



New Subway Train Procurement and Implications for Line 2 Modernization and Future Growth

Date: November 22, 2023
To: TTC Board
From: Chief Executive Officer

Summary

The TTC's Capital Investment Plan (CIP) (2023-2037) outlines capital requirements in the order of \$38.05 billion over the next 15 years, of which \$25.2 billion is unfunded. The subway network comprises 52% or \$13.3 billion of the necessary, but unfunded investment, predominantly for state of good repair, including critical fleet, asset replacement/renewal and to accommodate growth. A key portfolio of investment in the CIP includes "Modernizing the Subway and Expanding Capacity" encompassing two priority areas of capital needs:

- Modernization of Line 2 to replace assets at end of life (fleet and signalling system) to sustain safe, reliable service and enable future growth; and
- Enhancement of Line 1 capacity to accommodate growth to 2041.

This report outlines the interdependent capital projects in these two priority areas, and the requirement to obtain immediate full funding for 55 replacement trains for Line 2 and 25 growth trains for Line 1 through a new subway train (NST) procurement, at an updated estimated cost of \$3.2 billion for the combined total of 80 trains. In the absence of full funding for Line 2 NSTs, the ability to sustain a reliable service on Line 2 is at risk due to the age of the fleet and signalling system. Forecasted growth in customer demand on Line 1 will also not be accommodated without a new train procurement advancing.

Line 2 – Asset Renewal and Modernization

Line 2 Bloor-Danforth opened in 1966, and the current fleet of 61 T1 subway trains operating on the Line will be 30 years old (end of design life) starting in 2026. The signalling system, specifically, is aged technology at the end of life, and without Automatic Train Control capability, as is available on Line 1. Other key elements of Line 2, such as the Greenwood facility, are also due to undergo asset replacement and renewal.

In 2020, the TTC Board approved a fleet procurement strategy, which recommended the procurement of new subway trains for Line 2, subject to matching funding commitments, instead of a 10-Year Life Extension Overhaul (LEO) of the fleet. Investing

in new trains is better value for money and a prerequisite for modernizing Line 2 and supporting future capacity enhancement.

A portfolio of investment is planned for modernizing Line 2 to replace existing aging assets and to support future growth and expansion of the network in the long term. Major Line 2 projects and programs include:

- Procurement of 55 higher capacity NSTs to replace the T1 fleet at end of life;
- Implementation of Automatic Train Control (ATC) on Line 2 (Kipling to Kennedy) to replace Line 2's fixed-block system first installed prior to opening in 1966;
- Upgrades to the Greenwood facility to accommodate the new fleet, and address state-of-good-repair requirements; and
- Implementation of the Line 2 Capacity Enhancement Program (L2CEP) for projected ridership growth to 2041 and beyond. The program's scope includes infrastructure improvements for station capacities, electrical traction power, guideway enhancement, etc.

Modernization of Line 2 is dependent on the procurement of NSTs, as it is not recommended to implement ATC-enabled technology on the existing T1 fleet. ATC implementation is also necessary to achieve higher capacity, improved reliability and to unlock the opportunity for Platform Edge Doors on Line 2 in the longer term.

Accommodating Growth and Network Expansion

Securing full funding to invest in NSTs for Line 2 also unlocks the ability to address broader subway network needs associated with forecasted growth and provincially planned network expansion.

- Line 1 Growth to Meet Projected Demand: Current demand projections identify the need for 25 additional trains to improve the service headway to 105 seconds by 2032, for a total of 80 new trains. There is a future need for 13 additional trains required by 2037 to improve service headways to 100 seconds and extend the a.m. turnback from Glencairn Station to Finch West Station. In the absence of new trains for the line, there is risk of crowding and delays due to increased dwell times. New trains will also require investment in a new Train Maintenance and Storage Facility (TMSF), which requires further planning and the finalization of a site location.
- Line 1 Extension: The Yonge North Subway Extension (YNSE) being delivered by Metrolinx will require the procurement of eight additional trains to extend service to Richmond Hill. The current forecast provided by Metrolinx indicates YNSE has a target completion date of 2032.
- Line 2 Extension: The Scarborough Subway Extension (SSE) being delivered by Metrolinx is forecasted to be complete by 2030 and requires the procurement of seven additional trains to meet service requirements of the extended line.

Establishing a base train contract for Line 2 trains enables the TTC to procure Line 1 growth trains and provide options for Metrolinx to purchase trains for the YNSE and SSE. This procurement strategy achieves opportunities for improved unit pricing

through economies of scale, and ensures the expansion fleet is compatible with the TTC's fleet and infrastructure. Metrolinx is responsible for the full cost of the 15 trains for the YNSE and the SSE.

New Subway Train (NST) Procurement

In accordance with Board direction, the TTC advanced the NST procurement through a Request for Information (RFI) in 2020, market sounding in 2021, supplier prequalification in 2022, and issued a Request for Proposals (RFP) to market in October 2022, with the RFP award conditional on full funding being received from all orders of government. Based on the original timeline, NSTs were forecasted to be delivered between 2028 and 2032 for both lines. In June 2023, the TTC cancelled the RFP due to insufficient funds to proceed.

The TTC continues to seek full funding from other orders of government for NSTs, and has undertaken an updated analysis of cost, schedule and risks based on scenario planning for when funding may be secured. If full funding for NSTs is not achieved by Q1 2024 (Scenario 1) or latest Q1 2025 (Scenario 2), then the TTC will need to consider the least desirable option (Scenario 3) of further extending the life of Line 2 assets (fleet and signalling systems). This will result in abandoning the opportunity to modernize Line 2 and address future growth. A new train procurement would still be required under Scenario 3, albeit at a higher cost, with the procurement needing to commence in 2030.

Depending on full funding commitments, the 80 new trains under each new procurement scenario are expected to be delivered as follows for Line 2 replacement and Line 1 growth:

- Scenario 1 – 2030 to 2035 at an estimated cost of \$3.23 billion.
- Scenario 2 – 2031 to 2036 at an estimated cost of \$3.32 billion.
- Scenario 3 – 2036 to 2041 at an estimated cost of \$3.74 billion.

The timelines for new train delivery have implications on planning requirements for interdependent capital projects, Metrolinx expansion, and the ability to meet forecasted customer demand. The level of risk and possible degradation of service capacity and quality increases with the delay in procuring new trains. Note: the above cost estimates do not include the costs associated with other work and activities now necessary, and in particular under Scenario 3, the requirement to implement a 10-Year Life Extension Overhaul (LEO) for the T1 fleet at a cost of \$1.36 billion as an interim measure.

The preferred plan for Line 2's fixed-block signalling system is to fully replace with ATC in accordance with the delivery of ATC equipped NSTs for Line 2. Due to funding uncertainty for the new trains, an assessment of whether further investment can be made to extend the life of the existing signalling system to 2040 is being advanced.

Given the age of the Line 2 fleet, it is necessary to implement a 30-year State of Good Repair (SOGR) program for all T1 trains. The TTC will also advance planning for a 10-year LEO for the T1 trains as a back up option to sustain a service on Line 2 (Scenario 3). In the event the TTC needs to proceed with Scenario 3, available City funding for

new trains would need to be reallocated to extend Line 2 asset life in the immediate term, with new funds required to commence procurement for new trains in 2030.

This report recommends to: (a) continue with Line 2 modernization plans, while (b) advancing in parallel the necessary planning should the TTC need to implement temporary measures to extend the Line 2 fleet past design life by 10 years and further extend the life of signalling infrastructure. The report makes recommendations to government partners to prioritize new funding in their 2024 Budgets to enable Line 2 modernization to advance, and to support Line 1 growth and expansion by investing in trains and a Train Maintenance and Storage Facility. The new train RFP will be structured to allow for options to be exercised, to ensure the interdependent projects (Line 1 growth trains and TMSF) advance together.

Incrementally increasing time delays for the procurement will result in higher procurement costs, additional SOGR, and life-extension (sunk) costs as well as lost ridership revenues. Further, potential socio-economic benefits (travel time saved, increased reliability, new economic activity) will be foregone by transit riders and the broader economy. Full funding commitments are required as soon as possible to reinstate the train RFP to minimize the cost of investment and mitigate risks to the subway system.

Recommendations

It is recommended that the TTC Board:

1. Direct the Chief Executive Officer and Chief Financial Officer to prioritize funding in the 2024-2033 Capital Budget and Plan submission to fully fund the City's one-third share of the revised estimated cost of the 80 new subway trains estimated at a total cost of \$3.2 billion.
2. Direct the Chief Executive Officer, subject to confirmation of full funding for a base order of the New Subway Train procurement to:
 - a. Issue an RFP for a minimum of 55 new subway trains to replace the T1 trains on Line 2, and include options for a minimum of 25 Line 1 growth trains and future train requirements based on the fleet requirements outlined in this report.
 - b. Include with the base order the 15 expansion trains required by Metrolinx for the Scarborough Subway Extension and the Yonge North Subway Extension, subject to confirmation of full funding for these trains by Metrolinx.
3. Direct the Chief Executive Officer and Chief Financial Officer, to prioritize \$130 million in funding in the 2024-2033 Capital Budget and Plan submission to implement a 30-Year State of Good Repair program for the full fleet of Line 2's T1 trains at a preliminary estimated cost of \$163 million.
4. Direct the Chief Executive Officer and Chief Financial Officer, to prioritize funding in the 2024-2033 Capital Budget and Plan submission to advance in parallel risk mitigation activities for Line 2 at a cost of \$4.836 million over 2024 to 2025 for:

- a. An implementation planning study for a T1 Fleet 10-Year Life Extension Overhaul Program; and
 - b. An updated condition assessment and feasibility assessment of extending the life of the Line 2 fixed-block signalling system.
5. Forward this report to the City of Toronto, the Ontario Ministry of Transportation, Ontario Ministry of Finance, and Infrastructure Canada to inform ongoing intergovernmental discussions for funding on new trains for Line 2 and Line 1 and associated infrastructure, and request commitment of matching funding in the 2024 Provincial and Federal budget.
 6. Forward this report to Metrolinx, York Region, and York Region Rapid Transit Corporation for information.

Financial Summary

The TTC's Capital Investment Plan (CIP) (2023-2037) outlines capital requirements in the order of \$38.05 billion over the next 15 years, of which \$25.2 billion is currently unfunded. Since 2019, the City of Toronto has committed funding to invest an incremental \$8.95 billion in the TTC transit system, predominantly through the implementation of a City Building Fund levy. Of this amount, 70% or \$6.3 billion is allocated directly to the integrated subway network. The balance of funding supports other elements of the network. This reflects the City's commitment to increased investment in TTC state of good repair under the Toronto-Ontario Transit Partnership Preliminary Agreement (2019). Despite significant new funding, many key elements of the TTC's 15-Year CIP remain unfunded.

Line 2 Modernization and Line 1 Growth – Elements of the TTC's Subway Portfolio

Table 1 provides a summary of the estimated costs in the TTC's approved 2023-2032 10-Year Capital Budget and Plan, and the 2023-2037 TTC CIP, for key components of the subway portfolio that are interdependent with the new train procurement. For Line 2, full funding has been allocated in the 10-year window for the Line 2 ATC signalling system project and the modifications for the Greenwood facility. Unfunded amounts identified in Table 1 reflect requirements post-2032. One-third funding for the 80-train procurement order was also approved in TTC's Capital Plan, with matching funding requested from other orders of government.

Table 1. Approved 2023-2032 Capital Budget and Plan and 2023-2037 Capital Investment Plan (CIP) (\$Million's)

Program/Project	Estimated Final Cost (EFC)	Life to Date and Approved Funding 2023-2032	CIP Unfunded 2023-2037
Fleet			
80 New Subway Trains	\$2,493	\$817	\$1,676
Line 2 Fleet – T1 30-Year SOGR	\$33	\$33	0
Line 2 Infrastructure			
ATC Line 2	\$813	\$625 ⁽¹⁾	\$188
Line 2 Fixed-Block SOGR	\$189	\$137 ⁽²⁾	\$52
Greenwood Modifications (Shop, Yard Signalling, Carhouse)	\$753	\$703	\$50
Line 1 Infrastructure			
Train Maintenance and Storage Facility	\$2,864	\$550	\$2,314
Total	\$7,144	\$2,865	\$4,280
<i>Notes</i>			
<i>(1) ATC Line 2 is fully funded by the City from 2023 through to 2032, with unfunded amount post 2032. Unfunded amounts in the post 10-year capital plan window will be recommended for full funding in subsequent annual budget processes as new 10th year added.</i>			
<i>(2) Line 2 Fixed-Block Signal SOGR, includes unfunded amounts post-2032.</i>			

Table 2 provides revised estimates for TTC Line 2 and Line 1 projects interdependent with the NST procurement based on Scenario 1, which assumes full funding commitments are made to advance the NST procurement in 2024. Updated cost estimates in Table 2 reflect schedule impacts and changes in market conditions. In order to implement Line 2 modernization, one-third matching funding for Line 2 NSTs is required. If funding is approved for Line 1 growth trains, funding will also be required for the Line 1 TMSF to proceed.

Through the 2024 Budget process, the TTC will update the 10-Year Capital Plan and 15-Year CIP to reflect the estimates in Table 2 based on Scenario 1 planning assumptions. This includes updating the NST procurement cost and the City's one-third share for the full order of 80 new trains that will increase to \$1.077 billion, which will require additional City funding of \$260.117 million for the 80 new trains. Per practice, estimates will continue to be refined as project planning and design progresses, and final funding decisions are made.

Table 2. Updated Cost Estimates Per Planning Scenario 1 (\$Million's)

Program/Project	Revised EFC	Revised CIP Unfunded	Assumption on Funding Shares	Estimated Municipal Share	Requested Provincial Share	Requested Federal Share
Fleet						
80 New Subway Trains	\$3,232	\$2,414	1/3 each	\$1,077	\$1,077	\$1,077
Line 2 Fleet – T1 30-Year SOGR	\$163	\$130	100% City	\$163	0	0
Line 2 Infrastructure						
ATC Line 2	\$881	\$355	100% City	\$881	0	0
Line 2 Fixed-Block SOGR	\$224	\$87	100% City	\$224	0	0
Greenwood Modifications (Shop, Yard Signalling, Carhouse)	\$727	\$49*	100% City	\$727	0	0
Line 1 Infrastructure						
Train Maintenance and Storage Facility	\$3,296	\$3,065	1/3 each	\$1,099	\$1,099	\$1,099
Total	\$8,523	\$6,101		\$4,172	\$2,176	\$2,176
<p><i>Note: City funding shares towards the subway network reflect funding previously committed to be directed to TTC SOGR per the Toronto-Ontario Partnership Agreement.</i></p> <p><i>*Greenwood Shop, Yard and Carhouse is fully funded by the City from 2023 to 2032; unfunded amounts post-2032. Note: design progressed over 2023 and the final estimated cost has been revised to \$727 million from \$752 million.</i></p>						

Planning for Scenario 3: Updating Line 2 Condition Assessment and Planning Studies

The TTC, in partnership with the City, continues to seek Provincial and Federal partners to provide matching funding for the first 80 trains and a TMSF required to support Line 1 growth requirements. Per Scenario 1, the TTC would need a signal of funding commitment by Q1 2024 to restart a new train procurement, with first priority being on replacing the T1 trains on Line 2. The TTC would then proceed with ATC Line 2 procurement in tandem, given the interdependency between the projects.

In the event full funding is not secured for NSTs before Q1 2025 at the latest, the TTC will need to pursue extending existing fleet and signalling asset life for Line 2 (Scenario 3). To prepare, the TTC is advancing updates to planning and condition assessment studies as outlined in Table 3.

Table 3. Updated Line 2 Asset Life Extension Planning Studies (\$Million's)

	2023	2024	2025	Total
T1 LEO Assessment Study, RFI/RFP development, and technical and commercial specifications	0.7	2.3	1.79	4.79
Line 2 Signalling System – Condition Assessment Study Update		0.75		0.75
Total	0.7	3.05	1.79	5.54

Per Table 4, further delay of the NST procurement introduces additional cost and the need for increased funding. With each scenario, costs will escalate and new costs are added, given the need to implement interim measures to extend the assets beyond design life, if feasible. In Scenario 3, the City's one-third funding share for the NST procurement will need to be repurposed to fund the T1 LEO and new funding will be required for the eventual and higher cost NST procurement in 2030. Table 4 provides the estimated cost by scenario, as known to date.

Table 4. Scenario 1 to 3, Estimated Final Cost (2023 to 2040)

Projects (\$Million's, \$2023)	Scenario 1 EFC	Scenario 2 EFC	Scenario 3 EFC
Fleet			
80 New Subway Trains (55 for Line 2, 25 for Line 1)	3,232	3,319	3,739
Line 2 Fleet – T1 30-Year SOGR (includes \$1.8 million planning study)	163	\$163	\$163
Line 2 Fleet – T1 35-Year SOGR	n/a	n/a	TBD
Line 2 Fleet – LEO to 2036	3	5	1,360
Line 2 Infrastructure			
ATC Line 2	881	916	5 + TBD
Line 2 Signalling SOGR to 2035	224	224	224
Line 2 Signalling SOGR (2035-2041)	0.8	0.8	0.8 + TBD
Greenwood (Shop, Yard, Carhouse) Modifications for New Fleet	727	727	850
Line 1 Infrastructure			
Line 1 Train Maintenance and Storage Facility	3,296	3,371	3,734
Total	\$8,526	\$8,726	\$10,076 + TBD

Projects (\$Million's, \$2023)	Scenario 1 EFC	Scenario 2 EFC	Scenario 3 EFC
Note: Cost estimates – dependent on level of design, schedule and market conditions. TBD denotes line items, which require estimation following studies and planning activities identified in the report.			

The Chief Financial Officer has reviewed this report and agrees with the financial impact assessment.

Equity/Accessibility Matters

The geographic coverage and seamless integration of the TTC’s multi-modal system enables the TTC to serve equity-deserving communities across Toronto. TTC customers are diverse and use the system at different rates. For example, of the 3.2 million average weekday boardings pre-COVID:

- 27% were youth (15-24)
- 53% live in apartments
- 34% are not employed
- 24% make less than \$40,000
- 23% make more than \$100,000
- 32% do not own a car
- 58% identify as female
- 55% may be visible minorities

According to the 2016 Transportation Tomorrow Survey (TTS), many customers who use the TTC subway network are relying on public transit as their primary or sole means of transportation. A total of 30% of the ridership on Line 1 and 35% on Line 2 do not have access to a private vehicle. Compared against the system-wide demographics, the customer base of Line 2 is closely in line with that of the system-wide, proportion of socially and economically disadvantaged populations.

Investment in new trains and the modernization of Line 2 is critical to ensure the TTC can provide a high-quality service to those who rely on transit everyday. Further, the procurement of NSTs will ensure efficient use of resources to replace vehicles at end of life, add critically needed capacity to the system to meet future demand, and help maintain a modern and increasingly inclusive and accessible transit system.

Procuring new trains also provides an opportunity to review and improve designs through the identification and removal of barriers. During new vehicle specification, procurement, design and validation processes, the TTC will continue to ensure new vehicles meet all relevant standards under the Accessibility for Ontarians with Disabilities Act, leverage international best design practices, and work closely with the Advisory Committee on Accessible Transit (ACAT) to identify opportunities for continuous improvement.

Decision History

January 24, 2019: TTC 15-Year Capital Investment Plan and 2019-2028 Capital Budget and Plan: On January 24, 2019, the TTC Board approved the TTC's first 15-Year CIP. The TTC undertook a comprehensive review of all state-of-good-repair needs and capital requirements needed to support ridership growth. Total needed capital investments of \$33.5 billion over the next 15 years were identified.

Report: [TTC 15-Year Capital Investment Plan and 2019-2028 Capital Budget and Plan](#)
Decision: [Capital Plan Decision Report](#)

April 11, 2019: Line 1 Capacity Enhancements: Status Update and Preliminary Implementation Strategy. The report outlined the requirements and preliminary scoping of a Line 1 Capacity Enhancement Program to address the future growth needs of Line 1, which included key elements, such as the requirement for additional trains and maintenance and storage capacity to meet future capacity targets.

Report: [Line 1 Capacity Enhancements: Status Update and Preliminary Implementation Strategy](#)

February 2020: Province of Ontario-City of Toronto Transit Partnership Preliminary Agreement: In February 2020, Toronto and Ontario entered into a Transit Partnership Preliminary Agreement, which required the City to redirect \$6 billion in capital contributions that would otherwise be dedicated to the Provincial projects to support modernization upgrades or state-of-good-repair improvements to the existing transit system. Consistent with the Agreement, the City committed to invest an incremental \$8.95 billion between 2019 and 2032 to the TTC system. Of this amount, 70% is directed to the subway mode and associated infrastructure, with the balance funding other critical integrated elements of the network.

Decision: [City Council approved decision](#) to enter into an Agreement in October 2019.
Agreement: [Province Of Ontario-City of Toronto Transit Partnership Preliminary Agreement](#)

October 22, 2020: TTC Fleet Procurement Strategy and Plan: The Board approved the TTC's Fleet Procurement Strategy and Plan, which recommended the procurement of 80 new subway trains to meet the fleet replacement needs of Line 2 and future growth requirements on Line 1. The Board approved one-third funding and also directed staff to seek matching funding for the new subway trains from intergovernmental partners. Through this report the Board also approved the full funding of ATC on Line 2 from the incremental new City funding provided through a City Building Fund levy.

Report: [TTC Fleet Procurement Strategy and Plan](#)
Decision: [Fleet Procurement Strategy and Plan Decision](#)

January 9, 2023: TTC 15-Year Capital Investment Plan, Real Estate Investment Plan Update and 2023-2032 Capital Budget and Plan: The Board endorsed the 2023-2037 CIP (\$38.046 billion plan), the 2023-2037 Real Estate Investment Plan and the 2023-

2032 Capital Budget and Plan. The 2023 CIP identified \$25.2 billion in unfunded required investments predominantly for state of good repair, including critical fleet, asset replacement/renewal and to accommodate growth long-term.

Report: [TTC 15-Year Capital Investment Plan, Real Estate Investment Plan Update and 2023-2032 Capital Budget and Plan](#)

Decision: [Capital Plan Decision](#)

June 12, 2023: Sustaining a Reliable Transit System: Outlook 2024 and Beyond: The report provided an outlook on the immediate financial pressures of the TTC, including operating and capital pressures, such as modernizing the subway system through the procurement of new trains. The Board approved the request for a tri-partite discussion on the development of a long term, sustainable funding model for public transit.

Report: [Sustaining a Reliable Transit System: Outlook 2024 and Beyond](#)

Decision: [Sustaining a Reliable Transit System Decision](#)

June 12, 2023: Financial and Major Projects Update for the Period Ended April 29, 2023: The report sets out the operating and capital financial results for TTC Conventional and Wheel-Trans services and provides updates on TTC's major capital projects. This includes for Subway – Line 1/Line 2 Capacity Enhancement Program, ATC Line 2 Signalling and Purchase of New Subway Trains (T1 Replacement and Growth). A status update was provided on the train procurement and related projects.

Report: [Financial and Major Projects Update for the Period Ended April 29, 2023](#)

Issue Background

The TTC 15-Year Capital Investment Plan (annual since 2019), TTC 5-Year Service Plan and 10-Year Outlook (2019), and TTC Fleet Procurement Strategy and Plan (2020) outlined the need for further investment in the subway network to better serve customers and provide more frequent and reliable service. An additional 80 new subway trains were identified as required to replace the aging fleet and infrastructure (55 trains for Line 2) and to enable growth (25 trains for Line 1). The requirements for new subway trains, and a new Train and Maintenance Storage Facility were also included in the updated CIP for 2023-2037.

In 2020, the City provided incremental new funding for the TTC through a City Building Levy which resulted in funding being made available for making progress on necessary fleet investments across all modes, funding for ATC on Line 2, Greenwood Yard (shop, yard, and carhouse modifications), and one-third share of funding for new subway trains required over the next 10 years. The Board also directed staff to seek matching funds for the new train procurement from intergovernmental partners. In the absence of matching funds, a decision would eventually need to be made to reallocate available City funds to extend the existing T1 fleet life by an additional 10 years and pause the implementation of ATC on Line 2.

As a result of the October 2020 Board direction to advance the procurement for 80 NSTs with options for future growth, TTC staff developed the technical and commercial

specifications in collaboration with key stakeholders, including Metrolinx, ACAT and customer focus groups. Industry-leading consultants were engaged to refine the specifications, incorporating industry best practices and drawing from lessons learned from previous projects. To gain further insights into the market, the TTC issued a Request for Information (RFI) in 2020, followed by a comprehensive market sounding exercise in June 2021.

In January 2022, the TTC released a Request for Supplier Qualification (RFSQ) and shortlisted four vehicle manufacturers. A Request for Proposals (RFP) was issued in October 2022, and was designed to ensure the TTC and the City receive high-quality subway vehicles at competitive market prices by striking a balance between technical requirements and pricing considerations. This approach aimed to facilitate a late 2023 contract award and prototype delivery by 2027.

Award of the RFP was subject to receiving commitments for funding from the Provincial and Federal governments by Q1 2023, which was included within procurement documentation. The RFP was advanced without full funding being committed at the time in order to preserve the option of receiving new trains starting in 2027 to commence testing and commissioning in order to put into service over 2028 with delivery completed by 2032. This approach was co-ordinated with capital investments being made in interdependent projects on Line 2 and the early planning of a Line 1 TMSF. Options were also included in the RFP for 15 expansion trains to enable Metrolinx to leverage the TTC's base order to meet their train requirements for the YNSE and SSE planned opening dates.

Despite active engagement with intergovernmental partners, the matching funding was not secured in the required timeframe. Between April and May 2023, the TTC communicated with the RFP proponents about providing an update and a final decision on the status of funding and the NST procurement. On June 23, 2023, the TTC provided notice to the proponents advising of the cancellation of the RFP due to insufficient funding to proceed.

Proponents were advised that the TTC will continue to have discussions with the Provincial and Federal governments on funding requirements for NSTs. The TTC will consider the issuance of a new RFP for the train procurement once there is a clear signal of a full funding commitment for the new trains from all orders of government.

The purpose of this report is to outline to the Board the next steps and required actions to preserve options to modernize Line 2 and prepare for future growth while ongoing advocacy continues to secure critically needed funding.

Comments

This report reaffirms the need to procure new trains to address asset replacement and renewal requirements on Line 2 and to accommodate forecasted demand on Line 1. In order to lay out the key considerations and implications associated with the necessary investments for the modernization of Line 2 to sustain safe, reliable service and enable future growth, and the enhancement of Line 1 capacity to accommodate growth to 2041, this report is organized in four sections:

- An update on customer demand and fleet requirements to 2041.
- An overview of the new train procurement scenarios, which influence the requirements for interdependent capital projects.
- An overview of implications for Line 2 modernization efforts, and required temporary measures to sustain a Line 2 service ;and
- A discussion of the implications for future Line 1 growth and expansion, which depends on a base order of trains for Line 2 replacement proceeding to maintain the opportunity for future train procurement options that can be exercised.

Advancing a new train procurement as soon as possible is the best course of action to minimize additional cost and risks to the future capacity and quality of subway service.

1. Forecasted Customer Demand and Fleet Requirements to 2041

Customer Demand Modelling and Projections

The transit network in Toronto is undergoing transformation through new rapid transit expansion, with Toronto and the region continuing to experience population growth, congestion and the need to move efficiently and sustainably. Long-term forecasts inform fleet planning, capacity needs and preparation for growth possibilities. The TTC works with the City of Toronto's City Planning Division to model long-term forecasts using the City's GTAModel V4¹, a travel demand modelling platform developed at the University of Toronto.

The model accounts for population and employment growth as well as the effects of future transit projects, including Line 5 Eglinton, Line 6 Finch West, Yonge North Subway Extension (YNSE), Scarborough Subway Extension (SSE), Ontario Line, Eglinton Crosstown West Extension, Waterfront LRT, and GO Expansion. Additional assumptions in the modelling were also considered for each subway line based on latest project information provided by Metrolinx:

- Line 1 – YNSE assumed to open in 2032; and
- Line 2 – SSE assumed to open in 2030.

Recognizing customer demand declined over the pandemic and is currently rebounding, the forecasts were recently reviewed by the TTC and City Planning staff using the GTAModelV4. It should be noted the current long-term projections to 2041 are based on a number of underlying data sets, which are due to be updated. In particular, updated population and employment projections, updated land use to reflect the more recent introduction of Major Transit Station Areas (MTSAs) and multiplex zoning, and changes in travel behaviour from the new Transportation Tomorrow Survey (TTS). The next iteration of the model will be updated in 2024, and will also extend the forecast horizon year to 2051.

¹ A detailed description of the model is available at: <https://tmg.utoronto.ca/doc/1.4/gtamodel/index.html>

Current GTAModelV4 Inputs	GTAModel Updates in 2024
<ul style="list-style-type: none"> • 2041 Horizon Year • 2011 Transportation Tomorrow Survey (TTS) • 2013 Population and Employment Forecasts • 2016 Land Use and Growth Scenarios 	<ul style="list-style-type: none"> • 2051 Horizon Year • 2022 Transportation Tomorrow Survey (TTS) • 2023 Population and Employment Forecasts • Updated Land Use and Growth Scenarios

There is recognition hybrid work patterns that have emerged during the pandemic have dampened a specific segment of the TTC’s weekday demand, currently representing an 18% difference. It is important to note hybrid work patterns have not stabilized yet. In contrast, the TTC is observing increased demand in other segments of the customer base – such as an increase in personal and discretionary trips, and weekend and overnight demand. These factors will be require more detailed scenario modelling and analysis.

In the interim, the TTC continues to rely on the pre-COVID projections to forecast long-term demand. In reviewing the underlying assumptions, as it relates to population change, employment, land use, immigration, congestion, planned auto and transit networks and travel behaviour, it is reasonable to expect strong demand for transit with potential for growth, even if current hybrid work conditions continue.

As of October 2023, TTC demand has returned to 82% of pre-COVID weekday demand and 99% of weekend demand². September 2023 reached 85% of September 2019, with bus reaching 95% in September 2023, subway demand at 75% and streetcar at 73%.

Table 5 presents the 2041 customer demand forecasts measured in average weekday boardings, based on the pre-COVID forecasts. As seen in Table 4, customer demand for subway service is anticipated to grow over the next 20 years. In 2041, forecasts show that demand may increase by 55% on Line 1, 18% on Line 2 and 16% on Line 4 and 39% on aggregate.

Table 5. 2019 and 2023 Actual Daily Boardings and 2041 Forecasted Daily Subway Boardings

Subway Line	2019	September 2023	2041	Change 2019-2041
Line 1	858,000	610,000 (71% pre-COVID)	1,328,000	55%
Line 2	559,000	444,000 (80% pre-COVID)	661,000	18%
Line 4	56,000	44,000 (78% pre-COVID)	65,000	16%
Total	1,473,000	1,098,000	2,054,000	+39%

² Compared to same week in 2019

Forecasted Service Requirements

The GTAModel is also used to identify peak-hour demand forecasts, which are subsequently used to determine subway service requirements, including target capacity, service levels, and in-service train requirements. Based on forecasts, the requirement for new trains is focused on Line 1 and Line 2. At present, Line 4 has a sufficient number of trains to operate the service. It is noted Metrolinx has initiated a planning study to extend Line 4 in the future, and fleet requirements will be reviewed at that time.

In total, the TTC requires a fleet of 66 trains for Line 2 to meet service requirements to 2041. The need for new trains associated with Line 2 is driven predominantly by asset replacement requirements, with modest growth in fleet size to address new demand, and to accommodate service on an extended line with the opening of the SSE.

Forecasted Line 2 service requirements between 2025 and 2041 are outlined in Table 6. In summary:

- By 2032: 62 higher-capacity trains are required. Of this total, 55 new trains are to replace the existing 61 T1 trains³ to deliver 25.5 trains per hour (141-second headway or a target capacity of 27,900). Another seven trains are required for SSE.
- Beyond 2032: four additional trains are required for growth to deliver 30 trains per hour (120-second headway or a target capacity of 33,000). ATC on Line 2 is also required to enable an improved headway to be achieved.

Table 6. Line 2 Base Service Requirements

Item	2025	2030	2032	2035	2041
In-Service Trains	43	52	52	54	58
Total Trains	61	66	66	66	66
Trains per Hour	24.0	25.5	25.5	27.7	30.0
Capacity (pphpd ⁴)	24,000	26,100	27,900	30,400	33,000
Crowding	95%	98%	99%	95%	95%

Forecasted Line 1 service requirements between 2025 and 2041 are outlined in Table 6. In total, the TTC anticipates a need to add 46 additional trains phased over the identified time period. This is broken down as follows:

- By 2032: 25 additional trains would be required in order to increase capacity to deliver 34.3 trains per hour (105-second headway or a target capacity of 37,700) and eight trains required for YNSE;

³ The new trains will have capacity for 1,100 passengers per train. The existing T1 fleet has capacity for 1,000 passengers per train. As a result 55 trains are required to replace the existing 61 T1 trains.

⁴ Passenger per hour peak direction (pphd)

- Beyond 2032: a future option for 13 additional trains would be required to increase capacity further and deliver 36 trains per hour (100-second headway or a target capacity of 39,600).

In total, the TTC anticipates a fleet of 122 trains may be needed to meet service requirements out to 2041 based on current projections of demand growth. Train requirements to accommodate growth in demand will continue to be refined and evaluated as updated modelling is undertaken in 2024.

Table 7. Line 1 Base Service Requirements

Item	2025	2032	2035	2037	2041
In-Service Trains	61	94	94	106	106
Total Trains	76	109	109	122	122
Trains per Hour	25.5	34.3	34.3	36.0	36.0
Capacity (pphp)	28,000	37,700	37,700	39,600	39,600
Crowding	95%	97%	98%	95%	97%

In summary, a new train procurement will include a base order and options to address the full needs of the fleet procurement plan.

	Line 1	Line 2
Existing Fleet	76	61
New Train Procurement Requirements		
• Replacement (Base Order Minimum)		55
• Metrolinx Expansion (Option)	8	7
• Growth (Options)	25 + 13	4
Total Fleet (Existing + New Trains)	122	66

2. New Subway Train Procurement – Scenarios

Based on state of good repair and service requirements, the TTC still requires the procurement of new trains to meet the needs of Line 2 with options in the RFP for expansion and future growth on Line 1. Therefore, the TTC will continue to pursue the 2020 TTC Board-approved fleet procurement strategy, which recommended the procurement of NSTs for Line 2 and Line 1, subject to matching funding commitments, instead of a 10-Year Life Extension Overhaul (LEO) of the Line 2 fleet.

Investing in new trains is better value for money and a prerequisite for modernizing Line 2 and addressing growth on the network long term. This is supported by a business case which demonstrated that incrementally increasing time delays for NST procurement will result in higher procurement costs, additional SOGR and life-extension (sunk) costs, and lost ridership revenues. Further, potential socio-economic benefits (travel time saved, increased reliability, new economic activity) will be foregone by transit riders and the broader economy.

New trains are key to enabling the benefits of a broader portfolio of investments planned for Line 2. Major Line 2 projects and programs include:

- Procurement of NSTs to replace the T1 fleet at end of life, and including options in the procurement for additional trains post-2032;
- Implementation of ATC on Line 2 (Kipling to Kennedy) to replace Line 2's current fixed-block system first installed prior to opening in 1966;
- Upgrades to the Greenwood Carhouse and Shop maintenance facilities and yard signalling system to accommodate the new fleet, and address state-of-good-repair requirements; and
- Implementation of the Line 2 Capacity Enhancement Program (L2CEP) for projected growth in customer demand to 2041. Scope includes infrastructure improvements for station capacities, electrical traction power, guideway enhancement, etc.

This focus on modernization through asset replacement would provide the TTC with state-of-the-art technology and provide Line 2 customers with several benefits including:

- A more reliable transit service for passengers, reducing subway service disruptions.
- The introduction of high-capacity trains compared to the legacy fleet will cater to the projected growth in customer demand and provide a better travel experience.
- Open gangway design of the new trains allows circulation and redistribution of riders on train, relieving crowding in vehicles and platforms.
- The new trains will consume less energy compared to the current T1 trains, contributing to a more sustainable and eco-friendly system.
- Modern accessibility features that improve customer experience, including onboard display screens and information technology that will empower passengers with better route guidance, ensuring convenience and comfort.
- Enabling ATC on Line 2 will also lead to greater operational efficiency and improved reliability, thereby reducing customer wait times and operating costs.

Updated New Subway Train Investment Scenarios

The original plan was to award the contract for new trains in Q4 2023, with deliveries occurring between 2028 and 2032 for an order of 55 replacement trains for Line 2 and 25 growth trains for Line 1. This schedule also provided options for the delivery of the 15 expansion trains Metrolinx requires for the planned opening dates of the SSE in 2030 and the YNSE in 2032. An updated set of NST procurement planning scenarios have since been developed and are summarized in Table 8. The scenarios are based on an assumption of when full funding is secured to enable a new RFP to proceed.

If full funding for new trains is not achieved preferably by Q1 2024 (Scenario 1) or latest Q1 2025 (Scenario 2), then the TTC will need to consider the least desirable option (Scenario 3) of further extending the life of Line 2 assets (fleet and signalling systems) and abandoning the ability to modernize Line 2 and address future Line 1 growth.

A new train procurement would still be required under Scenario 3, with the procurement needing to commence no later than 2030. Available City funding for the new train order would need to be reallocated to fund the (sunk) cost of extending the life of Line 2 assets in the interim, and new funding would need to be provided for the eventual, but now higher cost procurement. These scenarios have been used to analyze potential impacts to cost, schedule, interdependent projects and the ability to meet forecasted demand out to 2041. The implications of each scenario for Line 2 and Line 1 is discussed below.

Table 8. NST Procurement Planning Scenarios

Scenario 1 (Preferred)	Scenario 2	Scenario 3 (Least Preferred)
<ul style="list-style-type: none"> • NST full funding commitment by Q1 2024 • Launch of RFP in 2024 • 30-YR SOGR program for the entire Line 2 T1 train fleet • Initiate planning for LEO program • Phased NST delivery from 2030 to 2035 	<ul style="list-style-type: none"> • NST full funding commitment by Q1 2025 • Launch of RFP in 2025 • 30-YR SOGR program for the entire Line 2 T1 train fleet • Advance planning for LEO program • Phased NST delivery from 2031 to 2036 	<ul style="list-style-type: none"> • Abandon NST procurement in near-term if full funding not secured by Q1 2025 • 30-YR and 35-YR SOGR program for the entire Line 2 T1 train fleet • Reallocate existing funding to implement LEO for the entire Line 2 T1 fleet • NST full funding commitment by Q1 2030 • Launch RFP in 2030 • Phased NST delivery from 2036 to 2041

3. Implications for Line 2 – Modernization and Future Growth and Expansion

The primary objective of Line 2 investment is to modernize the Line while simultaneously addressing state-of-good-repair requirements. As noted above, Line 2 opened in 1966, and the current fleet of T1 subway trains will be 30 years old (end of design life) starting in 2026. Other key elements of Line 2, such as the signalling systems, and Greenwood Yard, Shop and Carhouse are undergoing planning and design to support asset replacement and renewal to ensure the continued reliable and safe operation of the subway line.

Given the criticality of these key assets for Line 2, full funding has been provided in the 10-Year Capital Plan for the Greenwood facility that will continue to support the Line 2 fleet, and for the implementation of ATC on Line 2. Due to limited funding, and time

sensitive SOGR requirements across other modes, one-third funding was identified for new trains with a request for matching support from other orders of government.

Implementation of ATC on the line, however, is dependent on new trains in order to operationalize and achieve the associated benefits. Pursuing the implementation of ATC-enabling technology on the existing T1 fleet is not recommended, and is discussed later in the report.

Scenarios for Line 2 modernization have been planned with this key interdependency between new trains and ATC in mind. Options include either making an investment now in new trains and enabling ATC to proceed, or investing in extending the life of existing fleet and signalling assets by an additional 10 years. The latter option defers only temporarily the investment required in new trains for Line 2. Table 9 outlines the cost and schedule associated with each scenario for new trains and ATC procurement.

Table 9. Scenarios for New Trains and ATC on Line 2

Scenario	NST and ATC Rebaselined Estimated Final Cost*	NST and ATC Rebaselined Estimated Schedule
Scenario 1 – Funding for Line 2 Trains Confirmed Q1 2024	55 Trains: \$2.274 billion (80 Trains: \$3.23 billion) ATC –Kipling to Kennedy: \$0.88 billion	<ul style="list-style-type: none"> • Q1 2024 – Procurement for NST and ATC Commences • Q3 2025 – Notice to Proceed (NTP) for NST • 2030-2033 – Delivery of Trains • 2034 – Phased cutover to ATC
Scenario 2 – Funding for Line 2 Trains Confirmed Q1 2025	55 Trains: \$2.330 billion (80 Trains: \$3.32 billion) ATC – Kipling to Kennedy: \$0.92 billion	<ul style="list-style-type: none"> • Q1 2025 – Procurement for NST and ATC Commences • Q3 2026 – NTP for NST • 2031-2034 – Delivery of Trains • 2035 – Phased cutover to ATC
Scenario 3 – NST procurement deferred until 2030	55 Trains:\$2.625 billion (80 Trains: \$3.74 billion) ATC – Kipling to Kennedy: \$0.052 billion + TBD (Under Review)	<ul style="list-style-type: none"> • 2030 – NST Procurement Commences • 2031 – NTP for NST • 2036-2039 Delivery of Trains • 2040 – Phased cutover to ATC (Under Review)
* Average Per Unit Cost of Train likely to improve if included with 25 growth trains for Line 1, and options for other growth and expansion trains. Preliminary cost estimates subject to market conditions.		

In addition, due to the time sensitivity associated with the replacement/renewal of aging fleet and infrastructure, each scenario also includes new work required to advance implementation planning for further investment in existing assets past design life. A decision to fully commit to a 10-year life extension overhaul and invest in additional Line 2 signalling SOGR will be required by Q1 2025 at the latest. Table 9 does not include the activities and costs associated with parallel risk mitigation planning to be undertaken in Scenario 1 and Scenario 2, or the full cost associated with the T1 LEO and Line 2 Signalling SOGR under Scenario 3.

Impact of Deferring Investment in New Trains for Line 2 on the T1 Fleet

The TTC currently operates 61 T1 subway trains that were introduced to revenue service starting in 1995. Between 2026 and 2031, the fleet will reach their 30-year design lifespan based on the commissioning date, as illustrated in Table 10. The actual retirement/repair schedule of each train is assessed based on vehicle condition.

Table 10. Line 2 T1 Fleet Reaching 30-Year Design Life by Year

Year	2026	2027	2028	2029	2030	2031	Total
Number of Trains Reaching End of Design Life	4	10	15	14	13	5	61

As the T1 fleet approaches its 30-year design life, many systems on the fleet are obsolete with implications for effective maintenance and repair. Furthermore, the T1 trains are not recommended to be equipped with modern technologies, such as ATC and therefore prevent ATC being operationalized on Line 2 until the last T1 train is removed.

The T1s have served Line 2 well, but with age will eventually result in reduced availability. Moreover, to keep the fleet operational, major structural repairs may be required. A further update to the last study conducted by the Original Equipment Manufacturer (OEM) in 2020 to assess fleet structural integrity is needed. As the fleet ages, the likelihood of identifying train cars with structural deficiencies that require removal from service until replacement or repair increases. As more trains pass 30 years old, the number of potentially condemned cars increases, risking consuming all available spares. Options that replace or repair the trains earlier, help to mitigate the risk of Line 2 service reduction. Due to the uncertainty in timing to replace the T1s with new trains, there are now two key activities required for the existing fleet:

- An extension of the SOGR program for trains as they continue operating past end-of-life starting in 2026; and
- Advancing implementation planning and development of a T1 10-Year LEO program in event it is necessary to extend the train life to 40 years.

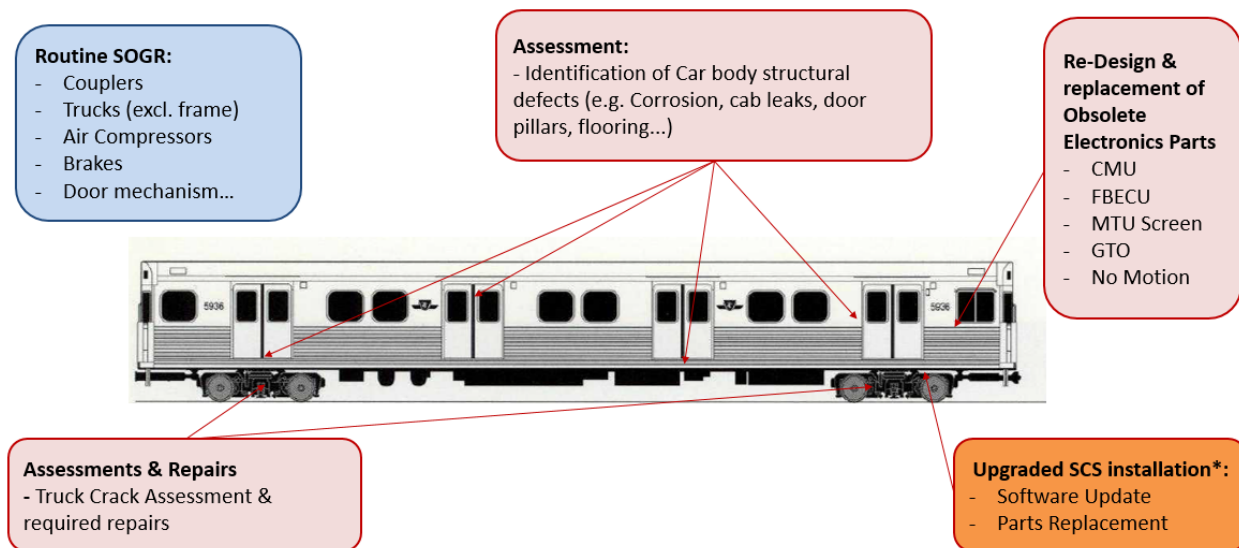
30-Year SOGR Program for Full Fleet and Potential for 35-Year SOGR Program

A reoccurring five-year SOGR and maintenance program is conducted based on recommendations from the manufacturer and lessons learned by the TTC. This aims to ensure vehicles remain safe and reliable while they continue to operate. A T1 30-Year SOGR study will be undertaken in 2024 at an estimated cost of \$1.8 million to finalize the scope of the 30-Year SOGR activities. The estimated cost of implementing the 30-Year SOGR activities is \$163 million for the full fleet at this time.

The 30-Year SOGR program is required to be performed on the full fleet regardless of timing to restart a new train procurement, as train deliveries under all three scenarios are post-2026. Under Scenario 3, a 35-Year SOGR program will also be required for the T1 trains if the life of the T1 trains is extended to 40 years. The scope and cost of a 35-

year SOGR is yet to be determined. Figure 3 illustrates some of the SOGR activities to be continued until the last T1 train is taken out of service.

Figure 1. Overview of Scope of T1 30 Year SOGR Activities⁵



T1 10-Year Life Extension Overhaul (LEO)

To determine the feasibility of extending the life of the T1 fleet, the TTC has conducted a couple of studies, including:

- A study by Alstom (previously Bombardier) in 2020: This study focused on the corrosion of structural members at the end sill and the side sill to skin interface, a problem first identified by the TTC around 2010. Alstom’s final report concluded that the T1 fleet can safely operate until the end of its 30-year design life.
- A study by Hatch (previously LTK Engineering) in 2022: Hatch was tasked with conducting a preliminary assessment of the feasibility and associated risks of extending the T1 car service life for up to 10 years beyond the 30-year design life.

The 2022 report concluded that extending the life of the T1 fleet would require:

- Critical structural repairs to maintain safety – The necessary structural repairs can be high-risk, high-cost, and require a multi-year program to implement.
- Significant system replacements to manage obsolescence – Many obsolete vehicle systems require replacement to maintain service for an additional 10 years. This activity has high engineering costs and risks of implementation delays, particularly for the safety-critical components that require replacement.

The 2022 report further stated that continuing operations beyond the current design life of the vehicle will expose the TTC to ongoing and increasing service impact risks, such

⁵ Final scope and costs to be determined by study. Acronyms in image: Car Monitoring Unit (CMU); Friction Brake Electronic Control Unit (FBECU); Monitoring Terminal Unit (MTU); Gate Turn-off Thyristor (GTO)

as reduced fleet reliability, decreasing operational flexibility, and negative impacts on customer satisfaction and TTC reputation.

As a result, the TTC currently maintains a higher-than-normal spare ratio of the T1 fleet in order to maintain T1 fleet availability to 2030. Ensuring a safe and operational fleet is the top priority. The TTC typically would seek to maintain a 15% spare ratio with fleet at early-to-mid life, to enable preventative maintenance to occur while delivering to peak service requirements. For the degree of corrective and preventative maintenance and associated activities required of the T1 fleet, there is a higher spare ratio being maintained (20 to 25%). The fleet procurement plan for Line 2 reflects a return to a 15% spare ratio as the TTC replaces the T1 trains with newer trains.

T1 10-Year Life Extension Overhaul (LEO) Program Overview

The core objective of the LEO program is to prolong the operational life of the T1 fleet by an additional 10 years without compromising vehicle performance. The T1 LEO program was originally scoped in 2019 by LTK Engineering through a carbody condition assessment and sub-system obsolescence review. The scope, along with more recent LEO vs New Subway Train (NST) options analysis, were performed by LTK Engineering and later Hatch in 2019, 2020 and early-2023.

The program will be designed to address specific tasks, requiring expertise in providing necessary repairs to the carshell and flooring structure as well as integrating required vehicle modifications and upgrades. A preliminary timeline for the LEO program's key milestones are outlined below:

- 2024-2025: Development of LEO scope and procurement plan.
- 2025: Decision to commence implementation of the LEO program..
- 2029-2030: Prototype delivery.
- 2030-2036: Delivery of LEO.

The above schedule has informed the expected fleet availability under Scenario 3. The TTC will undertake an updated LEO Assessment Study to finalize the scope and procurement plan for the LEO up to the critical decision point of Q1 2025. The estimated cost for this work is \$4.79 million. If full funding is not secured before Q1 2025 for the train procurement to proceed, a decision to fully commit to the implementation of the T1 LEO will be required (Scenario 3). The current estimated cost of a T1 LEO program for the full fleet is \$1.36 billion, which will be refined following the updated study.

Note: it is not recommended to include retrofitting the T1 fleet to include ATC technology as part of the T1 LEO scope. This would require significant financial commitment for an asset scheduled for retirement by 2036. The estimated cost to retrofit the vehicle to accommodate for ATC would be an additional \$400 million based on a Rough Order of Magnitude estimate. This would increase the estimate for the T1 LEO to approximately \$1.8 billion.

Further, the above schedule for a LEO program does not consider retrofitting the T1 fleet for ATC. It is estimated the timeframe to perform such a retrofit could take eight

to 10 years, surpassing the asset's extended lifespan. This program would also lead to significant service interruptions on Line 2 as cars undergo the process.

The 10-Year LEO of the T1s is a temporary measure, and a new train procurement would need to commence in 2030 to start delivery by 2036. In this scenario, existing funding for the NST procurement would need to be reallocated to fund the T1 LEO and new and now increased funding would need to be provided to fund the eventual, but now more costly NST procurement. The decision to proceed with a T1 LEO will also result in potential deferral of ATC implementation on Line 2, requiring the SOGR program for the signalling infrastructure to be reviewed.

Continued SOGR of Line 2 Signalling and Related Systems

The Line 2 fixed-block system has been in service in most sections for 57 years (commissioned between 1966 and 1980). A number of SOGR programs have been implemented, which have either replaced or refurbished much of the replaceable signalling system assets, contributing to a life extension of 27 years past current design life. The most recent condition assessment conducted in 2019 has informed SOGR planning up to 2035 and requirements identified in the TTC's 15-Year CIP. The scope of the SOGR program has been defined on the basis that ATC implementation would occur concurrently. The signalling SOGR program is a top priority to ensure continuous subway corridor availability, current passenger-carrying capacity, and compliance with industry standards and safety.

Table 11. Line 2 Signalling System Age

Section	In Service Date	End-of-Design-Life	Current Age (2023)	Projected Age at Replacement (2035)*	Projected Age at Replacement (2040)**
Keele to Woodbine	1966	1996	57	69	74
Keele to Islington and Woodbine to Warden	1968	1998	55	67	72
Islington to Kipling and Warden to Kennedy	1980	2010	43	55	60
*Assumption: ATC cutover achieved by 2035 under Scenarios 1 and 2. ** Assumption: ATC cutover can be achieved by 2040 under Scenario 3 (under review).					

The 2019 assessment of the Line 2 signalling system was conducted by an external consultant, SNC-Lavallin. The majority of the signalling equipment inspected was found in a 'fair to good' condition and the report concluded that will likely support a life extension to 2035 with adequate SOGR planning, execution and availability of functionally proven spares. It also identified the Kennedy signalling system is deteriorating at a faster pace than other signalling equipment on Line 2 and requires a comprehensive overhaul beyond what the SOGR program provides. Additional investment is required to enable the upgrade of the Kennedy signalling system estimated at \$28 million. The TTC is seeking to reprioritize approved funding to ensure

this project can be included in the TTC's 2024-2033 Capital Budget and Plan submission.

Additional study will also be required to determine the feasibility and scope to maintain the existing fixed-block system post-2035 (in Scenario 3), as the intention has been to modernize the signalling system with ATC. ATC is a key component of Line 2 modernization and would enable more frequent and reliable service in the longer term.

Current challenges of the signalling infrastructure include, but are not limited to, expected deterioration of cabling, component obsolescence and discontinuation of parts. In order to determine the feasibility and associated costs, an independent, comprehensive asset condition study will need to be undertaken to determine feasibility of a further ongoing SOGR program. The estimated cost of a study is \$750,000 and will be considered for inclusion as a priority in the 2024-2033 Capital Budget and Plan submission.

In summary, a delay in the train procurement directly impacts the ability to operationalize ATC on Line 2. Under Scenario 3, this requires further investment for increased, new and one-time costs in the existing signalling infrastructure to remain operational on Line 2 out to 2040 and presents new risks to the quality of line operations. The TTC will investigate the technical and financial feasibility to implement an ATC compatible fixed-block system that can later be utilized as part of the ATC System implementation. This will be a mitigation strategy to reduce unrecoverable costs due to extending the life of the current fixed-block signalling system. But note: ATC can not be operationalized on Line 2 until there is a fully ATC-compatible fleet on Line 2.

Impact of New Train Delivery Scenarios on Line 2 Future Service

The following section presents the impact of three NST delivery scenarios on the TTC's ability to deliver the required service capacity based on fleet availability. In-service train requirements to 2041 were prepared based on the forecasted demand (described above) and the fleet availability defined in the three NST delivery scenarios. For Line 2, two factors impact fleet availability:

- The NST delivery scenarios, which ultimately determine the number of new subway trains available to replace existing Line 2 trains; and
- The preventative and corrective maintenance programs underway of the T1 fleet in each scenario.

As described earlier in the report, in all scenarios a 30-year SOGR program is now required for the full T1 fleet as the train cars will turn 30 years between 2026 and 2031. The first new train possible for delivery under Scenario 1 is in the year 2030. Under Scenario 3, where new train delivery is not contemplated until 2036, a 35-Year SOGR program and 10-Year LEO program would also impact fleet availability.

The below graphs summarizes the service impacts on Line 2 under the base requirement and the three procurement scenarios assuming SSE opens in 2030. Crowding is forecasted to be either at approximate 100% in Scenario 1, with periods of crowding above 100% in Scenario 2 and Scenario 3, due to capacity not matching

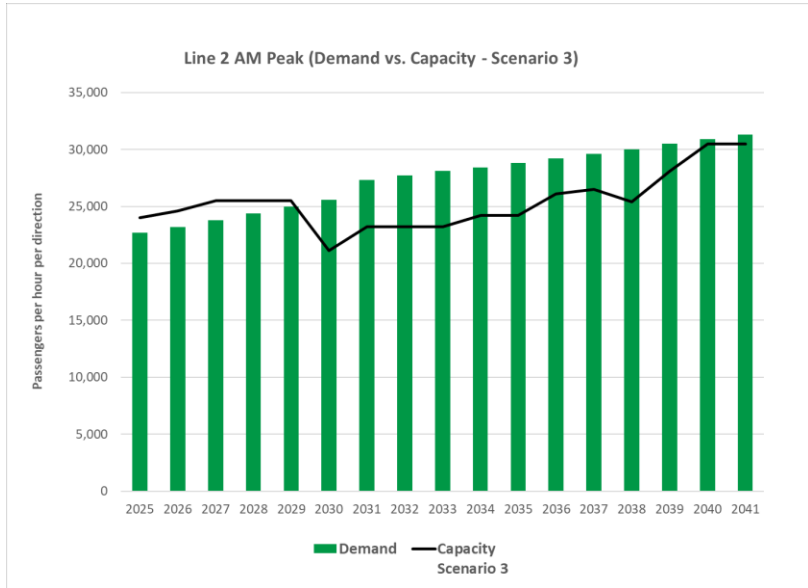
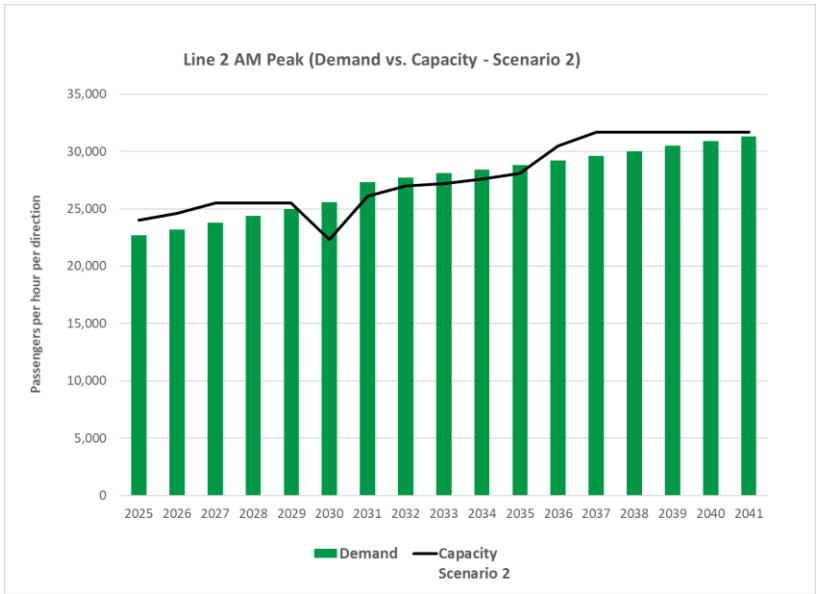
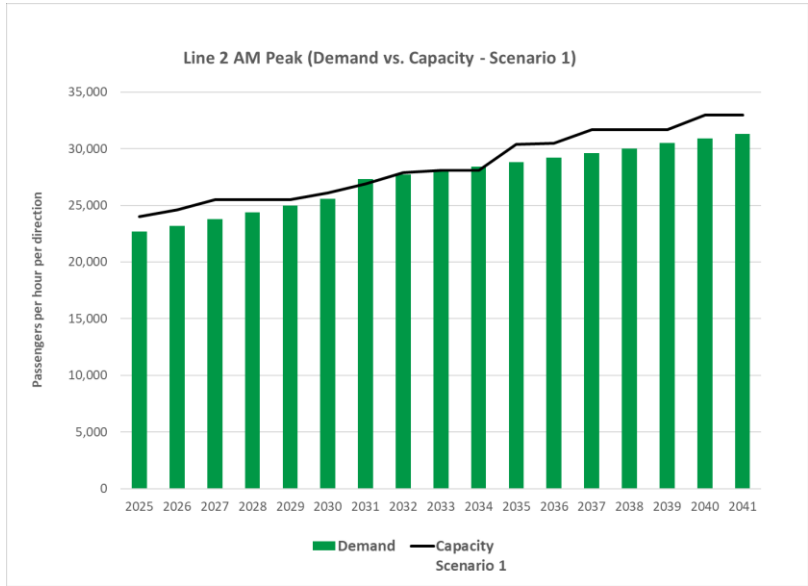
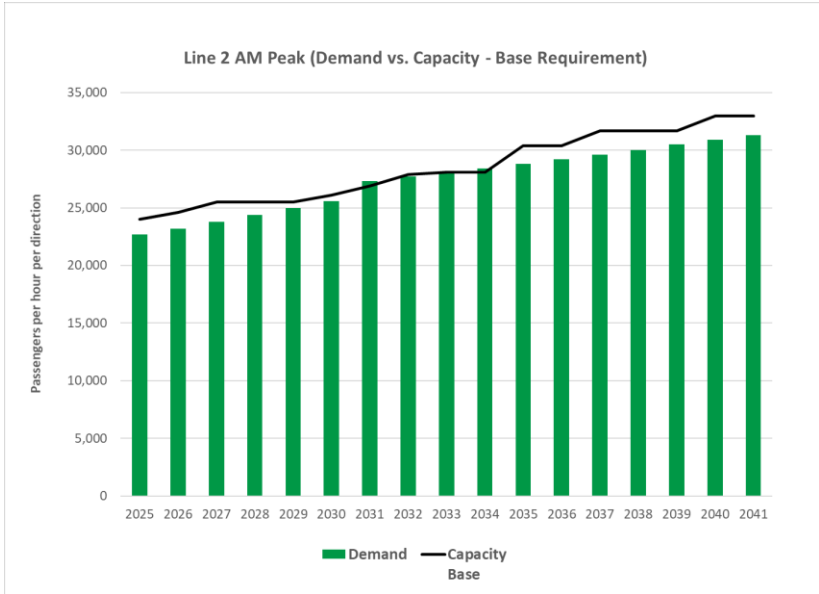
forecasted demand. In Scenario 3, there is a risk crowding may be more severe. This is presented for illustrative purposes only. Additional measures would likely be required to manage passenger volumes on trains and at stations if actual demand achieves forecast.

Scarborough Subway Extension

The current plan for Metrolinx is to test and commission the new extension with access to up to six trains starting late 2029 assuming a planned 2030 opening date. Under Scenario 1, where the TTC can proceed to issue the train procurement in Q1 2024, there is an opportunity to have some new trains available for this activity. Under Scenario 2, new trains are not expected to be delivered until 2031. This places additional reliance on the T1 fleet to support SSE.

In Scenario 3, new train delivery is significantly delayed beyond the planned SSE opening date of 2030. It should be noted there is a high risk the existing T1 fleet will not be sufficient to support SSE testing and commissioning and revenue service, in addition to meeting the needs of the existing line. Ongoing evaluation of the ability to operationalize SSE without additional expansion trains would be required in this Scenario, with consideration to ongoing review of demand projections and T1 fleet availability.

In addition, the opportunity for Metrolinx to implement and operationalize ATC on the new extension is subject to having new trains. Per discussions with Metrolinx, a fixed-block system is currently being designed for Line 2 extension. A decision to implement an ATC system on the Line 2 extension will need to be made by early 2024.



Next Steps for Line 2

To mitigate and/or minimize potential downstream risks, the TTC is undertaking the following:

- Continue to advocate for immediate matching funding for the Line 2 trains to enable ATC to proceed and to achieve modernization of the line. This will leverage commitments made in plan to renew and modify the Greenwood facility, and funding already earmarked for ATC Line 2 and one-third cost of the trains.
- In parallel, advance updated T1 LEO planning studies to finalize scope, schedule and cost estimates to extend life of the Line 2 fleet to 40 years in the event funding for new trains not made available. This also includes an assessment to determine feasibility of further delaying implementation of ATC on Line 2 and sustaining the existing signalling system as contemplated under Scenario 3.
- Continue to co-ordinate with Metrolinx to update planning assumptions as it pertains to the SSE project to ensure interdependencies between the TTC's train and ATC procurement for Line 2 are aligned based on the new planning scenarios for NST procurement.
- Complete the planning and design of the Greenwood facility modifications to accommodate new trains on Line 2, recognizing the T1 trains will need to be replaced eventually in all scenarios.
- Continue to monitor customer demand on Line 2 as it pertains to long-term growth projections to 2041. Work will also be underway with the City to update to 2051 projections over the next year.

Despite the above actions, the immediate advancement of a new NST procurement for Line 2 is critical to de-risk the future of the subway Line 2 operation. As the majority of the program is focused on state of good repair and asset renewal, the timelines for investment are dictated predominantly by asset life. Securing full funding to invest in a base order for the first 55 NSTs for Line 2 also unlocks the opportunity to address broader subway network needs. In particular, by establishing a large enough base train order and creating options within the RFP to enable train procurement for Metrolinx expansion projects and to procure growth trains for Line 1.

4. Implications for Line 1 Growth and Expansion

Growth in population and new development along Line 1 is expected to drive forecasted demand for the future of the subway line. Expansion of Line 1 north to Richmond Hill, through the Province's YNSE project, will also bring new connections to a wider population with planned development in the vicinity of Line 1 creating new demand for TTC services. As described in section 1 of the report, based on current projections, it is anticipated that by 2041 daily subway boardings on Line 1 may increase up to 55% over 2019 levels.

Despite current Line 1 average daily boardings being 71% of pre-pandemic levels, the need to build future capacity on the line remains. Line 1 was overcrowded pre-COVID, and the changes in land use planning around rapid transit corridors, and ongoing population growth, should be expected to continue to have influence on the demand for rapid transit services. The TTC continues to work with City Planning and other partners,

to assess long-term projections, and will be undertaking more detailed 2051 scenario analysis once the GTHA model is updated in 2024. This work will further refine capacity targets in future horizon years per usual practice.

Recognizing a need to continue to prepare for long-term growth, a number of key Line 1 capital investments are focused on enhancing capacity to accommodate the forecasted growth in customer demand along the line. The TTC has brought forward reports to the TTC Board on a Line 1 Capacity Enhancement Program with a core objective of improving service capacity targets for horizon years (34.3 trains per hour in 2032, 36.0 trains per hour starting in 2037).

The Line 1 Capacity Enhancement Program⁶ has identified a comprehensive program of improvements to meet the long-term needs of the line, that extend to the current 2041 planning horizon. Elements of the program include improvements to:

- Stations: modification to improve capacities and increase service at multiple stations along the line;
- Systems and Infrastructure: Electrical Traction Power Upgrades;
- Additional Fire Ventilation requirements;
- Guideway Enhancement; and
- A new Line 1 Train Maintenance and Storage Facility (TMSF).

The L1CEP is complementary to other key investments on the line, such as ATC (completed in 2022), and the tri-partite-funded Bloor-Yonge Capacity Improvements project now in progress. Further investments are planned in the 15-Year TTC CIP to meet service maturity requirements out to 2041. The need for additional trains to supplement the existing Line 1 fleet is critical to meeting long-term capacity targets.

Fleet Expansion Required to Meet Line 1 Growth and Expansion

The TTC is currently operating 76 Toronto Rocket (TR) trains on Line 1 that were first introduced into revenue service starting in 2011. The open configuration of the TR trains provide an additional 10% increase in capacity above the T1 trains operating on Line 2. Based on pre-COVIDd projections, the existing TR fleet was expected to meet service plan requirements until 2028, after which additional trains are required for the existing and extended line. YNSE is currently planned by Metrolinx to open in 2032.

As discussed in section 1 of the report, in total, the TTC anticipates requiring a fleet of 122 trains to meet service requirements out to 2041. With an existing fleet of 76 TR trains on Line 1, an additional 46 trains will need to be phased into the fleet based on current projections.

The immediate focus for Line 1 is to procure the first 25 growth trains and support Metrolinx in procuring eight additional trains for the YNSE to meet the 2032 forecast demand. Funding for additional trains to support service maturity will be sought in future years, and is predominantly outside the TTC's current 10-year capital plan window. The

⁶ See the quarterly Major Project Update Report for program status information : [Major Project Update Report \(Period Ended July 1, 2023\)](#)

ability to procure new trains to address growth for Line 1 is contingent on the base order of 55 replacement trains for the Line 2 trains proceeding.

Impact of New Train Delivery Scenarios on Line 1 Future Service

As outlined above, additional trains for Line 1 are required to achieve the current 2037 target goal of an improved service headway of 100 seconds. In-service train requirements to 2041 were prepared based on the forecasted demand and the fleet availability defined in the three NST delivery scenarios. The NST delivery scenarios ultimately determine the number of subway trains available for each year between 2024 and 2041. Assuming actual demand aligns with forecasted demand, there are insufficient trains to provide the required service capacity by the early 2030s.

The graphs below summarize the service impacts on Line 1 under the base requirement and the three procurement scenarios, assuming YNSE opens per Metrolinx’s planned target date of 2032. Based on forecasted demand, crowding may be expected to exceed 100% in the a.m. peak as early as 2029 on the existing line. The effect worsens from Scenario 1 through Scenario 3 as the train procurement is further delayed.

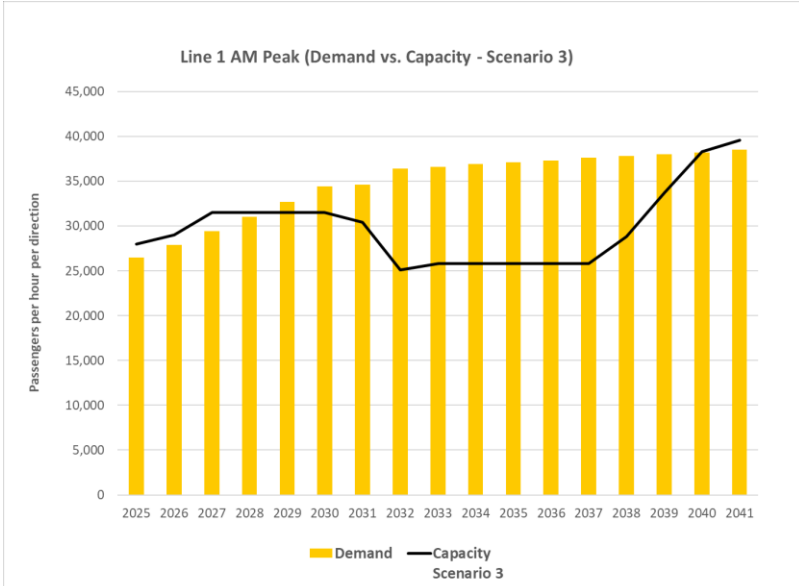
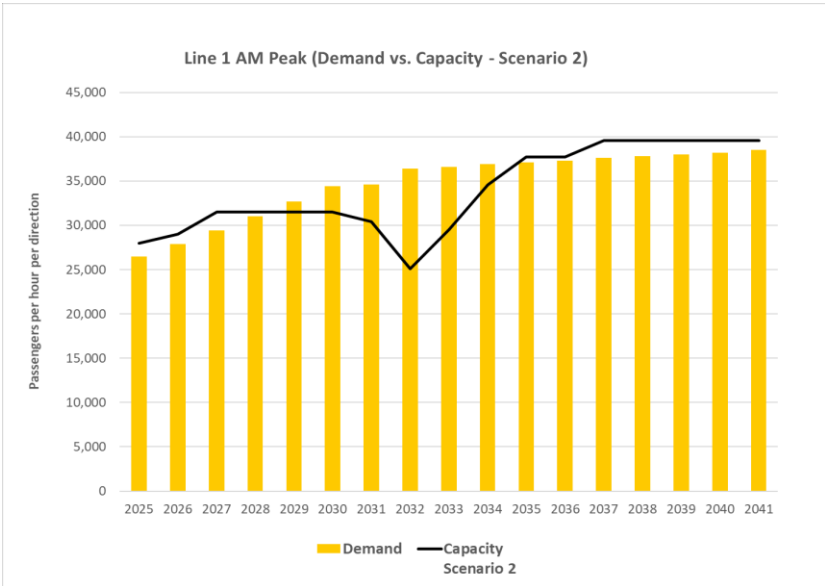
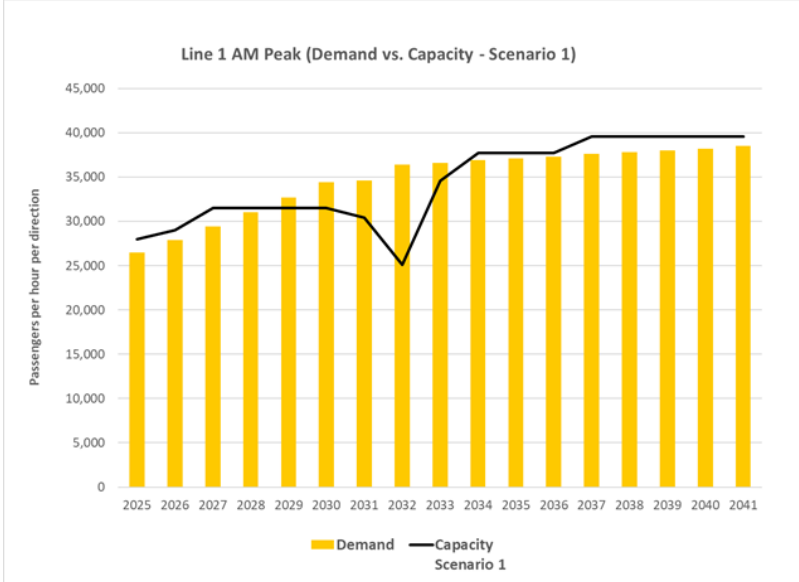
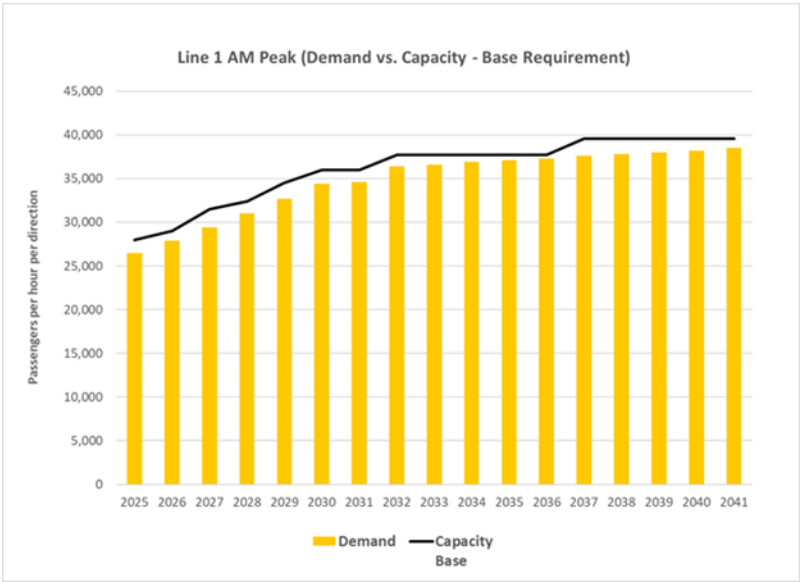
The graphs are provided for illustration. Excessive crowding in the 2030s would result in the TTC not being able to accommodate demand because service could not be provided reliably and sustainably. If actual customer demand levels meet current forecast for future years, the TTC will need to put measures in place to manage passenger volumes on trains and at stations at key points on the line.

Line 1	NST Delivery Phasing Assumptions	Preliminary Service Risk Assessment
<p>Scenario 1 (RFP proceeds in 2024)</p>	<p>2032-2034: 33 Trains Total (25 Growth and 8 for YNSE)</p> <ul style="list-style-type: none"> • 2032 – 1 Train (YNSE) • 2033 – 21 Trains (14 Growth; 7 NSE) • 2034 – 11 Trains (Growth) <p>Late 2030s: 13 Trains (Future Options)</p>	<p>5-Year Period – 2029 to 2034 where there is a risk demand would be greater than capacity based on current forecast. Results in service quality degradation and crowding.</p> <p>Operational measures required to manage A.M. Peak Period crowding; review of service levels for Line 1 extension if YNSE meets target completion date of 2032.</p>
<p>Scenario 2 (RFP proceeds in 2025)</p>	<p>2032-2035: 33 Trains Total (25 Growth and 8 for YNSE)</p> <ul style="list-style-type: none"> • 2032 – 1 Train (YNSE) • 2033 – 7 Trains (YNSE) • 2034 – 14 Trains (Growth) • 2035 – 11 Trains (Growth) <p>Late 2030s – 13 Trains (Future Options)</p>	<p>6-Year Period – 2029 to 2035 where there is a risk demand would be greater than capacity based on current forecast. Results in service quality degradation and crowding.</p> <p>Operational measures required to manage A.M. Peak Period crowding; review of service levels for Line 1 extension if YNSE meets target completion date of 2032.</p>

Line 1	NST Delivery Phasing Assumptions	Preliminary Service Risk Assessment
Scenario 3 (RFP proceeds in 2030)	2037-2041: 46 Trains Total <ul style="list-style-type: none"> • 2037 – 1 Train (YNSE) • 2038 – 7 Trains (YNSE) • 2039 – 14 Trains (Growth) • 2040 -- 11 Trains (Growth) • 2041 – 13 Trains 	12-Year Period – 2029 to 2040 where there is a risk demand would be greater than capacity based on current forecast. Results in service quality degradation and crowding. Operational measures required to manage A.M. Peak Period crowding; Discussion on timeline for YNSE opening would be required.

The demand forecasts reflect pre-COVID projections using the current version of the GTAModel, which requires update to reflect new land use, population and employment assumptions. Additional modelling analysis with the updated GTAModel in the coming year will refine the assessment.

The TTC continues to consult with Metrolinx and partners on the YNSE project plan and progression, and the interdependencies with the new subway train fleet procurement. The TTC will work with partners at Metrolinx and York Region to inform ongoing assessment of future customer demand as forecasts are further refined.



Additional Maintenance and Storage Capacity

A key component of expanding Line 1 capacity is expanded maintenance and storage capacity to accommodate fleet maintenance, storage and operational/fleeting requirements. As the total fleet size increases to 122 trains from 76 trains, there is a need to accommodate these requirements for 34 additional trains. Wilson Yard, which predominantly serves Line 1, does not have the capacity to absorb the requirements of an expanded fleet. The addition of another facility on Line 1 will enable fleeting to occur on both legs of Line 1, improving operational resilience and reduce operational costs due to deadheading. Table 12 outlines a proposed train storage plan for 122 trains.

Table 12. Line 1 Planned Train Storage Allocation

	Wilson	VMC – End Terminal	Davisville	Line 1 TMSF	Total
Yard	57	3	8	34	102
Carhouse	12	0	4	4	20
Number of Trains	67	3	14	38	122
% of Fleet	55%	2%	11%	31%	100%

To date, early planning has been underway to assess business requirements, evaluate opportunities to maximize existing train maintenance and storage capacity, and determine potential site locations, which will ultimately inform design and cost. The analysis to date has determined a new TMSF should incorporate the following:

- Storage for 34 trains minimum.
- Five Bays (one double length) for Preventative and Corrective Maintenance to support daily service.
- Double track access.
- Outdoor and indoor storage track for seasonal work cars.
- Outdoor material storage and staging area.
- Ancillary facilities (Traction Power Substation (TPSS), hostler platform, transportation, and employee facilities).
- Infrastructure and Engineering (IE) divisional shop building.
- An additional repair bay at the TMSF is under consideration to address long-term steady state maintenance shortfall.

At present, Metrolinx has included a smaller Train Storage Facility (TSF) as part of the YNSE project scope in the initial business case, which can accommodate space for 12 trains and provide for light maintenance (i.e. cleaning). At present, the TSF does not have the required storage space nor capacity for preventative or corrective maintenance for the full additional fleet necessary for Line 1 service maturity. The TTC will continue to work with Metrolinx to evaluate how best to meet full maintenance and storage needs of Line 1 with consideration for the various site constraints that exist.

Should full funding be available for the required growth trains, the TMSF planning and design work will need to continue to progress in tandem. At present, the TMSF is predominantly unfunded in the TTC's CIP. A preliminary rough order magnitude estimate places a new Line 1 facility at approximately \$3.2 billion. Further information will be reported to the Board as project planning progresses in co-ordination with key partners.

Next Steps for Line 1

In the event the TTC is able to proceed with a base order of new trains to replace the existing Line 2 trains, the RFP will include options that can be exercised to address Line 1 growth and expansion requirements. The TTC will also:

- Continue to evaluate site options for a Line 1 maintenance and storage facility and enlist support from the Province of Ontario, municipal partners, and Metrolinx to undertake the necessary due diligence to advance early planning analysis conducted by the TTC to date;
- Continue to co-ordinate with Metrolinx and key partners to update planning assumptions as it pertains to the YNSE project to ensure interdependencies between the TTC's capacity enhancement programs and train procurement for Line 1 are aligned. Key inputs from this report have been shared with Metrolinx to inform the next update of their Preliminary Design Business Case (PDBC) for the YNSE project; and
- Continue to monitor customer demand on Line 1 as it pertains to long-term growth projections to 2041 and beyond once updated land use and other key inputs are updated in 2024.

5. Conclusion

The TTC is continuing intergovernmental discussions to seek matching funds from other orders of government to restart the new train procurement. This report outlines the impacts, risks and mitigation strategies associated with further delay to the procurement of new trains to both Line 2 and Line 1. A signal of full funding commitment is needed to enable the TTC to restart the train procurement process in 2024, with award and notice to proceed provided to a successful vendor in late 2025. At minimum a full funding commitment for the first 55 replacement trains for Line 2 in 2024 will position the TTC to commence a renewed RFP process for new trains, and preserve options for the required expansion trains and growth trains for Line 1.

The TTC's 2024-2033 Capital Budget and Plan submission and updated 15-Year CIP will reflect the updated cost and schedule for the new train procurement, ATC and associated infrastructure based on a planning assumption of being able to proceed with procurement in 2024 (Scenario 1). If funding does not materialize, a report to the TTC Board will be brought forward to re-baseline the program to a 2025 assumption (Scenario 2), and provide an update on progress with key mitigation activities. Due to asset replacement/renewal timelines for Line 2, the TTC will now in parallel also advance preparation for a life extension program for the existing Line 2 trains and signalling system. This parallel program of activity can be abandoned if full funding for Line 2 trains is secured. Staff will make every effort to reprioritize available funding to

ensure the 2024-2033 Capital Budget and Plan submission can include full funding to 2025 for planning and development of the T1 LEO and Line 2 signalling assessment work.

The procurement of new trains is essential to sustain frequent and reliable service across the subway system now and into the future. It is also the most prudent and cost-effective course of action in the interest of building sustainable and liveable communities with high-quality transit as a choice mode of travel.

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Chief Executive Officer

Attachment

Attachment 1 – Interdependency of NST with Line 2 Modernization (Planning Scenarios)

Attachment 1 – Interdependency of NST with Line 2 Modernization (Planning Scenarios)

Scenario 1 – Commitment to Line 2 Modernization in 2024		Scenario 2– Commitment to Line 2 Modernization in 2025		Scenario 3 – Delay and Implement Temporary Measures to Extend Asset Life	
Assumption on NST Funding	<ul style="list-style-type: none"> Full funding secured for Line 2 Trains in Q1 2024 	<ul style="list-style-type: none"> Full funding secured for Line 2 Trains in Q1 2025 	<ul style="list-style-type: none"> No matching funding secured for Line 2 Trains by Q1 2025 		
Scope of Activities for Interdependent Capital Projects Per Scenario					
Line 2 Fleet	<p>T1 30 Year SOGR- 2027 to 2032</p> <ul style="list-style-type: none"> Required as 30-year design life will start being reached in 2026. <p>New Subway Trains:</p> <ul style="list-style-type: none"> NST RFP issued in Q2 2024 for minimum of 55 Replacement Trains with options for Line 1 Growth, and Metrolinx Expansion Trains; Delivery 2030 to 2033 (55 for Line 2) <p>T1 10 Year LEO</p> <ul style="list-style-type: none"> Assessment Study (2023-2024) – initiated to preserve back up option (scenario 2). Does not proceed past Assessment Study. 	<p>T1 30 Year SOGR- 2027 to 2032</p> <ul style="list-style-type: none"> Required as 30-year design life will start being reached in 2026. <p>New Subway Trains:</p> <ul style="list-style-type: none"> RFP for NST issued in Q2 2025 for minimum of 55 Replacement Trains with options for Line 1 Growth, and Metrolinx Expansion Trains; Delivery 2031 to 2034 (55 for Line 2) <p>T1 10 Year LEO</p> <ul style="list-style-type: none"> Complete Assessment Study (2023-2024); Complete Delivery Review/ RFI/RFP development (2024- 2025) Does not proceed to implementation. 	<p>T1 SOGR – 2026 to replacement of last T1 train: Inclusive of 30 YR and 35 YR SOGR activities</p> <p>New Subway Trains: NST Procurement deferred</p> <ul style="list-style-type: none"> Planning and RFP process re-started for 2030, as trains will reach 40-year design life starting in 2036. NST RFP issued in 2030 subject to full funding <p>T1 10 Year LEO – to extend T1’s to 40-Year Design Life.</p> <ul style="list-style-type: none"> Complete Assessment Study (2023-2024) Complete Delivery Review/ RFI/RFP (2024- 2025) Commence LEO in Q2 2025 Prototype: 2029 LEO Delivery: 2030 to 2033 		

	Scenario 1 – Commitment to Line 2 Modernization in 2024	Scenario 2– Commitment to Line 2 Modernization in 2025	Scenario 3 – Delay and Implement Temporary Measures to Extend Asset Life
Line 2 Signaling Systems	<p>Automatic Train Control</p> <ul style="list-style-type: none"> • ATC Line 2 RFP proceeds Q1 2024 • Line 2 ATC cutover 2034 <p>Line 2 Fixed-Block System Maintenance</p> <ul style="list-style-type: none"> • Line 2 Signaling – SOGR Program for existing fixed-block system to 2035 defined. • Due to uncertainty of NST funding and ability to proceed with ATC Line 2: Commence Signalling Condition Assessment and Study to determine feasibility of further 5 year extension of Line 2 existing fixed-block signaling system from 2035 to 2040. 	<p>Automatic Train Control</p> <ul style="list-style-type: none"> • ATC Line 2 RFP proceeds Q1 2025 • Line 2 ATC cutover 2035 <p>Line 2 Fixed-Block System Maintenance</p> <ul style="list-style-type: none"> • Line 2 Signaling – SOGR Program for existing fixed-block system to 2035 defined. • Due to uncertainty of NST funding and ability to proceed with ATC Line 2: Commence Signalling Condition Assessment and Study to determine feasibility of further 5 year extension of Line 2 existing fixed-block signaling system from 2035 to 2040. 	<p>Automatic Train Control</p> <ul style="list-style-type: none"> • Earliest date for Line 2 ATC cutover is 2040 (under review) and dependent on future train delivery schedule. <p>Line 2 Fixed-Block System Maintenance</p> <ul style="list-style-type: none"> • Line 2 Signaling – SOGR Program for existing fixed-block system to 2035 defined. • Plan for post 2035 and feasibility is subject to outcome of Line 2 Signalling Condition Assessment Study. Feasibility analysis on options to extend the life from 2035 to 2040 will determine scope, cost, schedule of extended SOGR program.
Line 2 Train Maintenance & Storage	<p>Greenwood:</p> <ul style="list-style-type: none"> • Shop Modification Underway • Carhouse Modification – Advance Design to Q1 2024, and then full implementation • Yard Signalling – System renewal to proceed (technology pending) 	<p>Greenwood:</p> <ul style="list-style-type: none"> • Shop Modification Underway • Carhouse Modification – Advance Design to Q1 2024; and then full implementation • Yard Signalling – System renewal to proceed (technology pending) 	<p>Greenwood:</p> <ul style="list-style-type: none"> • Shop Modification Underway • Carhouse Modification – Advance Design to Q1 2024; Decision on proceed/hold at construction phase • Yard Signalling – System renewal to proceed (technology pending)
Impacts to Third Party Projects: Metrolinx - SSE	<ul style="list-style-type: none"> • 7 trains included as option in NST procurement (2030 earliest possible delivery). 	<ul style="list-style-type: none"> • 7 trains included as option in NST procurement (2031 earliest possible delivery). 	<ul style="list-style-type: none"> • No option for Metrolinx to exercise for procurement of trains from TTC base contract for opening date.