670 million to extend the Spadina subway from Downsview Station in Toronto to the Vaughan Corporate Centre at Highway 7 in York Region ("the Project"). The subway extension Project will comprise a total of six new stations, at an estimated capital cost of approximately \$2.1 billion."²

The Project was reannounced on March 3, 2007, when then-prime minister Stephen Harper committed Ottawa to providing a one-third share (up to \$697 million) for the TYSSE. Aside from the province's one-third contribution, the remaining third was to be split on a 60-40 basis between the City of Toronto and the Region of York. The extension was slated to be open to the public in 2014.³

When ground was broken nearly 21 months later, on Nov. 27, 2009, the cost estimate had risen to \$2.445 billion: Queen's Park's contribution was up to \$870 million, the municipal share was up to \$878 million (\$526 million from Toronto and \$352 million from York Region). Ottawa held to its \$697-million share, roughly one-third of the original \$2.1-billion estimate.⁴

By 2011, the budget had risen to \$2.6 billion and the opening date was pushed back to 2015 from 2014).⁵ The budget had risen again to more than \$2.8 billion by 2015 (with a March 2016 opening date) when a project "reset" and another \$400 million was requested in hopes of having the line open by 2017. At that point, the TTC fired two project managers and engineering firm Bechtel was brought in to see the TYSSE project through to completion.⁶ The extra \$400 million was approved and, at a final cost of \$3.2 billion, the line opened to the public on Dec. 17, 2017.

In a Globe and Mail article, Andy Byford, the then TTC chief executive, pointed to a series of problems. Among them was the scope of the stations, which he said changed a few times, going from "utilitarian box structures to something much more grandiose" before being scaled back to the current, still quite grand, designs.⁷

Also, at the time of the 2015 "reset", KPMG was hired to probe project management and cost overruns on the TYSSE and other TTC projects, though the firm did not directly address cost implications of station designs or whether deep-bore tunnels through a low-density area was wise from a value-engineering perspective. KPMG's report, released in 2016,⁸ was based in part on interviews with people involved in the TYSSE and other projects. It did not include conversations with people who warned about potential problems, including David Gunn, a former TTC chief who raised concerns in a 2011 Globe and Mail article about "grandiose stations."⁹ At that point, the public was still being told the project was on budget and on schedule. Cut from the Globe story for space reasons was a comment from Mr. Gunn, questioning the decision to tunnel the TYSSE.¹⁰

Beyond cost considerations of tunnelling in a low-density context, some, including veteran transportation planner and engineer Edward Levy, point to the added risks of boring deep through areas with significant underground drainage issues. Noting obvious water-damage issues already showing up at some TYSSE stations, including York University and Pioneer Village, Mr. Levy calls it "a nightmare scenario that has always mitigated against secure, water-resistant subway building in our metropolitan area." He adds that, "Something went terribly wrong in the vicinity of Pioneer Village station, which delayed the project for many months, and this is just the initial example of what will, I fear, be a long series of very costly maintenance problems resulting from relentless water infiltration."

NOTES FROM 5.0

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- 6 TTC report for January 21, 2016 commission meeting.
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- 8 TTC Capital Program Delivery Review from the city manager and TTC chief executive officer: September 21, 2016, with KPMG report attached.
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- 9 “TTC makes dumbest decision ever, former head warns”: Stephen Wickens, The Globe and Mail, July 5, 2011. <https://www.theglobeandmail.com/news/toronto/ttc-makes-dumbest-decision-ever-former-head-warns/article585859/>
- 10 This report’s author wrote the 2011 Globe and Mail story based on his interview with Mr. Gunn.

6.0 TYSSE STATION COSTS

Photos: Stephen Wickens



Deep stations are particularly reliant on long and costly escalators, which aren't always in service.



The TYSSE stations have been lauded for beautiful designs, but they are the deepest and most expensive stations built to date on the TTC subway system.



Development is happening at Vaughan Metropolitan Centre station, where the long-term plan is to create a transit-oriented downtown for the city in York Region.

It is difficult to determine what role station costs played in this latest extension's cost escalation, especially because the TTC cannot account for specific components of the project, including broken-out final costs for two of the stops.

In 2011, when the budget was \$2.6 billion, \$100 million had been set aside for land acquisition,¹ a base factor in station costs. However, there are apparently no public records of how much land acquisition eventually cost in total.

A Freedom of Information request for details of the amounts paid to architecture firms for station designs did not yield information, either. Initially, the TTC said the information was available at the City of Toronto Archives. After archives staff were unable to find any records, the TTC said it had no information about how much the public paid to the architecture firms for the stations because it had sub-contracted design work.

In 2010, the TTC estimated the six TYSSE stations, exclusive of real estate, would cost \$857 million in total, about one-third of the then-overall project budget.

- Sheppard West station, which later became Downsview Park (\$100 million)²
- Highway 407 (\$140 million)³
- York University (\$124 million)⁴
- Vaughan Metropolitan Centre (\$200 million)⁵
- Finch West (\$148 million)⁶
- Steeles West, which later became Pioneer Village (\$145 million)⁷

According to a July 2014 progress report the TTC produced for the federal government, station-cost estimates appear to have risen 20 per cent in four years from \$857 million to \$1,028,500,000 (though that total may or may not have included design costs).⁸ As the TTC was at that point sticking with its overall \$2.6-billion estimate, the station-cost component may have risen from 33 per cent of the total to 39 per cent, if design costs were not included.

Aside from overall cost estimates, design budgets were rising quickly in the early years of the project. In March 2010, the TTC board approved a 72% budget increase for design work on Downsview Park station, from \$8 million to \$13.8 million.⁹ Less than three months later, the TTC board approved a 53% budget increase for the Finch West station (going from \$12.4 million to \$19 million).¹⁰

The following month, design budgets for two more stations were increased significantly: Pioneer Village rose 52%, from \$15.3 million to \$23.2 million,¹¹ while Vaughan Metropolitan Centre rose 96%, from \$12 million to \$23.6 million.¹² Less than a year later, in May 2011, the cost of design work for Highway 407 station, estimated at \$12 million in 2008, rose from its 2010 estimate of \$19.6 million to \$23 million. Final design costs then rose further.¹³

As Andy Byford said in 2017, overall station costs were eventually reined in. Some of that may have been a result of the “reset” begun in 2016, though five of the six stations were deemed to be more than 80% completed by then.¹⁴

Overall, it is unclear what the stations eventually cost because: a) for tendering and final-tally purposes, the TTC lumped in tunnelling with the Downsview Park and Highway 407 station costs; b) the TTC didn’t include design costs when it released station-cost totals to the public; and c) the TTC did not answer questions about what changes were made to cut costs after the project reset.

The TTC did confirm the stations are 20 to 25 metres deep (66 to 82 feet). That’s the equivalent of six- or seven-storey buildings underground, making the TYSSE stations the system’s deepest, so far, and about twice the depth of nearly all TTC subway stations built prior to the Yonge Subway Northern Extension in the 1970s. Final construction costs for the four TYSSE stations whose tabs were broken out came in below 2014 estimates done for the progress report demanded by Ottawa, and three of the four stations are listed as having cost less than the 2010 estimates, excluding the sub-contracted design costs.

Figure 4: TYSSE Station Construction Costs

Station	2010 est.	2014 est.	Final cost*	+ Design cost**
Downsview Park	\$100M	\$147.1M	n.a.	n.a.
Finch West	\$148M	\$163.5M	\$126.6M	\$33.2M
York University	\$124M	\$137.3M	\$118M	\$25.2M
Pioneer Village***	\$145M	\$215.6M	\$165.9M	\$45.3M
Highway 407	\$140M	\$159.4M	n.a.	\$32.6M
Vaughan Metro	\$200M	\$205.6M	\$197.8M	\$28.7M

* In 2017 dollars, multiply by 1.04 to get 2019 dollars.

** Design costs for each station appear to not have been included in the “Final costs,” but other TTC documents indicate they may have come to about \$200 million in total.¹⁵

*** Pioneer Village has been subject to litigation between the TTC and Walsh Construction. The contract’s value, according to court documents, had risen to \$223.8 million by 2018.¹⁶

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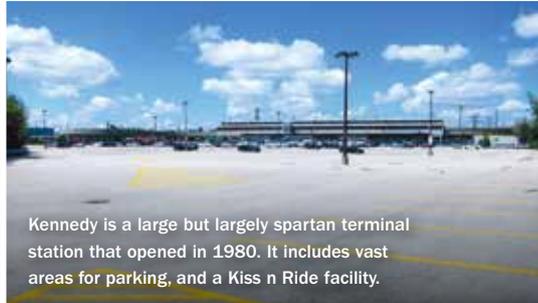
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- 11 Report to TTC meeting on July 14, 2010.
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- 14 Report from TTC CEO Andy Byford to the TTC board on January 21, 2016, titled Toronto-York Spadina Subway Extension – Schedule and Budget Reset, http://www.ttc.ca/About_the_TTC/Commission_reports_and_information/Commission_meetings/2016/January_21/Reports/Board_Report_TYSSE_Schedule_and_Budget_Reset_2016-01-21_fina.pdf
- 15 Report from TTC CEO Andy Byford to the TTC board on February 25, 2016, titled Toronto-York Spadina Subway Extension Procurement Authorization Amendments to Various TYSSE Consultant Contracts.
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7.0 COMPARING THE TYSSE WITH OLDER TTC PROJECTS

Photos: Stephen Wickens



Bessarion station was in danger of being eliminated altogether when cost savings were being sought for the Sheppard subway project.



Kennedy is a large but largely spartan terminal station that opened in 1980. It includes vast areas for parking, and a Kiss n Ride facility.



Downsview station.



Dupont station's Spadina Summer mosaics were designed to be uplifting for commuters starting their day.

A summary of older TTC subway-building contract awards can be found in the appendix (contract records in greater detail are available at the City of Toronto Archives).¹ For this chapter, costs related to stations from six specific projects (listed in reverse chronological order) were selected as the most useful cases for comparisons with the TYSSE:

- The five-stop Sheppard subway that opened in 2002;
- The one-stop Line 1 extension from Wilson to Sheppard West station (formerly Downsview) that opened in 1996;
- The addition of North York Centre station, which opened in 1987 on a 1970s part of the Yonge line;
- The twin one-stop extensions on Line 2 to Kipling and Kennedy, which opened simultaneously in 1980;
- Yorkdale station on the Spadina Line 1 extension that opened in 1978;
- Sherbourne and Yonge stations on the original Bloor-Danforth subway, which opened in 1966.

Sheppard subway (Line 4): The second most recent of the TTC's subway projects, this five-stop line opened on November 22, 2002, at a capital cost of \$934 million (\$1.28 billion in 2019 dollars). The line is technically 6.4 kilometres long, though the revenue operations route (excluding tail and connecting tracks to Line 1) is 5.5 km. When it opened, it was by far the most expensive subway Toronto had ever built, even though the Province, when it committed to funding the project, demanded emphasis on a “no-frills” approach that would aim to bring the proposed budget down by as much as 20%.

The Toronto Star reported that attempts at savings included the use of bare concrete floors instead of the terrazzo tiles traditionally used by the TTC (\$2.3 million), no ceiling finishes or sound insulation (\$2.4 million), the elimination of a bus terminal at Bayview (\$7.4 million),



Photos: Stephen Wickens

The Spadina Line, which opened in 1978, put more emphasis on artwork and design than any previous TTC subway project, but it still delivered its stations inexpensively compared with stops built in the 21st century. Eglinton West's homage to the iconic PCC streetcars that served the city for much of the 20th century, still appears to get the attention of subway users.

and the nixing of a direct connection between Leslie station and North York General Hospital (\$750,000).² The contingency fund for cost overruns was also removed and there was discussion of dropping Bessarion station altogether (original plans also called for a sixth station, at Willowdale Avenue, which was never built).

At the time, while speaking with reporters, Mr. Gunn, the then-TTC chief general manager, said there was little room for significant budget cuts. “The savings we’re trying to find aren’t going to amount to a lot overall; the budget is already tight for the project that politicians have locked us into. Once you’ve committed to a deep set of tunnels, your stations are going to be very expensive no matter what you tile the walls with, or whether you tile them at all.”³

Depending on which line length you use, Sheppard cost \$145.9 million/km or \$169.8 million/km (\$199.4 million/km or \$232.1 million/km in 2019 dollars). Either way, those numbers compare very favourably with the \$372-million/km (\$387-million in 2019 dollars) cost of the TYSSE. Overall, however, the Sheppard line’s per-km cost was more than twice the inflation-adjusted totals averaged for all prior TTC lines.

Line 4’s five stations cost \$371-million (in 2002 dollars)⁴, 39.7% of the overall project total (on par with the possible 39% for TYSSE stations when the 2015 “project reset” was deemed necessary). For comparison with the TYSSE (using 2019 dollars for both), Line 4’s stations cost an average of \$101.7-million while the TYSSE’s came in at \$158.6-million (not including design costs) – 56.9% more than the Sheppard line’s stations.

Line 4’s stations, however, even after accounting for inflation, were far more expensive than those on previous TTC projects – likely in large part because they are much deeper. Sheppard/Line 4 is 15 metres to 18 metres deep,⁵ or 50% to 100% deeper than the stations on older underground parts of Toronto’s subway (but considerably shallower than TYSSE stations, 20 metres to 25 metres).⁶ Bessarion is a very expensive station compared with ones built on earlier TTC projects, even after adjusting for inflation. But on the TYSSE, the public may have spent as much money just to design Pioneer Village station as it had done to build Bessarion. Sheppard’s stations are big because most are effectively underground buildings that are four to five storeys deep.⁷ They are costly despite employing fairly rudimentary designs and finishes (platforms are shorter, too, accommodating only four-car trains, though knockout panels will allow platforms to be extended easily when or if six-car trains can be justified).

Photo: Stephen Wickens

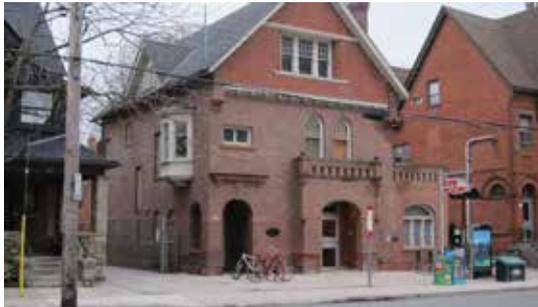


Image: Courtesy of The Serafin Family

Left: The north entrance to Spadina station, on the Spadina Line, made use of Victorian mansion. **Right:** Sigmund Serafin was hired by the TTC to illustrate plans for many of Toronto's early stations. This rendering of Bloor-Yonge station is looking south, with Yonge Street on the right. Toronto got the interchange station at a low price, but it is so inadequate for the subway network's needs that renovation plans are in the works that are expected to cost in excess of \$1-billion.

Figure 5: Sheppard Line Station Costs			
Station	2001 est.*	Final cost**	In 2019 \$
Sheppard Yonge	\$140.0 million	\$120.0 million	\$164.4 million
Bayview	–	\$61.0 million	\$83.6 million
Bessarion	–	\$35.0 million	\$48.0 million
Leslie	–	\$58.0 million	\$79.5 million
Don Mills	\$88 million	\$97.0 million	\$132.9 million

* Estimates from Feb. 17, 2001, Toronto Star article, pages B1, B4.

** Final costs supplied by TTC do not include tail track and tail-track tunnels, which totalled \$138 million (or \$189.1 million in 2019 dollars).

The Downsview Extension: On March 31, 1996, a one-stop Line 1 subway extension was opened from Wilson to Downsview station (since renamed Sheppard West). David Gunn, the TTC's chief at the time, chose not to attend the opening ceremony, saying the project he had inherited would add to the TTC's operating costs without bringing in new riders or revenue.⁸ In a June 2019 interview, he described the station itself as “unnecessarily grand.”

In May 2019, the TTC said by email it was “not resourced” to provide details on how much the station cost. City archives staff could not find a record either. Archive documents do show the entire project cost \$117 million (\$179 million in 2019 dollars). That means, after adjusting for inflation, the 1.6-km extension, including its station, cost just \$20.4 million more than an average TYSSSE stop. Downsview station (now Sheppard West) was likely costly on its own because it has a full-length mezzanine and sits as a single-use building on a large piece of real estate. Perception that it was extravagant helped shape then-transportation minister Al Palladini's views about how the then-future “no frills” Sheppard subway should be built. He wrote to Metro Chairman Alan Tonks in March 1996 to say Downsview station “is not the type of facility the province would envision being built under this ‘no-frills’ approach.”⁹



Photos: Stephen Wickens

Yorkdale station on the Spadina Line got a lot of attention when it opened in 1978 because of an art installation that put on a rooftop light show when trains entered the station. However, that electronic art work fell into disrepair. The sides of the station had windows designed to look like the windows on subway trains of that era.

On a per-km basis, using 2019 dollars, the 1996 extension cost \$111.9 million. That is about 25% more expensive than the inflation-adjusted average of Toronto’s first six subway projects, but less than half the \$232.1-million/km cost for the Sheppard subway. The TYSSE, at \$387 million/km cost about 3.5 times more than the Downsview extension, while the proposed Yonge North Extension is projected to cost 6.8 times as much, or \$756.8 million per km.

The Downsview project was likely cheaper than subsequent projects because it made use of an aboveground corridor portion and cut-and-cover construction where tunnelled.

North York Centre station (NYC): As the only stop the TTC has ever added to an existing subway (opening in 1987, more than 13 years after the Line 1 extension from York Mills to Finch), NYC offers a rare, fairly isolated case of a station cost. The TTC’s summary of Contract Y18-1 (awarded to Folco Construction), lists a final price of \$19.2 million (\$38.5 million in 2019 dollars).

The station would have been less expensive if it had been built as part of the original subway project, in part because the TTC felt in the 1980s that it was better overall to limit construction flexibility than interrupt service on the Yonge subway. Costs could have been higher, too if not for the fact that the stretch of Line 1, from Sheppard to Finch, has shallow cut-and-cover tunnels, allowing the station to be just 13 metres (42.7 feet) below the surface.

The cut-and-cover choice was made primarily to save costs with the YSNE project running over budget, but proponents of the decision also argued that switching to cut-and-cover tunnels would speed overall construction time by about a year.¹⁰

In the end, after adjusting for inflation, average station costs on the TYSSE were 4.2 times higher than NYC (not including TYSSE station design costs). Sheppard’s “no frills” stations on average were 2.6 times as costly as NYC.

The twin one-stop Line 2 extensions opening in 1980: Kennedy and Kipling are two large but largely utilitarian terminal stations that include expansive parking facilities and GO rail connections. The Kipling extension was 1.5 km (nearly all above ground). The Kennedy extension was 2.8 km (300 lineal metres above ground and 2.5 km of cut-and-cover tunnels). According to

archived documents, no part of the excavations on either end exceeded 40 feet (12.2 metres).

At least four figures were used as the final combined project cost: \$103 million, \$110 million, \$114 million and \$127 million (the lowest ones probably don't include extra rolling stock needs, though we were unable to confirm that). To be most conservative for comparisons, the highest cost number was used, which works out to \$402.6 million in 2019 dollars. On an inflation-adjusted basis, the project was done for \$93.6-million/km. By contrast, the TTC's newer, deep-tunnelled projects (TYSSE and Sheppard) came in respectively at \$383.7 million/km and between \$199.4 million/km to \$232.1 million/km in real dollars.

Contracts awarded for **Kennedy** (F3-1, F3-3 and F3-4) show the job was done by two firms, Mollenhauer and Folco, for \$10.6 million (\$33.7 million in 2019 dollars). The structure and finishes cost \$6.798 million, with \$1.1 million spent on the parking lot and roughly \$650,000 on escalators (half the \$1.3 million spent on escalators for the two-station project). The total includes \$2 million for tail tracks and crossovers (two figures, \$1.994 million and \$2.018 million, are referenced). Contract summaries do not show if land costs for the parking were separate, though they likely were not included in construction costs.

Kipling was more costly. Contract F7-1, worth a bit more than \$8 million, was awarded to Janin Building and Civil Works and covered the structure and finishes with an electrical sub-station and a Kiss-n-Ride facility. Contract F7-2 was awarded to Mollenhauer for construction of associated roadways and parking facilities for \$2.7 million. The all-in tab (likely minus land costs) was \$10.8 million (\$34.3 million in 2019 dollars).

The average price for these two stations in 2019 dollars is \$34 million, meaning that even after adjusting for inflation, stations on the TYSSE cost 4.7 times as much, while Sheppard-line stations cost about three times as much. Kipling and Kennedy are large terminal stations, and it's worth noting that the February 1966 *Coupler* (an in-house TTC publication) has an article explaining why terminals tend to cost about twice as much as regular stations.

Yorkdale station on the Spadina line: Yorkdale was a high-profile stop on the eight-station, 10-km extension of what had previously been known as the Yonge-University subway. It opened to fanfare on Jan. 28, 1978¹¹ and was a highlight of Toronto's first departure from standardized stations. Yorkdale featured a design by Canadian architect Arthur Erickson and the art of Michael Hayden, whose *Arc en Ciel* put on a ceiling light show visible from considerable distances when trains entered the station – until the art installation was allowed to fall into disrepair.

Unique designs on the line were in part a response to praise Montreal had received for its Métro stations. Critics comparing Montreal's stops with the TTC's early efforts ridiculed Toronto's "bathroom tile architecture."¹² Largely because the Spadina stations from Eglinton West north, including Yorkdale, were above ground (on an expressway median), they were inexpensive to build, a short-term benefit. But they were poorly located for spurring transit-oriented catchment zones capable of earning returns on the subway investment. Even with aboveground sections, Spadina-extension costs exceeded initial estimates by 42%, dampening the Province's enthusiasm for subway building and spurring Queen's Park to step up its quest to find a technology that would be cheaper than subways.

Other Spadina-line station costs were broken out, with the exception of Eglinton West, but this report has singled out Yorkdale because it was seen as having succeeded on architectural quality, art and aesthetics – concerns that some have blamed recently for soaring subway-building costs. Yorkdale station was built for \$4.8 million (\$19.8 million in 2019 dollars). Contract A15-1 was for the “construction of and architectural finishes for Yorkdale station and associated structures,” including a 1,000-foot (305-metre) enclosed bridge from the station into the shopping mall. The contract was fulfilled by Janin on Nov. 28, 1977.

Even after adjusting for inflation, Yorkdale cost about one-tenth of some TYSSE-extension stations – and it delivers more riders to the system on an average weekday than all of them except York University.

Figure 6: Station Costs That Could Be Determined For The Spadina Line

Station	Final cost	In 2019 \$
Wilson	\$11.2 million	\$46.2 million
Yorkdale	\$4.8 million	\$19.8 million
Lawrence West	\$4.6 million	\$22.1 million
Glencairn	\$4.1 million	\$17.0 million
St. Clair West*	\$13.8 million	\$66.7 million

* Contracts for St. Clair West’s 500-foot-long (152.4-metre) station at platform level include 1,059 feet of cut-and-cover tunnel construction.

Sherbourne and the Line 2 part of Bloor-Yonge: The University-Bloor-Danforth subway project (Union to St. George and Keele to Woodbine) was built in 75 months (November 1959 to February 1966). It had 25 stations over 16 km and cost the equivalent of \$1.6 billion in 2019 dollars. Nearly all the contracts for the project’s stations included tunnel work, but Sherbourne and Yonge (the lower part of Bloor-Yonge station) were broken out enough to get a sense of station costs in the 1960s.

Contract D1-A was awarded to the Foundation Co. of Canada and called for underpinning Bloor station on the Yonge Line, construction of the lower-level parts of Bloor-Yonge station and creation of interchange infrastructure (mezzanines, stairwells, escalators and washrooms), for \$1.4 million (\$11.3 million in 2019 dollars). An average TYSSE station cost 13.4 times as much in 2019 dollars. Work was done in 16 months ending in October 1964. Depth is listed as 45 feet (13.7 metres), deep for the time but necessary as it was below Bloor station on the Yonge Line. TYSSE stations are 20 to 25 metres below ground, or 46% to 82% deeper.

Contract D-2A was awarded to Dineen Construction Ltd. It called for construction of Sherbourne station with a second entrance at Glen Road for slightly more than \$1 million (\$8.6 million in 2019 dollars). Even after inflation, an average TYSSE station cost 18.2 times as much.

Work began Feb. 5, 1962 and the contract was fulfilled as of May 26, 1963. Station depth is 40 feet (12.2 metres), deep for the time, but far shallower than the stations we've opened in the 21st century.

The cost of Yonge station in the 1960s was extremely low, but it has turned out to be anything but a bargain. Bloor-Yonge has long been unable to handle crowds hoping to use it, often even well beyond the peak periods (the station was designed under the assumptions that interlining of Lines 1 and 2 would obviate much of the need to change trains, and that another east-west subway through downtown would be built by the 1980s). Recent cost estimates for expanding the overloaded interchange station have been in excess of \$1 billion, nearly two-thirds as much as the inflation-adjusted cost of the entire University-Bloor-Danforth project.¹³

Under-investment in the overall University-Bloor-Danforth project and a fixation on avoiding cost overruns also had tragic consequences: Nine construction workers lost their lives and many more were injured on the job.¹⁴ Protecting lives adds costs, but it is not something we should ever economize on.

NOTES FROM 7.0

- 1 City of Toronto Archives, Spadina Records Centre: Fonds 16 (TTC fonds), Series 836 (materials of the TTC corporate library), Subseries 2, File 33 ... Box 380746, Folio 11
- 2 “‘No Frills’ Sheppard Subway \$35 million over budget”: Paul Moloney, Toronto Star Pages B1 and B5, June 29, 1998.
- 3 David Gunn speaking with reporters at a scrum at City Hall, June 28, 1998.
- 4 Email from Stuart Green Senior Communications Specialist, Media Relations and Issues Management at the TTC, May 8, 2019.
- 5 Transit Toronto report. <https://transit.toronto.on.ca/subway/5110.shtml>
- 6 Email from Stuart Green Senior Communications Specialist, Media Relations and Issues Management at the TTC, June 10, 2019.
- 7 Storeys are roughly 3.3 metres to 3.5 metres tall according to the City of Toronto's midrise guidelines report, produced in May 2010. <https://www.toronto.ca/wp-content/uploads/2017/08/960c-Performance-Standards-for-Mid-Rise-Buildings.pdf>
- 8 “All Aboard the Wal-Mart Express” John Barber, The Globe and Mail, March 10, 2007.
- 9 “New Subway Faces Cut of \$100 Million”, by Bruce Campion-Smith, Toronto Star, April 3, 1996, Page A6
- 10 “TTC Urges Excavating Subway to Finch”, no byline, Toronto Star, November 24, 1970, Page A1 (by excavating, the headline means using cut and cover instead of bored tunnelling).
- 11 Prominent stories in all papers late January, 1978.
- 12 Subway Art debate, Toronto Star, Page B3, February 6, 1976. Toronto Alderman Colin Vaughan argues for art under the headline “Put joy in a drab place.” Etobicoke Controller Pete Farrow argues against under the headline “Service before cosmetics.”
- 13 “Toronto is Planning a Pricey Expansion of Bloor-Yonge Station to Reduce Overcrowding: David Rider”, Toronto Star, April 3, 2019. https://www.thestar.com/news/city_hall/2019/04/03/toronto-is-planning-a-pricey-expansion-of-bloor-yonge-ttc-station-to-reduce-overcrowding.html
- 14 “Painting is Theme of Plaque Honoring 9 Subway Dead,” no byline, Page 43, Toronto Star, November 16, 1966.

8.0 THE CASE OF THE LOST SCARBOROUGH CORRIDOR

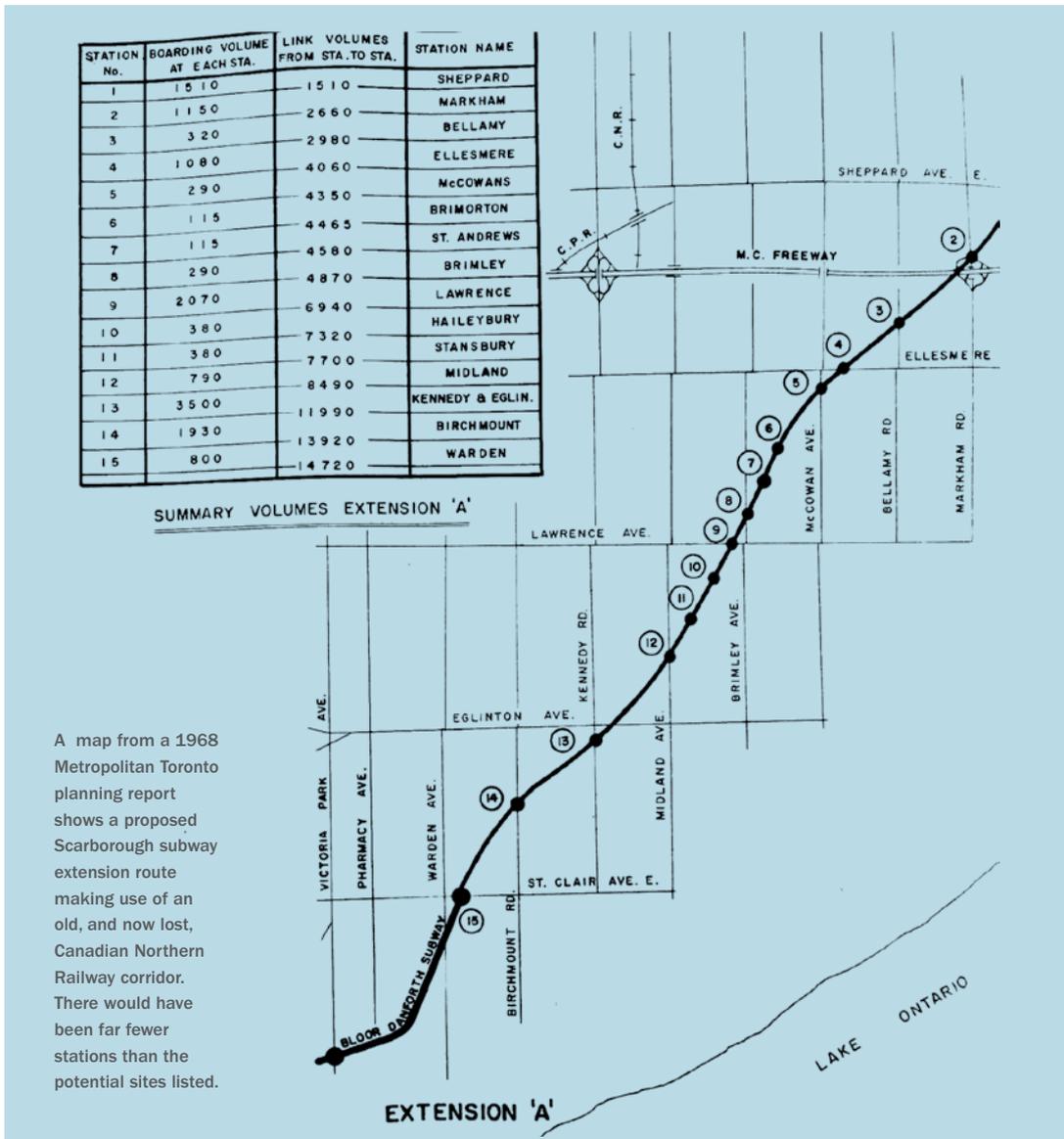


Photo: City of Toronto Archives

One of the most telling local comparisons from the past may lie in a route not taken decades ago, an opportunity not seized. Alternatives were considered before the Province, the old municipality of Metropolitan Toronto and the former city of Scarborough settled in 1981 on the Scarborough RT (SRT), which is now set to be replaced by the Scarborough Subway Extension (SSE).

The best-known alternative would have used light-rail vehicles, specifically the CLRV (Canadian Light-Rail Vehicle) streetcars that the TTC retired in late 2019. Officials settled on that option in 1977, before being overridden in 1981 because Queen's Park wanted an operating line to showcase ICTS technology being produced by the Province's Urban Transit Development Corp.

However, a subway extension was studied by the Metropolitan Toronto Planning Department and the TTC as early as 1968, when the Bloor-Danforth extension to Warden opened, and a subway option was in consideration as late as 1977, before being ruled out because it was projected to cost more than twice as much as the original \$68-million LRT estimate.¹

Archives and TTC staff were unable to find documents that would allow us to calculate a comparable per-km cost for the subway-extension option, but there are maps of the corridors considered. Option A in a 1968 Metro report shows the Bloor-Danforth continuing in the old Canadian Northern Railway right of way that Line 2 uses from just west of Victoria Park to just west of Kennedy station. That route comes close to McCowan and Ellesmere, but just south and east of the intersection (Scarborough Town Centre and Scarborough Civic Centre weren't developed until the early 1970s). There was also a less-likely Option B in 1968, using a corridor that became the north-south part of the SRT, but continuing up to the Canadian Pacific tracks north of Highway 401, giving what became Scarborough Town Centre a much wider berth.

Former Scarborough mayor Gus Harris and former senior TTC managers told this report's author in the 1980s that the cost of connecting Kennedy with Scarborough Town Centre by subway (likely with Option A) was estimated at between \$150 million and \$175 million in 1977 (\$597 million to \$696 million in 2019 dollars). Even the high end of that range is less than what was paid for the SRT (roughly \$220 million) – and it's worth reiterating the SRT's ICTS technology was developed to be a low-cost alternative to subway building. The high-end estimate for the entire 1970s subway proposal is less than the November 2019 estimate for just one kilometre of the new \$5.5-billion SSE plan – and, again, that's after adjusting for inflation.

While the 1970s cost estimate may seem remarkably low, it is in line with the final price for the two one-stop subway extensions to Kipling and Kennedy that opened in 1980. Undoubtedly, unlike the current SSE plan involving deep tunnels and deep stations, the subway idea from more than four decades ago would have used open-trench and/or at-grade and elevated tracks, like parts of the TTC's early subway system – and like what overseas metropolises with those enviable subway maps have done for subways beyond the old dense areas of their cities.

The Option-A corridor, though visible still in satellite images, has been lost. Key parts of it were sold off, providing a few small-scale residential developments and giving some homeowners larger backyards.² But a dollars-and-sense planning lesson remains: We should protect existing corridors for the long term and set aside corridors in official plans for new and expanding suburban municipalities. Even if we are going to eventually tunnel under arterial roads, long-term designated transit-corridors properly protected can ensure that shallower, less-expensive tunnels are feasible without the undue costs of relocating utilities.

NOTES FROM 8.0

1 “More Scarborough Transit Indignity”, by Stephen Wickens, September 6, 2013, [worldwidewickens.com](http://worldwidewickens.com/blog) blog. <http://worldwidewickens.com/?p=632>

2 CN has acknowledged the corridor is a “former dispersed asset,” but says all records of the transactions were transferred to the National Archives in Ottawa. ArchivesCanada.ca has been working to track down details but could not find them in time for this report.

9.0 INCREMENTAL OPPORTUNITY

**Relieving congestion:
the new downtown line.**



Thirteen years from now, we'll need relief from congestion on the busy Yonge subway line — and at Yonge/Bloor Station. The new Downtown relief line will deliver it.

Credit: TTC Pamphlet, 1985

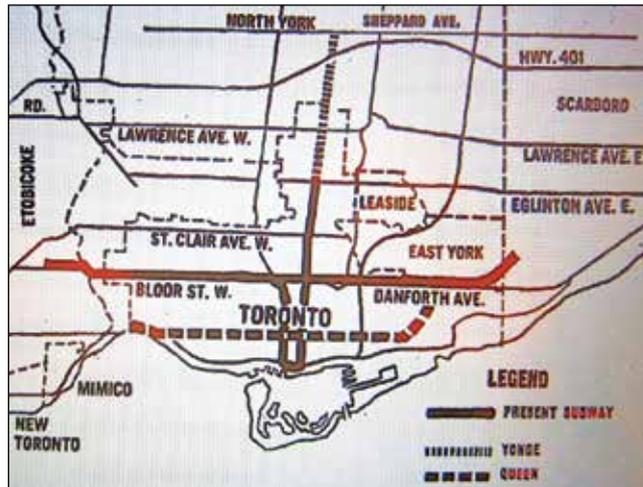
Two months after the SRT opened in 1985, the TTC and Metropolitan Toronto released a transit plan called Network 2011.¹ A Downtown Relief Line from Pape on the Bloor-Danforth subway to Union station was included at a projected cost of \$565 million (\$1.16 billion in 2019 dollars). While the proposal would have used different alignments and methods than those suggested in the city's recent Relief Line plan and the Province's Ontario Line, building it back when Toronto was good at building infrastructure cost-effectively would have saved billions over current proposals. The Ontario Line is so much longer that no fair comparison is available, but estimates from the city's plan for a project covering similar territory ranged between \$8 billion and \$9.2 billion.² That is 6.9 to 8.4 times as much as the inflation-adjusted estimate for the 1985 version of the Relief Line.

In 1968, when the Relief Line idea was called the Queen subway and crowding was already an issue at Yonge-Bloor,³ the TTC recommended a line from Donlands and Danforth, linking in the Greenwood maintenance and storage yard and extending 12.5 km to Roncesvalles in the west end for \$150 million to \$200 million (\$1.15 billion to \$1.42 billion in 2019 dollars). The project would have made extensive use of shallow, cut-and cover tunnels.

Either way, the lesson is that procrastination comes with ever-bigger prices when accepted delivery models – government procurement or P3 – are unable to keep costs under control.

NOTES FROM 9.0

- 1 “\$2.7 billion transit strategy called ‘affordable’ for Metro”, by Michael Smith, Toronto Star, Page A1, May 29, 1985. See also, pages 159-162 of Rapid Transit in Toronto, A Century of Plans, Projects, Politics and Paralysis by Edward J. Levy, Neptis 2015.
- 2 The Ontario Line Initial Business Case report, July 2019. http://www.metrolinx.com/en/regionalplanning/projectevaluation/benefitscases/20190725_Ontario_Line_IBC.PDF
- 3 \$200 million Queen subway proposed; TTC to curtail University service, Toronto Star, Pages A1 and A4, June 12, 1968. See also <http://worldwidewickens.com/?p=830>



Credit: Toronto Star Map, 1968



Credit: TTC Pamphlet, 1985

Taking the pressure off Yonge/Bloor is a priority. The Downtown relief line will do the job.

It'll open thirteen years from now. And it will connect Union Station with Pape Station.

And it will reduce congestion on the Yonge line and at Yonge/Bloor Station. Until the completion of this line, TTC will improve surface routes and add other short term measures, such as express buses on Sherbourne, to cut crowding.

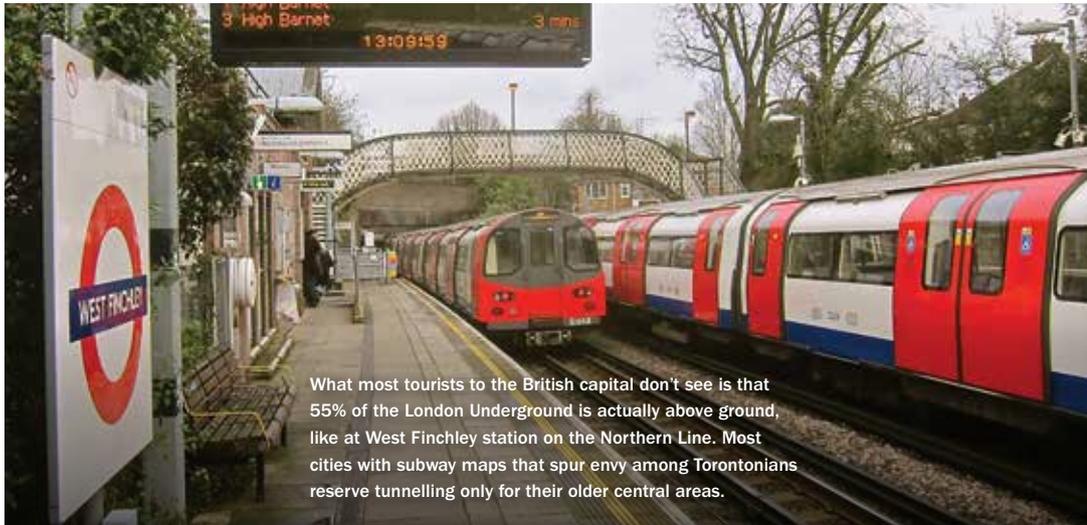
Most experts feel that the Downtown relief line will be a subway — but there may be new technology

by the time a final decision is made. Estimated cost of the project: \$565 million.

The project ties in with the \$93 million Harbourfront and Spadina light rail transit lines proposed for the late 1980's. These lines too are designed to help relieve downtown congestion — as well as giving transit-riding Torontonians easier access to all the attractions on the waterfront including the proposed domed stadium.

Above and on previous page: A TTC report accompanying the release of Network 2011 in 1985 promised to build the a Downtown Relief Line for \$565-million, which is \$1.16-billion 2019 dollars, a fraction of current estimates. A much longer version in 1968, called the Queen subway, was projected to cost \$150-million to \$200-million, or \$1.15-billion to \$1.42-billion in 2019 dollars.

10.0 COMPARING COSTS WITH FOREIGN CITIES

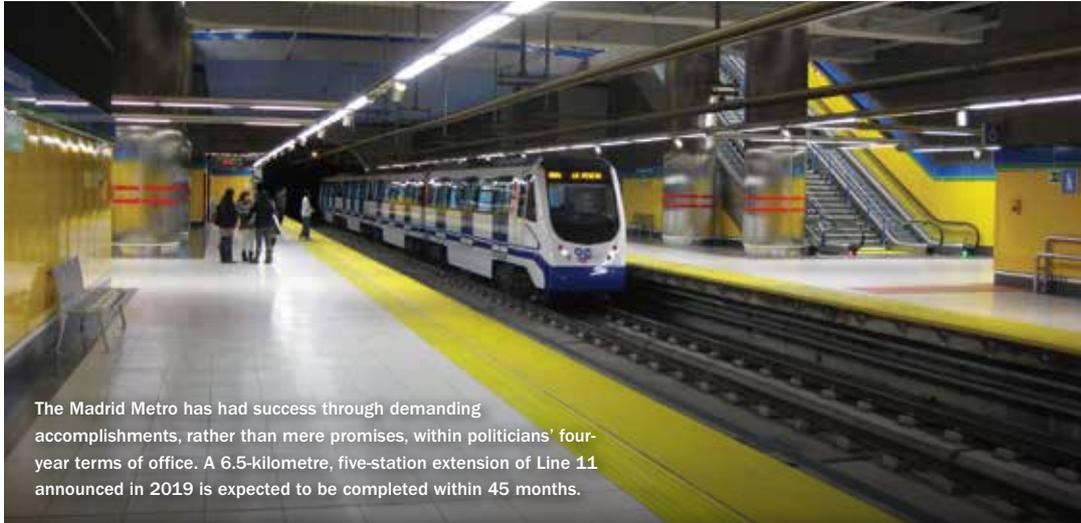


Fair international cost comparisons are difficult for various reasons. Transit agencies – despite most being public entities in democratic countries – tend not to make many details available in clear and standardized ways. Even if full details existed in open formats, however, simple comparisons would be risky, what with different labour markets; building codes and standards; soil, bedrock and water-table conditions; accounting methods; sensibilities regarding the role of public consultation and environmental assessments; business models and land-ownership regimes. Ever-shifting currency exchange rates further complicate comparisons when factoring in inflation. Comparisons can be useful, nonetheless, if we keep in mind the limitations. (This report skips over rapidly expanding systems in developing and autocratic countries in an attempt to keep comparisons fair.)

Professor Bent Flyvbjerg of Oxford University, who has written extensively on megaproject costs, has analyzed data from global metro projects. His research indicates Toronto was already expensive compared with European projects when the Sheppard line opened in 2002 (exceptions included London's Jubilee Line extension and the Météor Phase I, Line 14, project in Paris).¹

Berlin-based Israeli mathematician Alon Levy was doing a PhD at Columbia University while New York was building the notoriously costly Second Avenue Subway.² His research and questions about the SAS got the attention of New York Times reporter Brian Rosenthal, who went on to do an extensive, award-winning investigation into subway-building costs in New York.³ In 2011, Dr. Levy compared all-in per-km costs from 20 projects in 12 countries.⁴ Using his figures and adjusting for inflation, Toronto's TYSSE would come in as much less expensive than New York's SAS, less expensive than recent projects in San Francisco and London, on par with some in Japan and much more expensive than projects in Spain, Germany, France, Denmark, Switzerland, Italy, South Korea and Singapore. Estimates for the latest proposed projects appear set to move Toronto firmly into the high-cost bracket.

Dr. Levy had a tougher time obtaining station-cost details, but did a comparison involving New York, London and Paris in 2018.⁵ From MTA reports, he found SAS's 72nd Street station



The Madrid Metro has had success through demanding accomplishments, rather than mere promises, within politicians' four-year terms of office. A 6.5-kilometre, five-station extension of Line 11 announced in 2019 is expected to be completed within 45 months.

cost US\$793 million, 86th Street cost US\$644 million and 96th Street cost US\$812 million, a figure that included tunnel-boring machine (TBM) launch boxes. Less than three km of tunnels cost US\$415 million, while systems were US\$332 million. He calculates the stations, which are very deep, consumed 75% of total project costs.

In France, he found Grand Paris Express Métro stations in the €80-million to €120-million range (\$120 million to \$180 million in Canadian dollars), though GPE stops are about 20% shorter than Toronto's. The Paris Métro was mostly built with cut-and-cover tunnels, but GPE lines will be 75% underground and make extensive use of TBMs boring as deep as 16.8 metres underground (significantly shallower than the TYSSE or the proposed SSE project).⁶ Opening is slated for 2024.

London's Crossrail stations have been more costly than the Paris cases, but Crossrail tunnels are up to 40 metres deep because the line's core stitches together the London Underground network from below. Canary Wharf station was contracted at £500 million in 2007, which, at current conversion rates after adjusting for inflation, is about \$855 million Canadian. News reports put the latest forecast for Whitechapel station at £659 million (\$1.13 billion), 500% over budget.⁷ The whole Crossrail project is substantially over budget and may open nearly four years late.

Dr. Levy concludes that station depths – predetermined by tunnel choices – are the biggest station-cost factors, and that mined stations are much more expensive and time consuming than cut-and-cover stations, even if tunnels are bored. Crossrail's Whitechapel is both very deep (30 metres) and mined.

New York's SAS stations are similarly deep: The MTA said in an email the 72nd Street platform is 98.8 feet (30.1 metres) underground, meaning the track bed is 102.8 feet (31.3 metres) deep – the equivalent of a nine-storey building.⁸ That's more than twice as deep as the lower level of Toronto's Bloor-Yonge station, which, at 13.7 metres, is the deepest on pre-1970s parts of the TTC system.

The Madrid Miracle: There must be more to cost discrepancies than station and tunnel depths, as the case of Madrid illustrates. There, in what many have dubbed “the Madrid Miracle,” 150 km of subway with 120 stations were built in 12 years (1995-2007) for \$13.4 billion (\$16.3 billion in 2019 dollars).⁹ That was less than \$90 million/km at the time, or \$109.7 million/km in 2019 dollars – 22% higher than Toronto’s 20th-century average and on par with the TTC’s 1996 Downsview extension. It is, however, less than one-sixth of the November 2019 estimates for the proposed Scarborough and Yonge North extensions.

The Spanish capital has widely acknowledged advantages, including the fact it has nothing comparable to Ontario’s long approvals processes. Much credit for the Miracle has focused on politicians demanding actual achievements – getting projects built and meeting budgets within politicians’ four-year terms of office.¹⁰ Madrid’s approach has offered economies of scale with as many as 30 TBMs going almost non-stop at the height of the expansion. While many of the world’s least expensive subways have relied on cut-and-cover construction, Madrid went mostly with bored tunnels, but with emphasis on keeping them as shallow as possible.

Madrid also used single-bore tunnels large enough to accommodate both tracks of its trains, a technique expected to be used for the Ontario Line through downtown Toronto and the SSE in Scarborough (though the latter tunnels would have to accommodate the TTC’s wider trains). Madrid’s stations are also shorter than Toronto’s, often without secondary exits. The extra costs of some deep stations in Madrid have been partly offset with mixes of uses in and atop the structures, with weather-protected PATH-like links to local destinations.

Manuel Melis Maynar led the Madrid Metro during the Miracle years. Keys to success at reining in costs that he lists include a model whereby contracts are awarded based 50% on a technical score, 30% on cost and 20% on speed; designs are “streamlined, conservative and reused”; stations are always as shallow as possible; contracts are itemized, not awarded by lump sum; and there’s lots of oversight but no use of design-build and no use of consultants.¹¹

One other case we should briefly mention is Hong Kong, a city whose transit system is usually noted for its highly successful transit-oriented-development business model known as Rail + Property. Hong Kong has expanded its system rapidly while keeping construction costs down by avoiding tunnels whenever possible. About 62% of the MTR system is above ground,¹² a choice emulated by many of the other fast-growing urban rail networks in Asia.

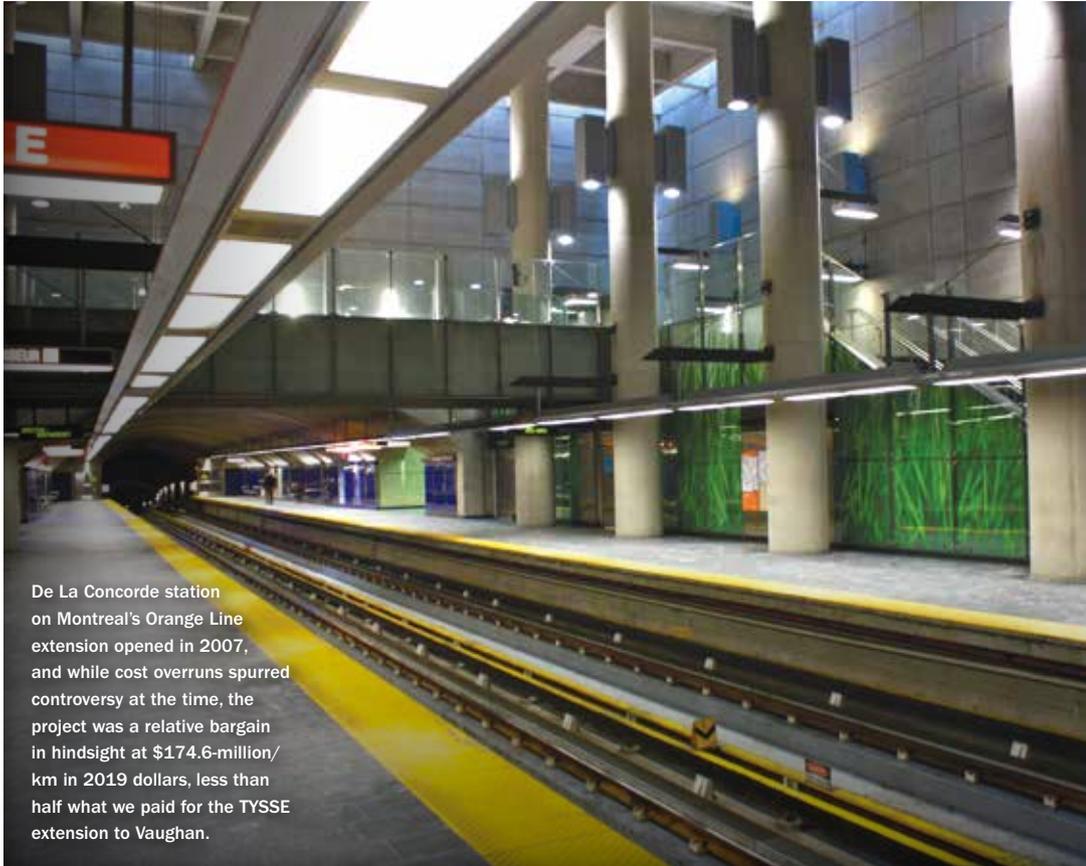
Even in London, beyond the areas most tourists see, Tube trains run extensively in daylight.¹³ Transport for London says 55% of the London Underground is above ground (not including London Overground, a huge and cost-efficient 21st-century rapid-transit success story with some possible parallels to Metrolinx’s GO Expansion plan and aspects of Toronto’s SmartTrack proposal).

The TTC also made extensive use of cost-effective, open-trench and above ground corridors in the 20th century for some of the most successful parts of the system. Costs have soared in Toronto since deep tunnels became the default.

NOTES FROM 10.0

- 1 “Comparison of Capital Costs per Route-Kilometre in Urban Rail” by Bent Flyvbjerg, Nils Bruzelius and Bert van Wee, Department of Development and Planning, Aalborg University, Denmark (2008). See charts on pages 22-23. Reference to the work of Don Pickrell (of Harvard) is on page 24.
<https://arxiv.org/pdf/1303.6569.pdf>
- 2 “What is the Cost of Building a Subway?” Alon Levy, November, 2019, presentation. Retrieved from the Pedestrian Observations blog
<https://pedestrianobservations.files.wordpress.com/2019/11/costspresentation2.pdf>
- 3 “The Most Expensive Mile of Subway on Earth” by Brian Rosenthal, New York Times, Dec. 28, 2017.
<https://www.nytimes.com/2017/12/28/nyregion/new-york-subway-construction-costs.html>
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- 4 “U.S. Rail Construction Costs”, by Alon Levy, May 16, 2011, presentation. Retrieved from the Pedestrians Observations blog
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<https://pedestrianobservations.com/2018/01/27/construction-costs-metro-stations/>
- 6 “Grand Paris Express”, retrieved from the Railway Technology website,
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- 7 “Crossrail Looks Pristine But Opening May Be Delayed For Two Years”, by Gwyn Topham, The Guardian, December 26, 2019.
<https://www.theguardian.com/uk-news/2019/dec/26/elizabeth-line-looks-pristine-but-opening-may-be-delayed-for-two-years>
- 8 Email from New York MTA spokesman Andrei Berman, June 7, 2019.
- 9 Tunnel Builder report, March 24, 2003.
<https://tunnelbuilder.com/metrosur/edition2pdf/page2.pdf>
- 10 “Need For Speed Drives Madrid Miracle”, by Jeff Gray, The Globe and Mail, March 27, 2006.
<https://www.theglobeandmail.com/news/national/need-for-speed-drives-madrid-miracle/article1327078/>
- 11 Costs Presentation by Alon Levy, retrieved from the Pedestrian Observations blog.
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11.0 TWO CASES FROM ELSEWHERE IN CANADA



De La Concorde station on Montreal's Orange Line extension opened in 2007, and while cost overruns spurred controversy at the time, the project was a relative bargain in hindsight at \$174.6-million/km in 2019 dollars, less than half what we paid for the TYSSE extension to Vaughan.

Photo: <https://en.wikipedia.org/>

Montreal's Orange Line Laval Extension. Despite cost-overrun controversies during construction and recent complaints about increased crowding on core parts of the Métro network in the morning rush hour, this 5.2-kilometre extension to suburban Laval is being hailed as a success.¹ Completed in 2007, it has turned out to be a bargain at \$143.3 million per km (\$174.6 million/km in 2019 dollars), even if the final tab seriously exceeded approved cost estimates (which had likely been lowballed). On a per-km basis, after adjusting for inflation, it was delivered for well under half the cost of the TYSSE and less than a quarter of the November 2019 per-km estimates for the proposed SSE in Scarborough and the Yonge North Extension to Richmond Hill.

Laval Extension stations are seen as elegant, as is the custom in Montreal. Agence métropolitaine de transport hasn't broken out station costs, but it reports that, of the overall \$748-million cost (\$911.5 million in 2019 dollars), infrastructure itself accounted for \$412 million, with the remainder spent on fixed equipment, financing and professional fees.² Deep tunnels were needed because the extension runs under Rivière des Prairies. Like the Madrid and Barcelona systems that Montreal's Métro is often compared to, a single-bore-tunnel approach that can accommodate both tracks was used (Madrid and Montreal use trains that are 26% narrower than Toronto's).³ Deep tunnels, of course, mean deep stations. Montmorency, the terminal, is 21 metres deep, roughly on a level with the shallower TYSSE stations.

However, just as some observers became convinced Montreal had the secret to building 21st-century North American subways at enviable prices, the proposed five-stop, 5.8-kilometre Blue Line extension is expected to cost \$4 billion. That's \$690 million per km, about 80% more than the TYSSE though less than the proposed Scarborough and North Yonge extensions.⁴ Société de transport de Montréal released a report in 2018, explaining that the proposed extension is expected to cost so much primarily because it will traverse a much more dense, urban environment than the Orange Line extension.⁵

Vancouver's Canada Line: The Canada Line case is important for this report even if it is more like the Eglinton Crosstown than a full subway, such as the TYSSE. It is 19.2 km long (nine km underground) much like the 19-km Crosstown (10 km underground). With 16 stations and provision for three more, the Canada Line was completed in 2009 for \$2.1 billion (\$2.5 billion in 2019 dollars).⁶

The 25-station Crosstown is slated to open in 2022 and is listed as costing \$5.3 billion in 2010 dollars (\$6.2 billion in 2019 dollars). Both projects will have been built using P3s, though comparisons on that count are hard because different P3 models were used. The Canada Line was the product of a design-build-operate agreement with SNC-Lavalin (the operating concession lasts 35 years). The Crosstown, meanwhile, is to be operated by the TTC after being built by a consortium called Crosslinx. Metrolinx owns the line and set the project scope. Project delivery has been co-sponsored by Infrastructure Ontario and Metrolinx.

The most seemingly obvious physical difference is that Crosstown has nine more stations (with 90-metre platforms, compared with 40- to 50-metre stops on the Canada Line), but that probably does not account for the fact that Crosstown, even after adjusting for inflation, will cost more than twice as much.

The Toronto Star reported in 2015 that the 15 underground Eglinton Crosstown stations will cost \$80 million to \$100 million each, while 10 at-grade stops will be built for \$3 million to \$5 million apiece.⁷ In 2019, Metrolinx said it is not in a position to say whether those cost estimates remain accurate and that it could not provide costs for individual stations, one of which, Avenue Road, is reported to be 32 metres deep.⁸ The Canada Line did not break out station costs, either, but one stop that is to be added soon on an elevated stretch in Richmond, Capstan Way, has a projected cost of \$32 million.⁹

One major difference between the two projects illustrates why the Canada Line is so important to this discussion: While the Crosstown's central underground portion is bored tunnel (except where it passes directly under the TTC's Line 1), the Canada Line includes a six-kilometre stretch under Cambie Street built with cut-and-cover tunnels. While the choice led to surface disruptions, controversy and lawsuits, it offers a recent case showing that cut-and-cover can still deliver large savings in certain contexts, while speeding construction and leaving shallow tunnels for which stations can feasibly be added (like in the case of North York Centre in Toronto during the 1980s). Underground Canada Line stations are expected to be added at 33rd and 57th, along with the one at Capstan Way.

B.C. Supreme Court documents related to lawsuits brought by Cambie Street merchants show SNC-Lavalin’s decision to employ cut-and-cover rather than boring tunnels for about one-third of the 19.2 km line cut costs by more than \$400-million, or 16%, enabling the project to hit its fixed \$2.1-billion budget.¹⁰

Courts have awarded three merchants compensation for “injurious affection” totalling \$181,040 (though that decision has been appealed), with 97 more cases still to be ruled upon.¹¹ Even if the \$60,000-plus payout average were to hold, a cumulative \$6 million would still be a good tradeoff for a \$400-million saving.

Nevertheless, if planning for the proposed Broadway subway is any indication, cut-and-cover disruptions must have incurred other costs that the courts were not asked to consider in the lawsuits, at least in the minds of Vancouver residents and their elected representatives. It’s more than a decade since Cambie Street was torn up for the Canada Line, but the memories apparently remain so unpleasant that city leaders have made clear the Broadway line will be entirely tunnelled, even with project estimates running at about \$500 million per km, or about 4.5 times what was paid for the Canada Line.¹²

Jane Bird, the former Canada Line CEO, credits the project’s fixed budget with helping to keep costs down and forcing project managers to be innovative, hence the cut-and-cover choice. SNC-Lavalin, the lead private-sector partner on the Canada Line P3 (also the lead management company on the Orange Line extension project in Montreal) declined requests to comment about the successes of these jobs. SNC also announced in August 2019 that it is moving out of the fixed-bid business.¹³

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12.0 IS CUT-AND-COVER STILL AN OPTION?



Photo: Stephen Wickens

Credit: TTC Coupler Magazine, 1950

Left: Even with the use of deep-bore tunnels, there have been lots of complaints about disruptions on the Eglinton Crosstown project. Right: Torontonians endured the excavation of Yonge Street beginning in September of 1949, and while the mess was huge, some parts of the street were functional again in time for Christmas shopping, thanks to the use of heavy timber decking.

More than half a century before Vancouver’s Cambie Street merchants sued over harm to their businesses from cut-and-cover tunnelling, shopkeepers in downtown Toronto were also struggling to hang on while the TTC dug up Yonge Street for Canada’s first subway. There was surprisingly little media coverage about anger over disruptions during 4.5 years of construction, maybe because a generation that had endured the Great Depression and sacrificed heavily to defeat Hitler was not much for complaining. Harms were nevertheless real for commercial tenants, even if the subway created massive land-value uplift for the property owners.

Five years after the Yonge line opened, there was renewed concern about disruptions expected with the planned University-Bloor-Danforth project. Responding to questions posed in a *Globe and Mail* editorial, the TTC made clear in May 1959 that Canada’s second subway would also largely be a cut-and-cover project.¹ The shallow approach to tunnelling was deemed to be a considerably faster way to build and significantly less expensive – the second point being a major concern with Queen’s Park and Ottawa refusing to help fund the project (at least initially). Regarding the costs of “traffic disruption, business losses, etc,” the TTC argued that any estimates would be “pure conjecture and there are offsetting benefits as shown by increased assessments along the route of the Yonge subway.”

Cut-and-cover also became the TTC’s cheaper and faster fallback when cost overruns on the largely tunnelled 1970s Yonge Subway Northern Extension (YSNE) stirred controversy.²

Even in the era of high-tech TBMs, a European Commission report states that “the cut and cover construction method (per km) is about three times cheaper than the conventional construction method (per km), but it represents an alternative method only for shallow excavation and soft ground conditions.” One sample-case study done for that report found cut-and-cover to be about 60% less expensive overall.³

Ryerson University’s Jinyuan Liu, a civil engineering professor who specializes in tunnelling-related studies and has been a consultant for projects in Asia and Europe, is quick to point out that cut-and-cover is not always the best choice for various reasons. However, he says it is “usually much cheaper and is often a much faster method” for subway building than deep tunnels with

TBMs. Dr. Liu points out that terrain, geology and water-table factors can reduce cut-and-cover cost advantages, and that utility relocations and the shoring of building foundations can further eat into the savings, especially in older, dense areas of cities.

Nevertheless, the Asian cities that are expanding their subway systems rapidly are able to do so in part because they still make extensive use of less-expensive methods, Dr. Liu says. “Elevated is even cheaper [than cut-and-cover], but it can divide neighbourhoods ... it’s disruptive after construction, too, and it shadows streets in downtown areas. Now [in North America] the question is the impacts on the community. But we have to remember there are always disruptions. Look at Eglinton: they tunnelled the underground parts of the [Crosstown] line, with cut-and-cover only at some stations ... and it’s still a big mess anyway.”

Like Vancouver and many Western cities, Toronto does not appear interested in potential benefits of cut-and-cover tunnels or open trenches (though some above-grade sections are being considered by the Province for its Ontario Line plan).

The TTC presents a contrarian view about cut-and-cover’s 21st-century potential: Even before Toronto held a value-engineering workshop for the SSE in September 2016, the project scope had settled on a 10.7-metre internal diameter single-bore under Scarborough arterials.⁴ When asked if cut-and-cover had been considered, TTC spokesman Stuart Green said by email the value-engineering team “did not identify any suggestions relative to cut and cover” (though even consideration of cut-and-cover would have been beyond the prescriptive scope of the workshop). “This is not surprising, though,” Mr. Green continued, “as it is generally recognized that cut and cover would be more costly than tunnelling for this project ... cut and cover is a costly approach and typically only used for short distances.”

The TTC made a similar case in a 2009 report about the TYSSE, which employed separate bores for each of the parallel tunnels. “Tunnelling will be done wherever possible – it is quicker and more cost effective than cut-and-cover construction.”⁵

It should be reiterated that parts of the proposed Ontario Line and the city’s SSE plan to tunnel under Eglinton Avenue and Danforth and McCowan Roads in Scarborough are expected to use a single-bore-tunnel method, like in cases in Madrid and Montreal, where the method appears to have helped deliver somewhat better prices.⁶ Even with a single bore, however, the November 2019 SSE cost estimate, with half as many stations as the TYSSE, is expected to cost \$723.7 million a kilometre. That’s 88% per-km more than the TYSSE and more than four times what Montreal paid for the Orange Line Laval Extension – even after adjusting for inflation. Single bore may reduce disruption during station construction but, as Dr. Liu points out, larger bores necessitate even deeper tunnels, which may add to the costs of stations and overall projects.

Both Alon Levy and Jonathan English (a Columbia University PhD candidate who has also been working on international infrastructure cost comparisons) concede Madrid, Montreal and other places have shown deeper tunnels and stations can be done cost effectively, and that cut-and-cover isn’t always the best value when a broad range of factors is considered. But they conclude that, in general, the deeper you go, the more expensive subway projects become. Other research suggests that underground stations tend to be about four times as expensive as surface

stops and elevated stations are slightly more than twice as expensive as at-grade stops.⁷

Mr. English, a Torontonian, suggests that, while more disruptive building methods may be unworkable in city cores with narrower streets and intense existing development, there is major potential benefit in using shallow or elevated methods for lines on, above or under wide suburban roads where utilities and building foundations would not be as much of an issue.⁸ He also suggests a solution to disruptions, such as those endured by merchants on Vancouver's Cambie Street and on Toronto's Eglinton Avenue, may lie in setting up compensation programs in advance of construction.

Jane Bird, the former CEO of the Canada Line consortium, has problems with that last suggestion. In a January 2020 email, she said: "Some jurisdictions around the world have paid compensation, but generally I think you will find governments loath to start down that road ... we're talking about temporary construction disruption. What do you say when you close a road permanently for a pedestrian mall, what about curb lanes/parking for bike routes ... it's a thin-edge-of-the-wedge argument." Ms. Bird, who now works for the Bennett Jones law firm says that "in terms of cost, generally, most engineers and [quantity survey] folks would likely confirm that cut-and-cover is cheaper – and much less risky, therefore easier, and cheaper for government to transfer risk to the private sector than TB [tunnel boring]."

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13.0 DESIGNS, FINISHES, ART AND AESTHETICS

Photos: Stephen Wickens



Left: Aside from the dark blue trim at the top of Queen’s platform walls, Eglinton is the spot to see the last of the Vitrolite that graced the original Yonge Line stations. **Right:** The \$5-million renovation of Museum station was generally well received when it was unveiled in 2008. Exhibits from the Royal Ontario Museum inspired treatment for pillars in the station, whose design had previously been seen as an orphan, more akin to the Bloor-Danforth stations, despite being on the University Line.

The TTC subway was a special source of pride for Toronto in the 1950s and ’60s. Montreal was still the bigger city and a rival for corporate head offices, a place on the global stage as the soon-to-be host of a World’s Fair and the Olympics, not to mention a rare place in Canada that was on the radar for mainstream America, having landed the first Major League Baseball franchise outside of the U.S.

In Canada, however, Toronto alone had a subway, and that system was clean, safe, steadily expanding and drawing praise from experts within and beyond the country. Then, Montreal made another big splash, building 20 km of subway in just 4.5 years. Not only had Toronto lost its unique status, praise lavished on Montreal’s elegant stations seemed to further stir civic insecurities. A few days before Montreal’s Métro opened, a Toronto Star columnist got a preview tour and wrote that “Montreal’s big imaginative showplace stations, with banks of escalators, wide entrances and exits, and ceilings that in some stations are several storeys high, put Toronto’s to shame.”¹ “By Toronto’s standards, Montreal’s construction pace – 4½ years for 12½ miles – has been breathtaking.” (The TTC did build more slowly than Montreal, but it was far faster than the current pace).

Commentators in the coming years ridiculed Toronto’s “bathroom tile” architecture. Terms such as “bland,” “antiseptic” and “pastel monotony” became staples of newspaper columns and letters to the editor. Shortly thereafter, benches and more escalators suddenly appeared at TTC stations. Then, with planning ongoing for the Spadina line (built between 1974 and 1978 from St. George to Wilson), a focus on architecture and art was applied to station designs. Locals were not unanimous in favouring a departure from standard designs that had served well (most of the Toronto Star letters-to-the-editor page on Feb. 6, 1976, debated whether art for Spadina Line stations would be an investment or a frill).

The original tiling schemes used for stations on the Yonge and Bloor-Danforth lines, with a regular rotation of base and trim colours, provided a unifying standard that aimed to help with “way-finding.”² The idea was, in part, that the colour schemes would allow riders, regular ones at least, to know where they were with a glance at the walls, even if the station name was not visible from vantage points on packed trains (there were no station announcements until the

21st century). The approach was similar to one used by architect Leslie Green for the Underground Electric Railways of London's deep Tubes.³

Even if Toronto's older stations had critics and the Vitrolite tiles on the original Yonge Line were not very durable, there have been defenders, including Mark Brader, who made the case in an early 1990s essay.⁴ Renowned architect John C. Parkin led the vision for the Bloor-Danforth stations, and his modernist station designs and simple finishes were evocative of an optimistic era in Toronto.⁵

While some locals remained jealous of Montreal's stations, complaints about tile choices on Yonge Line stations probably peaked in the 1980s, after the TTC removed and/or covered up most of the Vitrolite, and opted for irregular colours that disrupted the way-finding scheme. In particular, a bilious yellow at Dundas upset commentators when it was new.⁶ While many liked a \$5-million makeover at Museum, unveiled in 2008, some questioned more recent choices including the decision to give Pape Bloor's trim colour and vice versa.⁷

Individual architecture firms were commissioned for most stations on the 1970s parts of the Spadina Line (an approach revived for the TYSSE). Arthur Erickson did Eglinton West and Yorkdale, Dunlop Farrow did Lawrence West and Dupont, while Adamson did Spadina and Glencairn. St. Clair West and Wilson, the two most costly stations, were designed by the TTC's own architects. Stations were largely met with approval upon opening (even if the extension's ridership was a big disappointment). Dupont's *Spadina Summer* mosaics received praise, but the biggest attention-getter, for a while at least, was Yorkdale, where artist Michael Hayden's *Arc en Ciel* produced a light show when trains entered the station.⁸

The art budget for the Spadina line was \$500,000 or \$1.8 million in 2019 dollars.

Costs related to art at Glencairn station – *Joy*, by Rita Letendre – were in the public discussion recently. The original rainbow-like painted glass full-length skylight ceiling faded in the sunlight, developed leaks and was replaced with plain glass in the early 1990s. That ceiling also became leaky in recent years, leading to slippery platforms, especially during heavy rains and in winter. In 2017, the TTC voted to replace the 1990s ceiling with a re-creation of Ms. Letendre's concept. The accepted low-bid cost was \$10.7 million. Glencairn station, in its entirety, cost \$4.1 million to build in 1978 (\$17 million after adjusting for inflation).⁹

When the Spadina Line opened in 1978, it cost 42% more than estimates approved six years earlier (\$220 million versus \$155 million). However, with the exception of St. Clair West, which was deep and built with an underground streetcar and bus loop, station costs were not unusual for the time, even with an emphasis on art and unique designs. Details on fees paid to architects for Spadina Line stations appear to have been lost, or never released; attempts to find records at the City Archives and through Freedom of Information requests to the TTC did not yield results.

St. Clair West was an outlier on construction costs: The southern half of the station alone, cost more than twice as much as any other stop on the extension, with the exception of Wilson. Even at that, Wilson – a terminal station with a major bus terminal, commuter parking lots, a Kiss-n-Ride facility, as well as crossover and tail tracks – was less expensive than St. Clair West's southern half, and aesthetic considerations likely had nothing to do with the cost disparity. St. Clair West was not only deeper than any other Spadina station at more than 15 metres, its streetcar and bus loop required tunnels and portals out into the middle of St. Clair Avenue.

After adjusting for four years of inflation between 1974 and 1978, the Spadina line with eight unique stations, cost 13% less per kilometre than the YSNE, even though the Yonge extension came with half as many stations, all fairly spartan. The Spadina line's total cost also included Toronto's largest subway maintenance and storage facility, which accounted for 26% of the overall project cost. The key factor in this comparison appears to be that three of the four original YSNE stations were deep underground and the other was a terminal. On Spadina, only three of eight stations were fully underground.

Either way, the TTC reverted to standard utilitarian designs for its next three new stations – Kennedy (opened 1980), Kipling (1980) and North York Centre (1987). All three were shallow and delivered very inexpensively compared with current prices, despite two of the three being terminal stations.

In sum, there appears to be no evidence that an emphasis on uplifting design necessarily drives costs much higher; the \$500,000 spent on Spadina station art was a tiny fraction of the extension's \$220-million cost. Nevertheless, considering the TYSSE experience, planners and decision-makers need to re-examine whether big-name international architects deliver much value.

There may even be hidden costs in the TYSSE stations if the apparent focus on outward appearance hinders attempts by future Torontonians to capitalize on potential air rights.

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14.0 ABOUT THE SMARTTRACK STATIONS



In one of her final acts as Ontario premier, Kathleen Wynne joined Toronto Mayor John Tory in signing a memorandum of understanding regarding Tory's SmartTrack plan, which was originally supposed to be a cost-effective surface subway. Station-cost estimates, however, rival the most expensive deep stations on the TYSSE.

Photo: Former Premier's office

If shallow and at-grade utilitarian stations were sure to be inexpensive, one would think the proposed new SmartTrack stations would be cheap (especially those that will not require land for parking). Indeed, the promise of cost-effective upgrades to existing surface rail corridors was much of the appeal when SmartTrack was proposed during Toronto's 2014 mayoral election. Yet one estimated total cost for six new SmartTrack stations has been roughly \$1.2 billion. That's an average of \$200 million, or just shy of the cost for the two most expensive TYSSE stations, Pioneer Village and Vaughan Metropolitan Centre.¹ The average could prove to be higher still, according to one news report.²

James Perttula, Toronto's director of transit and transportation planning, said in an email that the SmartTrack station designs "were jointly developed by Metrolinx and the City to address GO rail operational and safety requirements, as well as City objectives related to station access and city-building opportunities."³

He goes on to say "Metrolinx developed cost estimates for the stations based on their standard practice, and the estimates included costs related to procurement and land acquisition. All costs were reviewed and validated by the City's rail engineering consultant [LeighFisher Canada] as being reasonable estimates given the level of design. The costs of each station vary based on each specific context. There are some technical challenges and complexities with inserting new stations in a rail corridor in an urban area while maintaining frequent service, particularly where corridor widening and bridge work may be required. "Final costs ... are still to be determined, and both Metrolinx and the City have an interest in reducing the station costs while providing optimal connectivity and multi modal access," Mr. Perttula adds. "In late 2018, Metrolinx changed course with the development of new GO stations, including SmartTrack stations, to explore opportunities for integrated transit-oriented development (TOD) with third parties."

The SmartTrack station estimates do appear, as Mr. Perttula asserts, to be in line with costs that Metrolinx and Infrastructure Ontario have approved for some of the new suburban GO stops, including Rutherford, which has been designed with large amounts of real estate and a structure dedicated to parking. These stations, however, appear set to cost considerably more than the estimates for the new Woodbine-Highway 27 station at \$95 million to \$120 million.⁴

To Metrolinx's credit, with operating costs set to rise because of plans for more frequent GO service, the agency is awakening to a need for change in its station land-use business model; parking eats up potentially valuable transit-oriented real estate and costs \$40,000 a spot to build. Plans were afoot to start charging commuters to store their cars at stations all day, but the transportation minister quickly expressed her reservations about this.⁵

Either way, even if it's true that the deeper your tracks the more expensive your stations will be, other factors are clearly in play.

NOTES FROM 14.0

- 1 "Mayor 'optimistic' SmartTrack will only cost city \$1.2B, but staff flag risks in funding plan" by Taylor Simmons, CBC News, April 10, 2018, Link retrieved January 29, 2020. <https://www.cbc.ca/news/canada/toronto/smarttrack-update-1.4612926>
- 2 "Council Approves \$1.46 billion SmartTrack plan" by Ben Spurr, Toronto Star, April 25, 2018. Link retrieved January 29, 2020. <https://www.thestar.com/news/gta/2018/04/25/council-approves-146-billion-smarttrack-plan.html>
- 3 Report to City of Toronto executive committee on the Implementation of SmartTrack Stations, April 10, 2018. Section on costs begins on page 27. Link retrieved January 29, 2020. <https://www.toronto.ca/legdocs/mmis/2018/ex/bgrd/backgroundfile-113811.pdf>
- 4 Infrastructure Ontario website, GO Expansion Rutherford Station Project. Link retrieved January 29, 2020. <https://www.infrastructureontario.ca/Rutherford-Station/>
- 5 "Metrolinx Plans to Convert Tens of Thousands of GO Station Parking Spot From Free to Paid", by Oliver Moore, The Globe and Mail, January 14, 2020. Link retrieved January 29, 2020. <https://www.theglobeandmail.com/canada/toronto/article-metrolinx-plans-to-roll-out-significant-increase-in-number-of-paid/>
Also see, "Caroline Mulroney says government is committed to free parking amid Metrolinx's plan to boost paid spots", by Oliver Moore and Laura Stone, The Globe and Mail, January 14, 2020. Link retrieved January 29 2020. <https://www.theglobeandmail.com/canada/toronto/article-caroline-mulroney-says-government-is-committed-to-free-parking-amid/>

15.0 WHAT ELSE IS DRIVING THE COST SPIRAL?

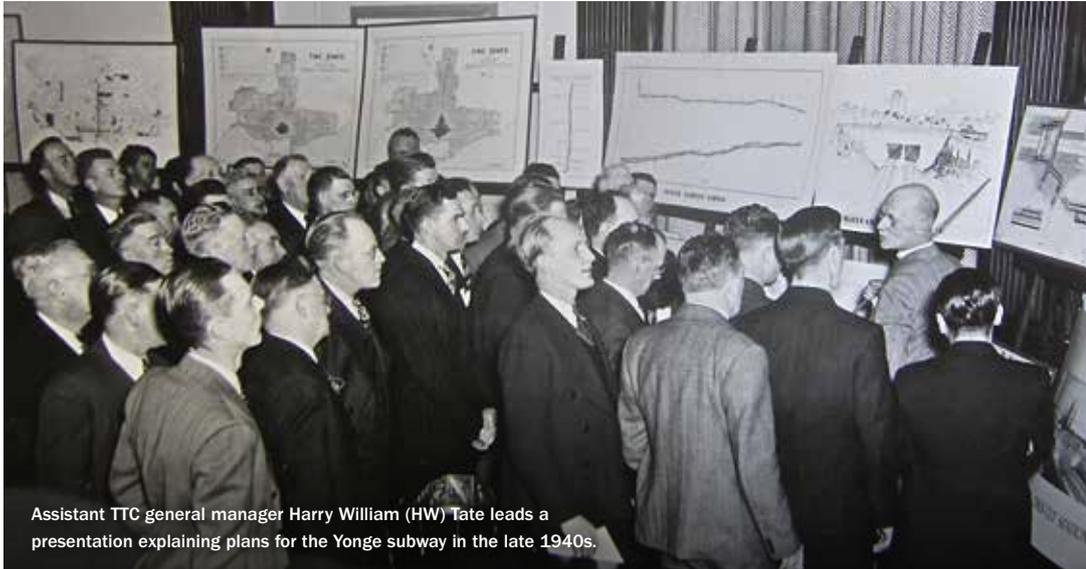


Photo: City of Toronto Archives

Assistant TTC general manager Harry William (HW) Tate leads a presentation explaining plans for the Yonge subway in the late 1940s.



Photo: Stephen Wickens

Open house hosted by Metrolinx to discuss the Ontario Line, January 27, 2020.

The shift to default use of deep-bore tunnelling in recent decades has coincided with soaring subway construction costs, and the shift has almost certainly been a major factor in cost trends – if not the biggest. It cannot be the only major cause, however. If it were, how would we explain the fact that costs have also been rising fast for surface light-rail projects? (per-kilometre costs for the Finch West LRT are multiple times higher than the 2009 Transit City estimate for the project, though comparisons are difficult in part because a 30-year maintenance arrangement has been lumped into the \$2.5-billion contract.)¹ In addition, rudimentary at-grade stations planned for SmartTrack are expected to cost as much or more than the “cathedral-like” TYSSE stops that prompted the debate that led to this report.

So what else could be driving costs higher?

Photo: Stephen Wickens

The rise in the cost of prefabricated concrete products, including tunnel liners, has been slower than the rate of inflation according to Statistics Canada.



Is it labour costs?

Construction workers, like people in most forms of employment, have received fairly steady raises over the past few decades, and it should not come as a surprise that raises have exceeded the rate of inflation recently, given widespread evidence of a skilled-trades shortage amid an extended building boom.

Statistics Canada's non-residential building construction index for major sub-trades indicates labour costs rose at about twice the rate of inflation between 2002 and 2017 – 60% versus 29.4%.² Wages for trades workers on residential projects, according to records of contracts involving the Labourers International Union between 2002 and 2015 (the most recent data available) rose 43% for carpenters and 52% for labourers compared with inflation of 25.7%. But it should be noted that records of labour negotiations during the late 1990s and union agreements going back further indicate a considerable amount of the 21st-century pay hikes involved catch-up after a decade of flat or even negative wage growth amid a 1990s building slump (negative growth, at least, after adjusting for inflation). Between 1989 and 2015, for example, labourers under Metropolitan Toronto Apartment Builders Association contracts saw all-in wage levels rise 87.6%, while the Bank of Canada puts inflation for that period at 67.6% – so the wage increases were still considerably higher than the rate of inflation, but much closer to it than within the shorter time frame (2002-2015).³

If the increased use of tunnel-boring machines is factored in, it can be assumed far fewer workers are drawing paycheques from subway-construction jobs, which makes it even less likely that soaring project costs in the past two decades can be blamed on wages that rose 30% faster than inflation over a full 30-year period. That 30% is significant, but the average inflation-adjusted per-km cost of Toronto's first six subway projects was \$86 million. The TYSSE cost \$383.7 million/km in 2019 dollars, or 346% more than the TTC's historical average. Estimates for the Yonge North extension are \$757-million/km, or 780% higher.

Another point that may indicate rising labour costs are not the primary driver of soaring project costs: Archived media coverage of labour disputes indicates that wages also rose fairly fast in the late 1960s and through to the '80s (both in absolute and inflation-adjusted terms), but the serious increases in subway-building costs this study found did not begin to firmly take hold until the 21st century.

All that said, Ontario's skilled trades shortage should be tackled promptly and decisively.⁴ Taking a page from London's Crossrail, Ontario should be able to qualify lots of workers for jobs in less time than it takes to go from the approval of projects to getting shovels in the ground, and there are people in many areas of Ontario and Canada who need jobs.⁵

Is it materials costs?

Anecdotally, there seems to be consensus among construction industry observers that prices for key materials have risen considerably in recent decades, although Statistics Canada data show much variation by product.⁶ Concrete reinforcing bar (rebar) prices more than doubled between 2010 and 2019, StatsCan reports, while prices were flat for precast concrete products, an essential component of subway tunnels. Precast-concrete-product prices actually lost ground versus inflation. Ready-mix concrete prices, meanwhile, rose 19.6% between 2010 and 2019, while inflation was 16.4%; not a huge difference.

Precast-concrete products, a big part of what the public sees in subway tunnels, also may not be a big part of overall costs. A contract won by Armtec Holdings to supply precast tunnel linings for the TYSSE was worth \$43.6 million, or less than 1.4% of the \$3.2-billion cost of that project. A contract won by Munro Ltd. to produce 14,785 precast rings and 88,500 tunnel liners for the Eglinton Crosstown is reported to be worth \$78 million. That's about 1.5% of the total project capital cost (about enough to cover half the costs of an average TYSSE station).⁷

"Aggregate, asphalt, concrete, rebar, et cetera have all increased in recent years," Patrick McManus, of the Ontario Sewer and Watermain Construction Association, said in a recent conversation. "It will be a significant part of why our industry's overall costs have risen." Mr. McManus was unable to offer specifics on how much overall costs have risen for sewer and watermain jobs, but he said he was certain that "while costs are up and people ask us why, we haven't seen anything like the cost increases you've discovered for subway projects."

Is it overall construction-sector productivity?

StatsCan's non-residential building construction price index indicates overall project costs have risen slightly faster than construction-sector wages over the 2002-2017 period, 63.2% versus an even 60%.⁸ The per-kilometre cost increase for subway building in Toronto over that same period, if we use the Sheppard line (which opened in 2002) and the TYSSE (2017) is 91.3%. That is about 50% higher than non-residential labour and project-cost increases, and more than three times the rate of inflation, which was 29.4%. With estimates for projected subway projects coming in at twice or more than the price paid for the TYSSE, it appears far less likely that construction-sector productivity is the overriding issue.

Altus Group's cost guides do not offer data for transit projects (though the real estate consultancy and industry database provider has started tracking costs for transportation buildings, including airports and bus garages and terminals). Altus data show that, on a per-square-foot basis in the GTA, construction costs certainly rose faster than inflation in the 2006-2017 period. While the Bank of Canada puts inflation at a shade higher than 20% for that 11-year period, the cost of building high schools rose in the 26%-to-35% range, the cost of building residential condos rose 33% to 40% and the cost of a class-A office-tower was up 40% to 48%.⁹

Falling productivity in the construction sector is a concern; some academics have used the term "Baumol Disease" or "Baumol Effect" to describe a trend whereby wages increase over time without customers receiving any added value in real terms.¹⁰ With public- and private-sector entities under continuing pressures to find ever-more cost efficiencies, reduced productivity threatens both our ability to get essential infrastructure built and the GTA's global economic competitiveness and quality of life.¹¹

There's lots of room for improvement, but there does not appear to be much hard evidence that reduced construction-sector productivity has been a primary driver of soaring subway costs in the 21st century. Subway-building cost increases have been two to three times higher than per-square-foot cost increases for other civil and residential construction work.

Is it the soil removal?

Concerns have been raised about rising soil-removal costs for big tunnelling projects, including in a 2012 RCCAO-sponsored report.¹² However, even the high-end 2012 estimate for the Eglinton Crosstown's soil-removal needs was only \$100-million – 1.9% of the \$5.3-billion project cost. When asked if that \$100-million tab is still accurate, Metrolinx said such detail is unavailable. When the TTC was asked about soil-removal costs incurred for the TYSSE, the response was, "We don't have this level of detail."

Soil removal costs may not be huge, but taxpayers may be missing an opportunity to defray them. Excavated soils are regularly used for the creation of new and often valuable waterfront real estate on other continents. Even here, in Toronto's past, construction soils provided fill upon which the Southcore lands sit and, beginning with the University-Bloor-Danforth subway, excavated soil and demolition-related materials started to build what became the Leslie Street Spit. Some countries have cut soil-removal costs through exchange registries that serve those seeking fill.¹³ The costs of soil removal and disposal are more than the proverbial drop in the bucket, but for the purposes of the current discussion, they do not appear to be major factors when it comes to spiralling infrastructure costs.

Is it the red tape?

There are crucial reasons to identify and address negative environmental impacts of mega-projects and to engage in public consultations. However, environmental assessments (EAs) and public-consultation processes come with costs in money and time and there is a point at which they can be counterproductive. Project delays drive up costs, and time is especially critical when project costs are rising fast.

Ontario's Environmental Assessment Act came into force in 1976. Its broad definition of "environment" encompasses ecological, social, cultural, economic and built environments. The Act has been reviewed several times and attempts have been made to improve it over the decades. Processes for transit projects in particular were streamlined in 2008,¹⁴ although delays have remained a concern and some transit experts have argued that the new rules put too much focus on assessing single proposed plans instead of fully examining a range of alternatives.

The RCCAO sponsored a series of studies of EAs and delays, one of which, in 2014, pointed out that despite attempts to speed up "the Municipal Class EA process in 2011, the time to complete an EA rose from an average of 19 months to 26.7 months, and the EA-study report costs have increased from an average of \$113,300 for the Original Study data to \$386,500."¹⁵

The Auditor-General also reported in 2016 that the Act needed modernizing.¹⁶

It is impossible to put a credible dollar figure on the costs of delays, but it is safe to say that to the extent EAs and the requirement for public consultation hinder the timely and efficient delivery of needed infrastructure, they work against the stated goals of the Act. Governments, however, also must be careful not to shift toward expediting projects at the expense of proper reviews. Public trust matters and it's increasingly common to hear consultation attendees express concerns that sessions put on by transit agencies are debriefings aimed at selling predetermined plans, and that meetings are held only to allow project proponents to tick off legally required boxes.

The TYSSE took 30 months to go from announcement to shovels in the ground, despite firm funding commitments from senior governments and help from high-tech design systems (and it still went about 50% over budget and missed its projected opening date by three years). The University-Bloor-Danforth project was designed by engineers using slide rules and went from

settling on the routes to shovels in the ground in 18 months, even though Queen's Park and Ottawa refused to help finance the project (at least initially). It also came in on budget and opened three years early (thanks to the province stepping up to guarantee some loans).

Much of the "Madrid Miracle" success has been attributed to the Spanish capital's emphasis on actual accomplishment within the four-year terms of elected officials. A lot of the failure in the GTA, meanwhile, can be blamed on the length of time needed to get projects approved and started, before election cycles bring in new politicians who tear up plans and start the lengthy processes anew.

In June 2019, Shoshanna Saxe of the University of Toronto civil engineering department reported at a conference in Helsinki that, while major road projects and airports in southern Ontario are completed fairly quickly, "linear rail and public transit projects often stretch over decades."¹⁷

The Province has identified a red-tape problem and introduced legislation aimed at further streamlining policies and regulations. In February 2020, it unveiled plans to speed EAs and property expropriations specifically related to its four priority GTA transit projects, but finding a fair and effective balance has never been easy.¹⁸

The TTC and Metropolitan Toronto were good at assembling real estate back when subways were built quickly and at better prices, and that efficiency was a factor. Records at the archives indicate at least 756 properties were expropriated to build the University-Bloor-Danforth subway and land acquisition accounted for more than 10% of that project's budget. It's tough to know whether current laws or reduced political will are responsible for more recent snags on this key aspect of subway building. There has been a hue and cry in recent years when even just a few properties were slated for taking in order to build second exits at older subway stations, and the attempt to acquire access needed to link Dundas West subway station and a nearby GO and Union Pearson Express stop has been going on for decades.

Queen's Park's sense that existing rules are needlessly onerous stands in contrast to the view in 1968 (shortly after the Bloor-Danforth subway opened), when former Ontario chief justice J.C. McRuer called for a full review of expropriation procedures in his Royal Commission on Civil Rights.¹⁹ Justice McRuer said in a front-page Toronto Star story that "the power to take a man's property by force, which has been handed out in Ontario with 'reckless and unnecessary liberality' and though often necessary in the public interest, is an invasion of civil rights."

Michael Paiva, who specializes in expropriation law, sees hope for a balance that protects public and private interests. "The land-acquisition process is often stalled because the government and property owners cannot agree on a number that fairly reflects the fair market value of the property," Mr. Paiva said in a recent email.

He argues that the process could be sped up through more frequent use of agreements under Section 30 of the Expropriations Act.

“Through these agreements, the target lands for expropriation are conveyed to the government for an amount agreed to by the property owners, and the formal Expropriations Act processes and requirements for notice are bypassed because the conveyance has been completed. Often these agreements are without prejudice to the full and final compensation to be paid to the land owner, meaning the owner can still seek further compensation If the government presented their best offers of compensation early, Section 30 acquisitions would occur much more rapidly. This should also have the benefit of reducing overall legal fees and expenses (for which the expropriating authority is required to pay under the Act).”

Depending on one’s perspective, EAs, public consultations and lengthy expropriation and approvals processes can be viewed as red tape or due diligence. One thing is certain, however: there are costs associated with delays.

Is it the benefit-cost analyses?

Big increases in subway-building costs in Ontario and elsewhere have also coincided with big changes in how potential projects are evaluated. In theory, benefit-cost analyses (BCAs) are designed to ensure the prioritization of the projects and project options with the greatest overall chances of delivering net value for the public. BCAs should be crucial tools for keeping down the costs of major infrastructure jobs by providing the best evidence for evidence-based decision-making. However, significant concerns have been raised about whether BCAs and their early-stage counterparts, initial business cases (IBCs), have evolved enough to measure and weight the many key factors for the public.

Some observers, including Columbia University economist and urban planner Elliott Sclar, have argued that BCAs need to break further from a traditional focus on mobility and formulaic attempts at measuring aggregate time savings in monetized terms. He would prefer greater emphasis on measuring broader access – maximizing webs of connectivity between people, jobs and other activities – to better reflect the reality that humans seek to move for daily economic and social reasons rather than merely to move more and faster.²⁰

Fred Salvucci, of the Massachusetts Institute of Technology’s civil engineering department and a long-time Boston-area transportation adviser, echoes Prof. Sclar’s points but goes further. He sees BCA processes as being vulnerable to unethical interference, which can render them more useful as tools for selling pet political projects than ensuring value for the public. “If you don’t measure, you can’t manage,” Prof. Salvucci wrote in a 2014 essay.²¹ “But what if we measure the wrong thing, or in the wrong way? Then our measurements and evaluation could lead us in the wrong direction. If the actual process of setting policy and choosing strategies and projects doesn’t use evaluation techniques to make decisions, but instead to justify decisions already made through other ‘political’ decision-making, improving our measurement and evaluation tools will not matter.”

Toronto-based transit researcher, advocate and journalist Steve Munro is among those convinced BCAs and IBCs have become part of a dangerous and secretive decision-based evidence-making scheme, “a very large fig leaf behind which political meddling can masquerade as good value for taxpayer dollars.” In an email, he said he questions the level of transparency and objectivity in the process whereby projects are chosen or rejected for study and that the

studies are overly focused on projects in isolation rather than how they might affect overall networks. He said he has seen evidence of pressure to identify positive cases for specific options early in the process, eliminating the latitude for tweaks and pivots, essentially keeping better alternatives discovered later in the investigative process off the table. He also laments that the decision-makers often “don’t understand the details, nor do they care to.”

Though the term BCA is fairly new, the idea has been around at least since the 1850s, when economist Jules Dupuit was Paris’s chief engineer.²² Mr. Dupuit, seen by many as the father of the BCA, produced detailed studies attempting to measure the far-reaching, interrelated and subtle benefits of public-works projects (mostly focused on canals, roads and toll bridges). Central to his work was the argument that the traditional idea of quickly choosing projects favoured by those in power and then single-mindedly focusing on delivering them for the lowest price tended to overlook many, if not most, potential benefits to the public and the economy as a whole.

Prospectuses used to raise capital when subway projects were almost exclusively privately funded in the decades prior to the 1920s, were akin to BCAs, even if the direct project-potential beneficiaries were private would-be investors rather than the public. Much intelligence, expertise and earnestness was subsequently applied to evaluating subway plans in the public interest, but it was decades before BCAs took a form close to what we use and is required now. It wasn’t until massive increases in computing power during the 1990s that formal BCAs became standard prerequisites for major infrastructure projects, so the idea is probably still in its infancy. The process may yet become sophisticated and useful.

It’s not as if Toronto blindly embarked on subway building before the adoption of the formal BCA. Even when the TTC was internationally renowned, mistakes were made, such as putting the Spadina Line in the median of an expressway and skipping the logical sequence of network building, from the middle out. The concern in 2020 is that Toronto’s subway projects were once delivered faster, cheaper and arguably with much more overall public bang for the buck before formal BCAs became the norm.

It might be just a coincidence, but it’s one we cannot ignore.

Is it the alternative financing and procurement model?

Some observers might also ask if it is just coincidence that costs and estimated costs of GTA transit projects have soared since the province formally adopted a public-private partnership model (P3).²³ A definitive answer to the question would be premature, even if the first P3-based transit projects and estimates look expensive.

Ontario used a P3 successfully to build the 407 toll road in the 1990s,²⁴ before creating SuperBuild to deliver hospitals and other buildings for the public. Then, in 2005, Infrastructure Ontario (IO) was created to oversee delivery of all P3 projects (AFP was the preferred term during the provincial Liberal era, 2003-2018). Most of IO’s track record relates to delivery of hospitals, courthouses and education-related buildings, and the agency has received generally glowing reviews in third-party reviews of its work, though reports note there has been room for improvement when it comes to on-time project delivery.²⁵

IO is now laying groundwork for projects that will establish its reputation in the transit sector by overseeing and co-sponsoring major jobs with Metrolinx. IO served in an advisory capacity on completed light-rail lines in Waterloo Region and Ottawa, as well as the partly completed VIVA rapid-bus project in York Region. It has taken a lead role in the under-construction Eglinton Crosstown line (being delivered by a 26-company consortium called Crosslinx) and the Finch West LRT (with a 14-company consortium called Mosaic). Current projects also include new stations for GO Expansion. IO is slated to oversee delivery of major lines in the planning stages, including the Hurontario LRT in Mississauga and four proposed projects in Toronto – the Ontario Line; the TTC Line 1 Yonge North Subway Extension; the TTC Line 2 Extension deeper into Scarborough (SSE); and a western extension of the Eglinton Crosstown in Etobicoke.²⁶ However, unprecedented per-kilometre cost estimates for those first rail projects raise questions about whether IO has yet developed the expertise, tools and processes needed to deliver value for the public in the transit sector, let alone wrestle project costs back down to more traditional levels.

Transit infrastructure projects differ from hospitals and colleges in two big ways. Firstly, they are “linear” or “horizontal,” meaning greater risk as they traverse varied contexts over distances, interacting with utilities and other infrastructure, including streets that must continue to function. Secondly, they have potential to create major real estate value premiums along the route, an opportunity North Americans have been reluctant to exploit seriously – at least in recent decades.

P3s are supposed to deliver better value for the public’s money by leveraging up-front capital as well as private-sector expertise and efficiencies to design, build, finance and manage projects, sometimes with long-term concessions to operate and maintain the infrastructure. The theory is that net costs to the public over full project life cycles will be minimized because the private sector takes on the risk of cost overruns and faces penalties if jobs miss deadlines. Among the assumptions is that traditional public-sector project delivery necessarily relies upon “more prescriptive specifications,” eliminating opportunities for innovation.²⁷

The P3 approach has strong supporters, some of whom have suggested the approach can go so far as to get developers to deliver subways inexpensively.²⁸ It also has harsh critics eager to pounce upon any individual shortcoming as proof the P3 concept is a bad deal for the public.²⁹ The split is usually along ideological lines, and there are moderates from the political middle who see merits in the theory, but many devils in the details.³⁰

Alon Levy, an Israeli mathematician who has studied rising infrastructure costs globally, says P3s have not worked well in Europe. He notes that Manuel Melis Maynar, the man behind the Madrid Miracle, “insists on not using design-build and (by implication) not using a P3.” Dr. Levy compared two recent French high-speed lines and concluded that the Sud Europe Atlantique (a P3 project) was significantly more expensive than the non-P3 Est Phase 2, even though the non-P3 line has a tunnel and the P3 has no tunnels. He adds that “risk-shifting to the private sector is a long-established practice in New York and some of the sources in Brian Rosenthal’s (New York Times) articles cite that as a factor behind high costs.”

One could argue that all subways have been P3s in some form and to various degrees. Until the 1920s subways tended to be private enterprises, but gradually became public-sector projects for most of the 20th century as capital dried up for investments with long-term payback times and growing competition from car-based transportation.³¹ Even then, construction, engineering and architecture firms, materials suppliers and vehicle manufacturers remained private-sector partners.

In recent decades, “the pendulum has swung back toward experimenting with greater private-sector involvement in all aspects of public-transit service,” Matti Siemiatycki of the University of Toronto has written.³² He credits Europe for leading the way on P3s, at least on a project-by-project basis (though Asian cities may have been consistently more effective, using more permanent private-public arrangements, some that long predate trends in Europe).

Prof. Siemiatycki worked with researcher Naeem Farooqi to produce a 2012 report that raised concerns about a lack of transparency when it comes to data and project information needed to gauge whether P3s in Ontario were delivering real value for the public’s money.³³ “No empirical evidence is provided to substantiate the risk allocations, making it difficult to assess their accuracy and validity,” they wrote, and that was back before IO got seriously involved with transit projects.

As a possible example of that: The public-realm version of a 2018 value-for-money (VfM) report done for the Finch West light-rail line notes that Deloitte completed the assessment of risks transferred to the private sector using IO’s guidelines, but it does not show how this was accomplished in any detail.³⁴ The report found that the project would have cost \$2.5-billion if delivered by the traditional public-sector model, but \$1.934-billion if delivered through IO’s model, a 22.7% saving.³⁵ Yet the contract on IO’s website³⁶ is still listed at \$2.5-billion (but with a disclaimer, “Neither Infrastructure Ontario nor Metrolinx makes any representation or warranty regarding the accuracy or completeness of the content or form of these documents”).

There also appears to be an assumption the public sector cannot provide maintenance at competitive prices. The record shows too much work in that area has long been deferred on Toronto’s system, largely due to funding constraints, so it might be worth seeing what the P3 model has to offer. Maintenance is a critical transit-system need, even if it doesn’t excite voters the way promises of new subways can. Nevertheless, caution is warranted over costs being quoted and lengthy contract terms.

Ontario’s Auditor-General has questioned the AFP/P3 role on the Eglinton Crosstown. Among other things, A-G reports have said IO’s “use of consulting contracts could be better managed and that deliverables need to be more clearly identified.” A 2018 report questioned whether a negotiated claim settlement with the Crosslinx consortium demanded enough evidence to justify a payout to keep the project on schedule, a payout that cost the public \$237-million over and above the agreed-upon AFP contract cost. ^{37, 38}

Soon after the A-G’s 2014 report, a group of big companies in the P3 field asked the Lawrence Centre at the University of Western Ontario’s Ivey School of Business to produce a report comparing P3s with traditional approaches to infrastructure project delivery (the companies are

said to have had no input on the report's contents).³⁹

Three of the six case studies in the Lawrence Centre report are transit-projects, and all three have been discussed in this report. The TYSSE and the Montreal Orange Line extension to Laval are presented as examples of how traditional procurement with public-sector project management is fraught with danger for taxpayers, while the Canada Line in Vancouver is held up as a P3 success. It is tough to argue with the portrayals of the TYSSE and the Canada Line. It is essential to note, however, that while the Laval extension cost overruns look huge in percentage terms, the project, as this report has pointed out, delivered an excellent price on a per-km basis. After adjusting for inflation, the extension was built for less than half the per-km cost of the TYSSE and less than a quarter of the November 2019 estimates for the SSE in Scarborough and the Yonge North extension to Richmond Hill.

Cost overruns in Montreal may have been attributable to lowballed initial and approved estimates, as well as optimism bias, high-risk factors that tend to come into play when politicians are eager to sell the merits of a favoured megaproject. The point is key because fixating on ensuring there are no cost overruns is perilous if it creates an incentive to inflate cost estimates that may leave the public to pay much more in the end than it would have otherwise. Inflated estimates would also likely be disproportionately valuable to P3s' private parties in that they can help more to determine what the market will bear than to keep prices down for the public, especially as precedents for continually rising prices are set.

TD Economics produced a 2015 report on the A-G's findings, "Cost Does Not Equal Value."⁴⁰ It says the "A-G makes many valid points about how IO could improve some of its processes," but takes issue with an "oversimplified analysis" that "ignored many of the valuable benefits that AFP projects have brought. It is a case of knowing the price of everything, and the value of nothing." It goes on to say: "On the surface, P3s appear to have a higher price tag on the tangible aspects of the project than in a traditional procurement project. However, that ignores the fact that the tangible costs in an AFP are a more complete pricing of all of the risks of the project. Since the private contractor in an AFP must budget for the probability of having to pay out on the risks of the project, the expected value of these costs are better internalized in the bid. In contrast, the public sector cost as measured by the AG does not include a pricing of the risks that inevitably exist in a large public infrastructure project. It also ignores the value for taxpayers achieved by reducing the overall risk of the project by transferring risk to the party best placed to manage it."

The TD report concludes that the A-G's "narrow focus on the higher tangible costs of P3s does a disservice to an innovative model of government procurement which has enabled a more transparent and accurate accounting of the full costs of a project before construction begins. In contrast, final costs for traditional projects are frequently much higher than initially budgeted, and projects are frequently delayed."

That may be the case for non-transit projects (which this report has not examined), but claims about accuracy and transparency in accounting for IO's transit projects warrants scrutiny. Itemized details that might help explain soaring costs of projects being led by IO and Metrolinx

are not readily available in the public realm, or at least not presented in clearly prepared reports. Even costs under broad general headings are hard to find. The Finch West LRT line, for example, is a DBFM project, yet IO's Value For Money (VfM) report on the website does not break out costs for the design, build, finance and maintain components.⁴¹

Questions asked about key costs of projects or project components for this report were not or could not be answered, in some instances because, we were told, the information was "commercially sensitive." When the Hamilton LRT was cancelled amid the request-for-proposals (RFP) process, the public was denied access to a third-party consultant's report on the cost increases because it contained "proprietary and commercial information."⁴² Lack of transparency is not exclusively a P3 problem: The TTC was also unable to provide many key cost details about the TYSSE, which we should emphasize was not a P3 or IO project.

Canadians have been slow to embrace P3 transit projects, even since the Canada Line success in Vancouver, which came in on budget and on time (but short on capacity). Not only did Canada Line meet its budget, the budget it met (including a 35-year operating deal) was less than half what is being paid for the reasonably comparable Eglinton Crosstown project. Demand for P3 projects will likely grow if the public's faith in traditional public-sector procurement processes remains thin or erodes further. However, unless Ontario's P3 process can prove it is better able to maximize transit-project value, the public's patience surely will not last.

Years after Prof. Siemiatycki, Mr. Farooqi and the Auditor-General raised questions about IO's ability to protect the public by accurately pricing project risks, there's no evidence public agencies have made much progress, at least for transit projects. As it stands, the public is largely in the dark, forced to rely on politicians who lack the knowledge to make final value-shopping decisions on complex multibillion-dollar projects. The Eglinton Crosstown, for example, is usually referred to as a \$5.3-billion project, but the contract is for \$9.1-billion if you include the 30-year maintenance component.^{43, 44} That may be good value, but there's a reasonable chance key players responsible for the contract will not be around in the 2050s to answer if it is not.

There also remains the issue of the November 2019 per-km subway construction estimates that are nearly double the TYSSE price tag – a price so high it essentially disqualified the TTC from delivering future infrastructure projects.

Infrastructure Ontario CEO Ehren Cory was asked for an explanation of the cost spiral, how the latest transit-project estimates were compiled and who did the work. In response, we received the following statement from an IO spokesman:

"IO employs a number of different tools and inputs to develop cost estimates at different stages of project development including the use of expert third party cost consultants who provide independent calculations regarding estimated project costs. After a project is initiated cost estimates are refined as a project moves through approvals, procurement and into pre-construction. Those estimates/budgets are then carefully monitored throughout construction. At this early stage, estimates for many of the projects you cite in your email are continuing to be refined while further planning and design work is undertaken.

“While IO has not specifically reviewed the inflation-adjusted cost figures in the chart provided, your point about the cost of transit infrastructure is well-taken. That said, it’s worth noting that cost escalation in the construction industry is not unique to transit projects. There have also been, for example, cost escalations in the residential housing construction sector (approximately 9% over the past two years) about double the rate of inflation. External research points to a number of factors for cost increases in the construction industry, including low labour productivity rates and the need to navigate challenging site conditions. Furthermore, the scope of transit projects have changed considerably over time with additional design, planning, approvals, engagement, code and compliance requirements. This is in addition to a more complex physical landscape of additional utilities and nearby large buildings and other structures that need to be secured and protected for this work to take place. Please note that IO has not specifically reviewed the cost.

“The P3 model that IO uses allows for open and competitive procurements that ensure that we receive the best value for taxpayer money. For upcoming transit projects, IO is actively working to attract a broader bidding pool of international companies in order to tap into new innovations and ideas. There have been extensive market soundings with the industry to address their concerns surrounding improving the evaluation criteria, how to expand industry capacity and reducing risks.”

Follow-up questions to IO, including about which specific consulting firms are providing estimates for the major transit projects, went unanswered.

For now, there is no hard evidence that Ontario’s shift toward a P3 model has played a role in driving up transit infrastructure costs, but there are also no signs it is helping to rescue Ontarians from soaring costs. If there is a problem, it may be more with the specific P3 model, rather than with P3s in general. In theory, P3s allow for innovation, while it is assumed the traditional public-procurement model is more rigid and prescriptive. But, under Ontario’s P3 model, would bidders for the Richmond Hill extension, for example, have the freedom or incentive – as SNC-Lavalin did in Vancouver – to decide a shallow cut-and-cover subway offers better value at a much better price than the current plan with deep tunnels and large underground station buildings? It is also not clear if a consortium would be disqualified for submitting a proposal, using its best transit-planning and project-delivery expertise, that recognizes there may be large net negative value in tunnelling the Eglinton West LRT extension instead of going above ground.

Jane Bird, the former Canada Line CEO, credits part of that project’s success to SNC-Lavalin’s ability to respond as it did to the restrictions of a fixed budget (though SNC-Lavalin announced in August 2019 that it plans to get out of jobs involving the fixed-cost model).⁴⁵ Another key to the Canada Line success, Ms. Bird says, is that governments in B.C. empowered the private partner to act decisively. “If [relationships with government are] good, the decisions are made up front, ongoing decision-making is delegated properly and defined, which allows it to be quick, and agile, and responsibility and accountability are aligned.”

Other industry people echo those ideas, saying empowering the chosen consortium can minimize “change orders” and “scope creep,” two factors often blamed for cost overruns, both in P3 and traditional-procurement projects.

Amid the ethical challenges inherent when public and private interests intersect, it is advisable that government, opposition parties, the Auditor-General, academics and media step up their vigilance in monitoring all aspects of the P3 processes, especially as IO experiments with models for transit projects.

Some key issues, including risk allocation related to land acquisition, utility relocations and delays in the approvals process, are on the current provincial government’s radar,⁴⁶ but it remains to be seen if legislation will serve to deliver value for the public as well or better than it helps owners of private-partner companies. There have been reports recently that private-sector partners, despite being very profitable in the 21st century, are expressing fears too much of the risk is being shifted their way.⁴⁷ With costs soaring so fast, there may be the possibility that the models are building so much risk into projects that neither public nor private partners in our P3s will be willing to buy in much longer.

As mentioned earlier, transit projects differ from hospitals and universities in that they have potential to create major real estate-related premiums. To date, IO’s business model has largely ignored opportunities and best practices for capturing or trading transit-oriented real estate value uplift the public’s investments create.

There might be hope on this front: recently, a senior public official conceded to an audience of transit professionals that most of the potential value premiums from publicly owned real estate near and atop Eglinton Crosstown (and TYSSE) stations was squandered because development professionals – public and private – were not involved at the very start of the planning process. (Two private-sector real estate professionals who spoke off the record with the author in 2015 expressed amazement that the Eglinton Crosstown request for proposals had already closed before an RFP was issued for developments at individual stations.)⁴⁸

The senior public official, who cannot be identified because they spoke under Chatham House rules, assured his audience that lessons had been learned from the initial attempt at leveraging the worth of transit-oriented real estate on the Crosstown and that changes will be in place for future projects. It might also be encouraging that Metrolinx has entered into joint-venture real estate projects at GO stations, including Mimico.⁴⁹ In a January 2020 email, Metrolinx said “Opportunities for TOD [transit-oriented development] at Port Credit GO are in the early planning stage for delivery after the completion of the Hurontario LRT.”

Whether the public employs enough real estate expertise at IO and Metrolinx, or whether a new arms-length public development company is required are issues that should be discussed. A separate Crown corporation akin to the development firms owned by large public-sector pension funds might be the best way to ensure the public’s transit-oriented lands are managed as well and as profitably as possible, and that real estate professionals working in the public interest have a seat at the table from the earliest stages of transit infrastructure projects.

Is the bidding process good enough?

This study has uncovered no evidence that anything illegal or untoward has taken place in the bidding for GTA transit projects. Further, there is no reason to doubt the commitment or competence of Canada's competition watchdogs. Soaring project costs, however, could be a red flag and Ontarians should not ignore any potential causes of the cost escalation.

The Organization for Economic Co-operation and Development has warned all member countries to be vigilant about the possibility of bid rigging on big public-works jobs.⁵⁰ Canada's Competition Commissioner in 2016, John Pecman, also warned the country's various levels of government and their procurement agencies to be alert to signs of collusion. "Knowing what we do, that the construction sector and the whole infrastructure sector is susceptible to bid-rigging – and studies have shown that, including the OECD – it was incumbent on us to prioritize our awareness work to help deter this type of conduct from happening," Pecman said.⁵¹

If Quebec's four-year, \$40-million Commission of Inquiry on the Awarding and Management of Public Contracts in the Construction Industry, taught the public anything, it is that we would be naïve to think unscrupulous people will not make an effort to see what they can get away with.⁵² In concluding her 1,741-page report in 2015, Justice France Charbonneau wrote that corruption and collusion are "far more widespread than originally believed."^{53, 54}

Government procurement expert Stephen Bauld recently wrote that "much more needs to be done in Canada" to heighten awareness about the threat of bid-rigging and to give authorities the resources needed to investigate suspected cases as well as the legislation to respond effectively once cases have been brought to light.⁵⁵

There have been other signs and warnings the procurement process has room for improvement, including revelations about the process of assessing bids for the Trillium Line project in Ottawa.⁵⁶⁻⁵⁹ In Toronto as well, the OPP was called in to investigate signs of corruption in the bidding for paving contracts, though the status of the probe remains uncertain.⁶⁰

With Queen's Park planning to put roughly \$30 billion in public money on the table for transit projects in the GTA it's essential that our processes are up to the task of rooting out the less-than-scrupulous operators.

Aside from concerns about vulnerability to bid rigging, the public should question whether enough groups bid for work to ensure proper levels of competitiveness (it is an issue IO seemed to be aware of in its statement earlier in this report).

Bidding begins with proponent teams responding to an RFQ and, according to third-party reports assessing IO's record, "typically" three proponents are shortlisted to bid on DBF (design-build-finance) and DBFM (design-build-finance-maintain) projects at the RFP stage.⁶¹ The Eglinton Crosstown, however, is a DBFM project and IO confirms only two consortiums even came forward for that job at the RFQ stage.⁶²

There were only two bidders for the Cooksville GO project, a \$128.4-million station-rebuild DBF. (It is also a case of a station plan conspicuously devoid of transit-oriented development, especially considering it will be a junction between GO's Milton rail route and the Hurontario LRT

line.)⁶³ The IO website announced a winning bidder for GO's East Rail Maintenance Facility, an \$859.2-million DBFM project, but does not indicate if there was more than one bidder.⁶⁴

Amid soaring prices, IO should encourage more groups to compete for work, even if it means opening up to bidders from continents where transit infrastructure is being delivered faster and more cost-effectively. That might be an especially important idea with concerns the GTA will not have the capacity to build the transit promised in current plans.⁶⁵

VfM reports compiled for each IO project also provide a "Fairness Monitor" letter attesting that the procurement process is "open, fair and competitive." It would be useful to reconsider the appropriateness of outsourcing this key oversight responsibility to the private sector given opportunities for conflict of interest.⁶⁶

In conclusion, there was no clear evidence that the bidding process itself has played a role in driving up the cost of transit projects. However, there have not been a sufficient number of full "linear" or "horizontal" infrastructure projects to make a fair determination. With four major projects being planned for the GTA carrying unprecedented cost estimates and one having recently been cancelled in Hamilton over cost concerns (and possibly a lack of interest from bidders), it is in the immediate public interest of all Ontarians and Canadians to ensure that improved processes be implemented urgently.

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APPENDIX

Summarized from documents at the City of Toronto Archives, Spadina Records Centre: Fonds 16 (TTC fonds), Series 836 (reference materials of the TTC corporate library), Subseries 2, File 33 ... Box 380746, Folio 11

The Original Yonge Line

- Opened March 30, 1954 with 12 stations over 7.4 kilometres.
- Final cost: \$67 million (\$648 million in 2019 dollars).
- Cost breakdown: \$55 million for infrastructure and \$12-million for rolling stock.

University-Bloor-Danforth project

- The basics: 16 kilometres of mostly cut-and-cover subway, with 25 stations
- The cost: \$206-million, (\$1.84 billion 2019 dollars if you used 1959 as the base year, \$1.6-billion if you use 1966).
- The province guaranteed a \$60-million loan for the Municipality of Metropolitan Toronto, allowing a speed-up of construction. Queen's Park announced help in the run-up to the 1963 election, but it turned out not to be retroactive and was only for parts of the project (land acquisition and track bed work) that were largely finished when the new policy became effective in April 1964.
- According to Coupler, an in-house TTC magazine, provincial assistance amounted to \$12 million of the \$206 million total, and Ottawa provided a \$29.5-million loan, eventually forgiving \$7.4 million of the principal. Essentially, senior levels of government contributed \$19.4 million of the \$206 million, or 9.4%. The Municipality of Metropolitan Toronto and the TTC ended up paying 90.6%
- In April 1959, Metro allotted \$21-million of the \$206-million UBD project tab for expropriation of 756 properties. Rolling stock cost \$30-million.

The University Line portion:

- The **U-1** contract for St. Andrew and Osgoode stations plus 2,900 lineal feet of twin cut-and-cover tunnels awarded to Johnson-Perini-Kiewit with DeLeuw Cather as consultants for \$6,739,506 (68,047,344.96 in 2019 dollars). Work began April 12, 1960. Contract fulfilled on Oct. 15, 1962. St. Andrew is 44 feet deep and Osgoode is 37 feet.
- The **U-2** contract was awarded to Robert McAlpine Ltd., with Atkins Associates at consultants. It called for two stations, St. Patrick and Queen's Park as well as 5,320 feet of twin tunnels for \$7,879,078 (\$70.2 million in 2019 dollars). Work began Dec. 14, 1959 and the contract was deemed fulfilled on Sept 19, 1962. St. Patrick station is 40 feet below the surface and Queen's Park is 32 feet. High-water-table shields were required at an additional cost of \$375,000 (\$3.3 million in 2019 dollars)
- The **U-3** contract was awarded to McNamara-Raymond. It called for two stations, Museum and St. George, and 3,425 lineal feet of twin cut-and-cover tunnels for \$6,805,102 (\$60.6 million, 2019 dollars). Work began Nov. 9, 1959, and the contract was deemed fulfilled

on June 1, 1962. St. George was a two-level station, 21 feet at the Line 1 platform and 40 feet for Line 2). There was also 170 lineal feet of Milan-method cut-and-cover tunneling for \$183,000 (\$1.6 million in 2019) done by Icanda Ltd. of Montreal.

The Bloor-Danforth Line portion:

- 586 houses had to be demolished.
- Nine deaths of construction workers, many stations got only one exit and there were lots of complaints about a lack of escalators.
- The **D-1** contract was awarded to the Foundation Company of Canada and called for one two-level station, Bay (Yorkville), as well as 2,800 lineal feet of twin cut-and-cover tunnels for \$5,144,168.09 (\$44.4 million in 2019). Work began Feb. 5, 1962, and the contract was deemed fulfilled on Jan. 16, 1964. The lower station level was 46 feet deep and the upper one was 32 feet.
- **D-1A** was awarded to the Foundation Co. of Canada and called for construction of the Yonge station parts of Bloor-Yonge station, making it an interchange, including the underpinning of Bloor station on the Yonge line for a total of \$1,359,481.95 (\$11.7 million in 2019 dollars). Yonge station depth is 45 feet.
- **D-2** was awarded to Robert McAlpine Ltd. and called for 2,250 lineal feet of twin tunnels from the east end of Yonge station to a spot 32 feet within Sherbourne station for \$2,742,818.00 (\$23.7 million in 2019). Work began Feb. 5, 1962, and the contract was deemed fulfilled on May 26, 1963. (The westbound tunnel was done using a “shield” approach while eastbound was done “mole” style. Mole turned out to be nearly twice as fast and cut labour costs by about 50%).
- **D-2A** was awarded to Dineen Construction Ltd. and called for construction of Sherbourne station with a second entrance for \$1,020,000 (\$8.6 million in 2019). Work began Feb. 5, 1962. Contract deemed fulfilled on May 26, 1963. Station depth is 40 feet.
- **D-3** details are unclear (they appear to call for the bridge between Sherbourne and Castle Frank, some cut and cover and Castle Frank station itself, 2,432 lineal feet for \$2,800,000 (\$23.7 million in 2019 dollars). Feb. 12, 1963 to Aug. 22, 1964.
- **D-4** was awarded to McNamara Construction for the laying of tracks across the Viaduct’s lower level for \$385,000 (\$3.3 million in 2019 dollars).
- **D-5** was awarded to Robert McAlpine Ltd., calling for 6,000 lineal feet of twin cut-and-cover tunnels and three stations, Broadview, Chester and Pape for \$6,400,000 (\$55.2 million in 2019 dollars). Work began Nov. 1, 1962. The contract was fulfilled on Dec. 4, 1964. Broadview is 40 feet below the surface, Chester and Pape are 45 feet deep.
- **D-6** was awarded to Johnson-Kiewit, calling for 4,500 lineal feet of twin cut-and-cover tunnels from Dewhurst Blvd. to Monarch Park Ave. including Donlands and Greenwood stations for \$7,610,000 (64.4 million in 2019 dollars). Donlands station is 33-feet deep while Greenwood is 32. Work began Aug. 6, 1963 and contract was deemed fulfilled by April 27, 1965. It’s unclear how much of the Y connection for Greenwood Yard is included in this contract. The tunnels are configured to create the grade separation.

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- **D-7** was awarded to McNamara Construction to build the Greenwood storage and maintenance yards for \$5,370,000 (\$45.1 million in 2019 dollars). April 1965 Headlights magazine article about the facility says key buildings and track spacing were designed to facilitate development above the Greenwood Yard.
 - **D-8** was awarded to Johnson-Kiewit, calling for 3,520 lineal feet of twin cut-and-cover tunnels from Monarch Park Ave. to west of Woodmount Ave, including Coxwell station for \$4,055,000 (34.3 million in 2019 dollars). Work began Aug. 6, 1963 and contract was deemed fulfilled by Feb. 17, 1965. Depth of Coxwell station 35 to 40 feet. Water table at some points was only 15 feet below surface.
 - **D-9** contract was awarded to Redfern Construction, calling for 1,527 lineal feet of twin cut-and-cover tunnels from Woodmount Ave. to and including Woodbine station for \$2,731,284 (\$22.7 million in 2019 dollars). Work began May 15, 1964 and contract was deemed fulfilled by October 7, 1965. Station depth is 40 feet.
 - **B-1** contract was awarded to Taylor Woodrow calling for 3,000 lineal feet of twin cut-and-cover tunnels from Huron Street to Markham Street including two stations, Spadina and Bathurst (both with second entrances) for \$3,860,000 (\$32.7 million in 2019 dollars). Bathurst station reaches a depth of 35 feet and Spadina 37 feet.
 - **B-2** was awarded to C.A. Pitts Engineering and Construction calling for 4,300 lineal feet of twin cut-and-cover tunnels and two stations, Christie and Ossington, the latter including a second entrance, for \$4,075,000 (\$34.5 million in 2019). Work began on Sept. 12, 1963; contract was fulfilled on Feb. 9, 1965. Both stations are 40 feet deep.
 - **B-3** was awarded to Russell Construction, which defaulted. Work was completed by Robert McAlpine Ltd. B-3 called for 4,300 linear feet of twin cut-and-cover tunnels and two stations, Dufferin and Lansdowne (the latter with a second entrance) for \$4,425,000 (\$36.8 million in 2019). Work began on May 14, 1964, and the contract was deemed fulfilled on April 30, 1965. There were water-table issues with it being as shallow as seven feet in some spots. Dufferin station is 30 feet deep and Lansdowne is 36.
 - **B-4** was awarded to Robert McAlpine Ltd. and called for 3,744 lineal feet, 1,842 in true twin tunnels under the rail corridors and 1,902 feet of twin cut-and-cover tunnels between Lansdowne and Indian Road including one station, Dundas West, for \$7,405,000 (\$62.7 million in 2019 dollars). Work began on July 18, 1963, and the contract was deemed fulfilled on Feb. 28, 1965. There were water-table issues with it being as shallow as four feet in one spot. Dundas West station is 40 feet deep.
 - **B-5** was awarded to Varamae Construction with DeLeuw Cather as the consultants. It called for 908 lineal feet above ground and included Keele station for \$1,866,500 (\$15.5 million in 2019). Work began on May 15, 1964 and the contract was deemed fulfilled on May 31, 1966 (a bit more than three months after the line opened). Station height is listed as 33 feet seven inches, but it's tough to tell whether that's to the roof. Soil conditions were listed as quicksand.

The 1968 Bloor-Danforth Extensions

- The total cost was \$777.7-million for nine stations over 9.9 km. There were including two large terminals with extensive parking lots (It's worth noting that the TTC in the February 1966 edition of *The Coupler* says terminals cost about twice as much as average stations on the line). Three stations were above ground (Old Mill, Victoria Park and Warden). Final funding breakdown for this, the last project prior to the Davis formula but the first with significant provincial funding, was \$49.3-million from Metro, \$17.6-million from TTC and \$10.8-million from Queen's Park.
- Eastern part is three stations and 4.4 km. (580 m hand tunnelled, 1,140m cut and cover, remainder above ground in a former Canadian Northern Railway corridor.
- Western part is six stations and 5.5 km (mostly shallow cut and cover with about 1 km of open cut, elevated and bridges).
- Contract **E-1** was awarded to Taylor Woodrow, calling for 5,700 lineal feet from Cedarvale Ave. to Victoria Park Ave. (1,900 tunnel and 3,800 cut and cover) including one station, Main Street, for \$6,772,585 (\$55.2 million in 2019). Work began on June 18, 1965 and the contract was deemed fulfilled on Jan. 19, 1967. Station is 39 feet deep.
- **E-2** was awarded to Taylor Woodrow, calling for 6,300 lineal feet from west side of Victoria Park Ave. to the west side of Warden Ave., including Victoria Park station for \$1,836,339.80 (\$15.0 million in 2019). Work began on Oct. 26, 1965. The contract was deemed fulfilled on Nov. 29, 1967 (seven months late). Station included six bus bays and is 18 feet above street level. It also had 260 parking spaces on 2.1 acres. This part of the line made use of the Canadian Northern Railways corridor, abandoned in 1926.
- **E-3** was awarded to Johnson-Kiewit and V.K. Mason for 2,391 lineal feet above ground, including one terminal station, Warden, with nine bus bays, 1,577 parking spots and a kiss-n-ride entrance for \$4,809,125 (\$37.6 million in 2019 dollars). Work began on April 21, 1966 and the contract was deemed fulfilled on May 9, 1968 (the day before the line opened and seven months late).
- **W-1** contract was awarded to Redfern Construction and DeLeuw Cather consultants calling for two stations (High Park and Runnymede) over 4,575 lineal feet (808 feet of that was above ground and 3,767 cut-and-cover tunnels) for \$4,391,601 (\$35.8 million in 2019). Work began on Sept. 24, 1965, and the contract was deemed fulfilled on March 23, 1967. High Park station is 24 feet deep and Runnymede is 33.
- **W-2** was awarded to Robert McAlpine Ltd. with Atkins Hatch consultants, calling for 3,760 lineal feet from Runnymede Rd to Riverside Dr, including one station, Jane, for \$3,938,562 (\$32.1 million in 2019). Work began on June 18, 1965 and the contract was deemed fulfilled on Nov. 22 1966, about seven weeks ahead of schedule. Jane station hits a depth of 44 feet.
- **W-3** was awarded to Varamae Construction, calling for 1,570 lineal feet and Old Mill station, including an 800-foot bridge upon which 294 feet, 59% of the station, would sit, for \$1,449,837.67 (\$11.8 million in 2019). Work began on March 1, 1965, and the contract

was deemed fulfilled on Aug. 10, 1966. The station is 29 feet deep at its west end, but above ground for most of its length over the Humber Valley.

- **W-4** was awarded to Johnson-Kiewit calling for 6,500 lineal feet, mostly cut-and-cover tunnels with a 310-foot bridge over Mimico Creek and one station with two entrances, Royal York, for \$5,941,891 (\$48.5 million in 2019 dollars). Work began Sept. 7, 1965, and the contract was deemed fulfilled on Oct. 16, 1967, three months late. Royal York station is 32 feet deep.
- **W-5** was awarded to Robert McAlpine Ltd. calling for 1,764 lineal feet and the Islington terminal station with six bus bays, 1,259 parking spots and a kiss-n-ride entrance for \$4,332,980 (\$33.9 million in 2019). Work began July 20, 1966, and the contract was deemed fulfilled on May 9, 1968, one day before the opening ceremonies and seven months late. No details on station depth.

Yonge Subway Northern Extensions (Open 1973 and 1974)

- The Yonge Subway Northern Extension (YSNE) was approved by the Ontario Municipal Board on July 13, 1967, and was to include three new stations over six kilometres from Eglinton to Sheppard at a cost of \$79,553,000. Work began in September 1969 and, in December 1969, the OMB approved extending the line a further 2 kilometres to Finch Ave for an additional \$31,376,000 (\$110.9-million in total).
- By summer of 1970, cost estimates had risen by about one-third to \$145.5-million from \$110.9-million. As part of attempts to rein in costs, the section from Sheppard to Finch reverted to cut-and-cover tunnels, saving 12.8% on that section (from \$43-million down to \$37.5-million). Also, plans to rough in a station at Park Home, which later became North York Centre were scrapped to save money. However, the decision to revert to shallower cut-and-cover tunnels made it feasible to eventually add the station, which opened in 1987, 13 years after the subway extension.
- Costs nevertheless ended up more than twice as much per kilometre than the Bloor-Danforth extensions that opened in 1968, in part because area residents successfully protested against plans to use cut-and-cover construction, prompting a switch to deep tunnels, including under the Don Valley near York Mills station, where original proposals called for an above-ground viaduct. Contracts listed include some tunneling with the stations, making hard station-cost comparisons difficult. The stations were done cut-and-cover style, even if most tunnelling wasn't.
- The choice to go with deep tunnels meant the TTC plumbed what were unprecedented depths for Toronto's subway. A summary of Contract **Y-3** indicates the north end of the Lawrence station is 21.3 metres (70 feet), more than 35% deeper than the lower level of Bloor-Yonge station. Y-3 was for Lawrence and slightly more than twice the length of the station (including underground bus-connections) cut-and-cover style for \$11,291,724 (or \$66.5 million in 2019 dollars).
- Contract **Y-4** tells us the tunnels at Glen Echo and Yonge were more than 28 metres (92 feet), about twice as deep as any other spot on the system at the time.

- **Y-5** for York Mills included 1,793 feet of cut-and-cover tunnels and the station, awarded to H.J. O’Connell Ltd to \$5,385,939.65 (\$37.8 million in 2019 dollars). It was expensive for the time but inexpensive compared with current stations. Depth reached 15.8 metres (55 feet) at the north end.
- **Y-7** for Sheppard station and an additional 749 feet of tunnel done cut-and-cover style, was awarded to Foundation Co. of Canada for \$5,988,144.35 (\$32,062,505.18 2019 dollars). The south end of Sheppard station was 18.9 metres (62 feet), unusually deep, at least until the TYSSE opened (the Sheppard subway, which opened in 2002, connects from above Sheppard station’s Yonge-line platform).
- **Y-16** for Finch station was awarded to Dineen Construction Ltd. for \$5,526,882.30 (\$29.6 million in 2019 dollars). It called for 1,680 feet of cut-and-cover that would include 500 feet for the station and 500 feet for the terminal station tail tracks. At 11.7 metres below the surface, the excavation is slightly deeper than the average pre-1970s stations but very shallow compared with TYSSE stops, which are 20 to 25 metres deep.

The Spadina Line (Open 1978)

TTC contract summaries are not quite as clear as for the previous jobs:

- Eight stations over 10 kilometres, built partly in hopes of relieving Yonge-line crowding and generating ridership for the underused University line.
- Expressway median alignment was chosen by Metro Council in 1972 in part because it was to cost \$155-million rather than the \$185-million estimated for a route under Bathurst Street (some suburban politicians preferred the median route because it might keep alive hopes of a full Spadina Expressway to downtown).
- Work began in 1974 and, by 1975, cost estimates had soared more than 40 per cent to \$220 million. Architects were employed for unique, non-standardized station designs, and there was a \$500,000 budget to provide art in the stations.
- Contract **A3-1** was awarded to Kilmer Van Nostrand calling for 2,290 lineal feet of cut-and-cover tunnels from St. George station to Bernard Ave., including one new station, Line 1 Spadina, for \$8,872,945.41 (\$42.9 million in 2019). Work began on March 20, 1975. The contract was deemed fulfilled on Oct. 11, 1976, eight weeks early.
- There appears to be no record in the archives of an **A4** contract.
- **A5-1** was awarded to Kilmer Van Nostrand calling for 1,880 lineal feet of cut-and-cover tunnels from Bernard Ave. to Davenport Road, including one station, Dupont, \$5,630,793.85 (\$27.2 million in 2019). Work began on March 20, 1975, and the contract was deemed fulfilled on July 30, 1976, on time. A water main had to be relocated by Metro for an additional \$795,718 (\$3.8 million in 2019 dollars). Station was 38 feet deep.

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- **St. Clair West** was an elaborate station for the time with underground streetcar and bus loops. Kilmer Van Nostrand (**A7-1**) and Montcalm Construction (**A7-2**) were awarded contracts. Montcalm's included 589 feet of cut and cover including the south half of the station (roughly 250 feet), including the loops, and ramps and portals to St. Clair Avenue. **A7-2** work started on Dec. 11, 1975 and was fulfilled by Nov. 1, 1977 for \$10,804,814.72. (\$52.2 million in 2019 dollars). Station depth was 50 feet at track level with a 20-foot average at the bus/streetcar loops. **A7-1** included 470 feet of cut and cover including the north half of the station for \$2,985,748.27 (\$14.4 million in 2019). Work started Nov. 13, 1974, and contract was fulfilled as of Sept. 17, 1975. Both contracts combined came to \$13,790,562.99 (\$66.7 million in 2019).
 - **Eglinton West** station, quite rudimentary. The contract, including "830 lineal feet of subway structure north of Eglinton including Eglinton West station structure." Contract was fulfilled by Folco Construction for \$2,332,950.25 on Sept. 17, 1976. (10.3 million in 2019 dollars).
 - **Glencairn:** Mollenhauer Ltd. fulfilled the contract on Oct. 31, 1977, for \$4,116,707.22 (\$17.0 million in 2019 dollars).
 - **Lawrence West:** Janin Building and Civil Works Ltd. got the contract (**A13-1**), and it appears to be solely for the station with a final value listed at \$4,575,193.86 (which is \$22.1 million in 2019 dollars)
 - **Yorkdale:** Contract **A15-1** for construction of station and architectural finishes and associated structures (1,000-foot bridge from station into mall) fulfilled by Janin Building and Civil Works Ltd. on Nov. 28, 1977, for \$4,790,237.25, 19.7 million in 2019).
 - **Wilson:** Contract **A17-1** for station structure and finishes, kiss-n-ride facility, bus terminal and electrical sub-station) fulfilled by Mollenhauer on Dec. 23, 1977, for \$11,182,740.92 (\$46.1 million in 2019 dollars). Construction of Wilson's parking facilities (588 spots) was covered under a different contract worth \$617,118.46 granted to Advance Paving, and fulfilled in July 1980, about 2.5 years after the line opened.
 - **Wilson Yard:** Contracts A18-1 and A18-2, awarded to Kilmer Van Nostrand and Janin Building and Civil Works Ltd., respectively for \$6,407,747.58 (\$30.9 million) and \$5,811,149.66 (\$28.0 million in 2019 dollars). Total was \$58.9 million (\$283.9 million in 2019 dollars).
 - **Downsview:** NA ... TTC says it is "not resourced" to provide the information. Archives' open files don't cover 1996

Kennedy + Kipling Extensions (Open 1980)

- The west extension was 1.5 km (above ground) with estimates ranging from \$40 million to \$49 million (in 2019 dollars, \$127.1 million to \$155.7 million).
- The Kennedy extension was 2.8 km, 300 metres above ground and 2.5 km of cut and cover, with estimates ranging all the way from \$74 million to \$91 million.
- The 1979 annual report estimated the combined cost of the project at \$103.5 million (though that appears to not include rolling stock). Most other TTC estimates contained in TTC update reports put the combined cost at between \$114 million and \$140 million. A Globe and Mail news brief put the final cost at \$127 million, which was seen as \$2 million less than the final estimate of \$129 million. Karl Mallette, then TTC chair, also used the \$127 million figure on opening day while greeting riders (including this report's author), on the Kennedy platform. There is also a mention in the 1980 annual report that "the \$99-million extensions" opened on Nov. 22.
- Kennedy, according to documents at the city archives, came in a \$6.798 million for structure and finishings, with \$1.1 million for the parking lot and probably about \$650,000 for escalators, which would be half the \$1.3 million spent on escalators for the two-station project. Folco handled the structure and Mollenhauer did the finishing and the parking facilities. Add \$2 million in contracts for tail tracks and crossovers done by Folco (amounts vary by source, \$1.994 million to \$2.018 million). Roughly \$10.6 million all in (\$33.7 million in 2019) Contracts were F3-1, F3-3 and F3-4 (no record of an F3-2)
- **F7-1** contract listed for structure and finishes with an electrical sub-station and kiss-n-ride facility at Kipling was awarded to and fulfilled by Janin Building and Civil Works Ltd. for \$8,042,403.73 (\$25.6 million in 2019\$).
- **F7-2** was awarded to Mollenhauer Ltd. for construction of associated roadways and parking facilities for \$2,735,247.25 (\$8.7 million in 2019). All in tab appears to be \$10,777,650.98 (\$34.3 million in 2019)

North York Centre station

From TTC's 1984 annual report ... work to start on the TTC's "60th subway station, the North York Centre station, scheduled to open in 1987. It's the only station the TTC has ever added to an existing line, and it was done without interrupting service (something that could only be done on a cut-and-cover part of the line). This \$26.5-million facility will provide direct access to the new \$250-million city-centre complex in the city of North York." (\$59.8 million in 2019). The 1987 annual report indicates the project came in at \$6.1 million less than the original estimate, \$20.4 million. (\$40.9 million in 2019 dollars). Contract report puts total cost at \$19.2 million.

Downsview extension (Open 1996)

The 1.6-km, one-station extension, which opened March 31, 1996, and cost \$117 million. It's 543 lineal metres of above-ground tracks through top end of Wilson Yard and 1,072 metres cut-and-cover including station and tail track. (BoC inflation calculator puts \$117 million figure (x1.53) at \$179 million 2019 dollars.

