For Action

2024 TTC Asset Management Plan

Date: April 11, 2024
To: TTC Board
From: Chief Capital Officer

Summary

This report provides the TTC Board with an overview of the Asset Management Plan (AMP) in compliance with the Asset Management Planning for Municipal Infrastructure Regulation, O. Reg. 588/17 (as amended by O. Reg. 193/21).

The AMP details all the information required by the O.Reg for all assets owned and managed by the TTC, and these are grouped into the following asset categories:

Fleet	Revenue vehicles (buses, streetcars, subway trains), non-revenue vehicles, and the industrial equipment used to service those vehicles.
Linear Infrastructure	Subway track, Streetcar Way and overhead power.
Facilities	Maintenance facilities, subway stations, bus and streetcar stops, and administrative buildings.
Systems	Communications systems, signals, electrical systems, and mechanical systems.
Structures	Box structures, bored tunnels, stations, bridges, Prince Edward Viaduct (track beams and sidewalks), culverts, retaining walls, and miscellaneous structures.

Information on inventory, age, condition, life cycle activities, costs, and risks is presented according to the asset classes above, with overall performance and levels of service considered across the TTC's transit services.

Key conclusions of this plan indicate that a significant portion of the $25.1 billion in assets are entering, or in some cases, are well into their twilight years, and that the condition of these assets will span from poor to excellent.The plan also identifies the lack of adequate state-of-good-repair funding.

Once approved by the Board, this plan will be provided to the City of Toronto to be incorporated into the overall City Asset Management Plan that must be approved before July 1, 2024 by City Council to comply with legislated timelines.

Recommendations

It is recommended that the TTC Board:

1. Approve the attached 2024 Asset Management Plan.

2. Forward the TTC's 2024 Asset Management Plan to the City Manager of the City of Toronto for submission and incorporation into the City's Asset Management Plan.

Financial Summary

Funds are included in the TTC's 2024-2033 Capital Budget and Plan under Program 3.9 – Enterprise Asset Management, State of Good Repair to implement the TTC's Enterprise Asset Management Program, which was approved by the TTC Board at its meeting on December 20, 2023, and by City Council on February 14, 2024.

The 10-Year Capital Plan includes a total of $59.25 million for the Enterprise Asset Management Program. In addition, the TTC is upgrading its Information Technology systems to implement Maximo to enable asset management planning and end-to-end asset life cycle management processes.

Funds for the Maximo scope of work are also included in the the Council-approved TTC's 2024-2033 Capital Budget and Plan under Program 7.19 – Enterprise Asset Management System, State of Good Repair. The total project cost for the Enterprise Asset Management (IT) system is approximately $29.93 million, comprising of costs to the end of 2023 of $12.14 million, and approved funding in the 2024-2033 Capital Budget and Plan of $16.9 million. A budget adjustment to account for the $0.9 million of unspent funds in 2023 being carried forward to 2024 will be included in the 2024 Capital Budget Adjustments for Incremental Carry Forward Funding and Future Year commitments report that will be subject to City Council approval, bringing the approved funding in the 2024-2033 Capital Budget and Plan to $17.8 million.

Combined, there is $77 million approved funding in the 2024-2033 Capital Budget and Plan in support of this work, as summarized in the table below:

Project ($000's)	2024 Budget	2025	2026	2027	2028	2029-2033	10-Year Total
Enterprise Asset Management	4,250	5,250	5,250	5,500	6,000	33,000	**59,250**
Maximo	7,224	5,657	4,909	-	-	-	**17,789**
Total	**11,474**	**10,907**	**10,159**	**5,500**	**6,000**	**33,000**	**77,039**

Through the progression of the Enterprise Asset Management (EAM) Program, additional funding may be required and will be included in future budget submissions for the Board's consideration and approval.

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

Equity/Accessibility Matters

The EAM Program seeks to ensure that TTC assets meet the performance requirements set out by the TTC in its corporate policies and plans. This includes levels of service requirements relating to equity and accessibility. These requirements provide accessibility objectives for TTC services that ensure decisions are made that align with customer needs and the guidance of the Advisory Committee on Accessible Transit (ACAT).

Decision History

In accordance with Provincial Regulation, Asset Management Planning for Municipal Infrastructure Regulation, O. Reg. 588/17 (as amended by O. Reg. 193/21), the City of Toronto Corporate Asset Management Policy CAM-001 was adopted by City Council on June 19, 2019 and came into effect on July 1 of the same year. It provides the framework to develop a whole government asset management approach that will ensure long-term asset sustainability, demonstrate a commitment to good stewardship of the City's infrastructure assets, and support improved accountability and transparency to the community through the adoption of appropriate asset management practices.

The TTC Board authorized the award of a contract in the amount of $7,155,703, inclusive of HST, for Enterprise Asset Management Professional Services at its meeting on April 13, 2023. This contract provides expert EAM professional services for a duration of up to three years to accelerate the establishment of the TTC's EAM practice, implement the TTC's EAM Program and its sustainment; and develop the TTC's Asset Management and Investment Plan that must meet asset management regulatory compliance milestones set out in the Ontario. Reg. 588/17, as amended. The contract includes two optional, one-year extensions at the TTC's sole discretion.

TTC Enterprise Asset Management (EAM) Program: Contract Award for Professional Services.

At the February 22, 2024 meeting, the TTC Board endorsed the report, providing an overview of the TTC's Enterprise Asset Management Program (EAM). The intent of the EAM Program is to mature the TTC's asset management capabilities to align with international best practice. The program will also ensure that TTC is complying with the Asset Management Planning for Municipal Infrastructure Regulation, O.Reg. 588/17.

Enterprise Asset Management Program Update

Issue Background

As previously reported, the Province of Ontario enacted the Asset Management Planning for Municipal Infrastructure Regulation, O. Reg. 588/17 (as amended by O. Reg. 193/21), to ensure that municipalities have a sustainable plan for managing their infrastructure assets. The Regulation requires municipalities to prepare and

maintain a comprehensive asset management plan that includes an inventory of their infrastructure assets, condition assessments, lifecycle cost analysis, and risk assessments.

The TTC, being a City of Toronto agency, must comply with the requirements of the Regulation. Once endorsed by the Board, information from the TTC AMP will be integrated into the overall Asset Management Plan for the City of Toronto.

Comments

Toronto Transit Commission Asset Management Plan

To meet the requirements of Ontario Regulation 588/17, the TTC has developed the attached Asset Management Plan (AMP). This Plan addresses the requirements of the O.Reg 588/17. It encompasses all assets owned and managed by the TTC, and includes information on inventory, age, condition, asset lifecycle activities and the capital and operating costs required to maintain current service levels. It also includes how the TTC will respond to growth and how it will leverage increased asset management capabilities in the future to address asset-related challenges.

In order to comply with 2024 regulatory requirements, the Regulation stipulates that all municipalities shall prepare an asset management plan by July 1, 2024. To meet the prescribed timeline for delivering the 2024 Asset Management Plan, the TTC will provide the attached AMP to the City of Toronto once the Board approves it.

Asset Categories

The attached document details the information required by the Regulation for assets owned and managed by the TTC, grouped into the following asset categories:

		Replacement Cost ($Billion)
Fleet	Revenue vehicles (buses, streetcars, subway trains), non-revenue vehicles, and the industrial equipment used to service those vehicles.	$7.1
Linear Infrastructure	Subway track, Streetcar track and overhead power.	$2.8
Facilities	Storage and Maintenance facilities, subway stations, administrative buidlings; bus and streetcar stops.	$5.0
Systems	Communications systems, signals, electrical systems, and mechanical systems.	$1.1

		Replacement Cost ($Billion)
Structures	Box structures, bored tunnels, stations, bridges, Prince Edward Viaduct (track beams and sidewalks), culverts, retaining walls, and miscellaneous structures.	$9.1

Information on inventory, age, condition, life cycle activities, costs, and risks is presented according to the asset category above, with overall performance and levels of service considered across the TTC's transit services.

Asset 2024 Valuation

The replacement value of all TTC's assets is estimated to be $25.1 billion. This value is based on the 2023 Property Insurance Report, which provides the replacement cost of TTC assets, including, but not limited to, facilities, tunnels, structures and associated equipment, and fleet. This information was calculated as of December 31, 2022, and covers the insurance period from June 1, 2023, to June 1, 2024. This valuation represents the current replacement value of all assets owned by the TTC and excludes other assets managed by the TTC, but owned by other agencies.

Asset Condition

The average condition of TTC assets is included in the respective asset category sections of the AMP. Given that the TTC average asset age spans from relatively new to nearing their respective end of life, the condition would reflect the age range. Consequently, the condition of the asset categories will span from poor to excellent.

Level of Service

In 2013, the TTC introduced its first 5-Year Corporate Plan with the vision: *To be a transit system that makes Toronto proud.* The next 5-Year Corporate Plan is due to be published in 2024 and forms part of an integrated planning and performance framework the TTC utilizes. This framework demonstrates how the goals, objectives and intended outcomes of the TTC can be achieved through the alignment of key business planning activities. In addition, the 5-Year Service Plan & 10-Year Outlook (2020-2024) identifies service-related improvements to public transit service in the city of Toronto. An updated version (2024-2028) is expected to be published in 2024.

The Service Plan also identify how the TTC is responding to growth requirements, meeting the challenges of changing ridership demands and meeting the financial challenges of maintaining existing service levels and upholding the state of good repair. Given the significant pending growth in the size of the transit portfolio, it should be noted that there will be an increase in funding pressure to sustain the existing level of service for the asset portfolio.

.

Asset Life Cycle Activities

Life cycle activities are carried out across the life of an asset during construction or acquisition, maintenance, operation, and decommissioning. These activities are required to maintain service levels, realize maximum value, and manage the risks associated with assets failing to meet defined service levels. Aligned to the requirements of the Regulation, this Asset Management Plan presents the life cycle activities required across asset classes to maintain the TTC's current service levels.

Life cycle activities and the point at which they occur vary between assets according to their inherent nature, the required level of service, their operating context, use and condition. As assets approach the end of their serviceable life, life extension programs may also be implemented to prolong service life ahead of replacement or renewal. However, it should be noted that as assets near the end of service life, the maintenance cost will increase significantly. Details of the life cycle activities applicable to each asset class and the sub-assets within each class are contained in the relevant sections of the attached plan.

Asset Management Maturity at TTC

The TTC is an asset-intensive organization that provides a high-quality transit service to Canada's largest urban centre and economic hub. As indicated in the February 22, 2024 Board report, in order to ensure that TTC's assets are able deliver a safe, reliable and integrated transit service, the TTC is maturing its asset management capability through its Enterprise Asset Management Program. This program will meet the requirements of the Regulation as well as go beyond compliance to fully align with asset management best practice.

Aligning the TTC's EAM Program with current international best practices will support the TTC's asset management capabilities and enable many elements required for keeping assets in the state of good repair. Asset management is not new to the TTC, but rather an ongoing journey. While this is the first organization-wide asset management plan in compliance with the Regulation, it is not the first application of asset management practices at the TTC. Previous initiatives include:

Asset Management Initiative	Timeline
• Chief Operations and Infrastructure Officer hired to focus exclusively on maintenance and SOGR across the organization's infrastructure	2018
• First TTC CIP to outline our funding shortfalls in the SOGR	2019
• Asset Management consultant retained to modernize business model • Accelerated SOGR and modernization work	2020
• Accelerated SOGR and modernization work	2021
• Implemented IBM Maximo Linear Asset Management module for TTC's Subway Track assets • Enhanced staff asset management training • Embed a track maintenance specialist into Subway Track Maintenance	2022
• Introduced TTC Enterprise Asset Management Program • Recruited Head of Enterprise Asset Management	2023

Asset Management Initiative	Timeline
• Initiated TTC EAM Maturity Program • Reviewed Track Maintenance policies and standards	
• Review track inspection process, defect prioritization, and repair practice • Completed TTC first Asset Management Plan • Development of asset management maturity roadmap	2024

While this Asset Management Plan meets the requirements of the Regulation for 2024, the next phase of compliance, due on July 1, 2025, requires the TTC to have a financial plan that identifies the funding needs to ensure all assets are maintained in a state of good repair to meet future levels of service. The 2025 Asset Management Plan will also further inform the preparation of the TTC's Capital Investment Plan (CIP). The TTC's 2024-2038 CIP has identified a total of $47.855 billion in base capital needs over a 15-year period, of which $12.398 billion is funded, leaving $35.457 billion in unfunded capital needs.

The 2024 AMP, prepared in accordance with the requirements of O. Reg. 588/17, affirms that an estimated 50% or $12.6 billion of TTC assets are entering, or in some cases, are well into their twilight years. Particular concern over the lack of funding for state of good repair applies currently to:

1. Line 2 Bloor-Danforth subway elements (power, signals, communications systems, and vehicles) that are at/or approaching end of life.
2. Facilities maintenance of garages, yards, carhouses and various other buildings (HVAC, roofs, structures, elevators, escalators, and plumbing).
3. Bus fleet with the majority now over halfway through its lifecycle.

The streetcar network will predictably be at risk within five to 10 years without capital funding commitments for rehabilitation.

Contact

Sam Sidawi, Head – EAM Program Delivery
416-472-2499
sam.sidawi@ttc.ca

Signature

Gary Downie
Chief Capital Officer

Attachments

Attachment 1 – TTC Asset Management Plan

ASSET MANAGEMENT PLAN

Toronto Transit Commission
2024

Contents

LIST OF TABLES

LIST OF FIGURES

1. Executive Summary

This document is TTC's first comprehensive Asset Management Plan aligned with *Ontario Regulation 588/17: Asset Management Planning for Municipal Infrastructure* (O.Reg). It details all the information required by the O.Reg for all assets owned and managed by TTC, grouped into the following asset categories:

Fleet	Revenue vehicles (buses, streetcars, subway), non-revenue vehicles and the industrial equipment used to service those vehicles.
Linear Infrastructure	Subway track, streetcar way, and overhead power.
Facilities	Garages and maintenance facilities, subway stations, administrative and operational buildings, bus and streetcar stops, and shelters.
Systems	Communications systems, signals, electrical systems, and mechanical systems.
Structures	Box structures, bored tunnels, station structures, bridges, Prince Edward Viaduct (track beams and sidewalks), culverts, retaining walls, and miscellaneous structures.

Information on inventory, age, condition, lifecycle activities, costs and risks is presented according to the asset classes above, with overall performance and levels of service considered across the TTC's transit services.

Asset Inventory

The scope of assets that the TTC owns and manages is large and varied, and comprises of the vehicles, infrastructure, facilities and support systems necessary to operate and maintain the TTC's bus, subway and streetcar services. The asset inventory changes regularly as new assets are commissioned and older assets are decommissioned at the end of life.

The vehicle fleet consists of 2,572 accessible buses (including 250 paratransit Wheel-Trans buses), 204 streetcars and 143 subway trains, with the fleet and other asset classes supported by more than 900 non-revenue vehicles. There are a further 6,400 small and 1,900 large items of industrial equipment, which support the maintenance of TTC assets.

The TTC maintains more than 70 kilometres of mainline subway track across three active lines (following the decommissioning of Line 3 in 2023) and 388 kilometres of Streetcar Way. Streetcars are powered by 454 kilometres of overhead/traction power feeders and 368 kilometres of overhead contact system.

Across the subway and streetcar network, the TTC is responsible for the maintenance of 77 box structures, 43 bored tunnels, 75 bridges, four culverts, 170 retaining walls and 474 miscellaneous structures. In addition there are 38 overhead structures that are maintained by the City. The Prince Edward Viaduct is jointly maintained by the TTC and the City.

The vehicle fleet is stored, maintained and operated from 22 separate facilities located across the TTC network, which include garages, carhouses, yards, and shops. There are also 58 substations to support movement of fleet and provide power to the facilities. Across the subway network (including the now decommissioned Line 3), there are 75 subway stations with 164 elevators and 329 escalators moving both passengers and freight. The TTC also maintains more than 9,500 bus and streetcar stops/shelters, alongside two bus terminals and nine Wheel-Trans hubs.

Corporate and professional services also operate from five administrative buildings across the city, and the TTC maintains 29 other buildings, including emergency service buildings, operator convenience and waiting rooms, as well as a number of parking lots.

Operation of transit services across all three transportation modes is facilitated and supported by communication, signalling, electrical and mechanical systems. These systems are made up of many thousands of individual assets, with further details contained in the relevant sections of this Plan.

As the TTC is currently developing a central system for the storage and management of all asset inventory data, the information presented in this Asset Management Plan has been provided by the teams in the TTC and is the best available data at the time of publication.

Asset Valuation

The replacement value of all of the TTC's assets is estimated to be around $25.1 billion, and represents the replacement value of TTC assets for the insurance renewal period from June 1, 2023, to June 1, 2024. This value covers the replacement cost of TTC assets including, but not limited to, facilities, tunnels, structures, and associated equipment and fleet.

Average Age

The age of the TTC's asset portfolio varies significantly across the different asset classes.

The vehicle fleet for example, is constantly evolving with the purchase of new vehicles and the decommissioning of older assets, whereas some of the TTC's infrastructure has existed for more than 100 years.

Details of the average age of assets has been provided in this Plan where data exists, but this has not been possible across the entire asset portfolio. These gaps will need to be addressed in future iterations of the Plan.

Asset Condition

Across its wide variety of asset classes, the TTC uses different methodologies appropriate for each asset class to assess overall condition. In some cases, data is obtained from formal inspections, but for others it is based on a qualitative assessment by Subject Matter Experts (SMEs) or utilization of a proxy, such as age against expectations for serviceable life.

For most asset classes, the data and/or original scoring framework has been assimilated against a common five-point scale (1 Excellent to 5 Critical/Poor) as shown in Appendix G: Condition Scoring Frameworks. However, for structures assets commonly recognized approaches to inspection and condition assessment are used to generate a condition rating on a four-point scale (Good, Fair, Poor and Very Poor).

The average condition of TTC assets is included in the respective asset category section, however, overall they fall within the following ranges:

Fleet	2.1 (Good) to 3.7 (Adequate)
Linear Infrastructure	1.0 (Excellent) to 4.0 (Marginal)
Facilities	*Unknown – Not enough data exists to provide a rating.*
Systems	1.0 (Excellent) to 5.0 (Critical/Poor)
Structures	Very Good to Very Poor

Levels of Service

In 2013, the TTC introduced its first 5-Year Corporate Plan with the vision: *To be a transit system that makes Toronto proud*. The Plan set out a number of strategic objectives to deliver on this vision, with further paths laid out in the next iteration of the Plan, which was published in 2018. The next 5-Year Corporate Plan is due to be published in 2024.

The 5-Year Service Plan & 10-Year Outlook (2020-2024) identified service-related improvements to public transit service in the city of Toronto. An updated version (2024-2028) is expected to be published in 2024.

In alignment with the 5-Year Service Plan, a range of service level KPIs are utilized to track and monitor the service provided by the TTC. These performance measures are grouped under the following categories:

- Customer Experience
- Ridership and Finance
- Safety and Security
- Buses and Wheel-Trans
- Streetcars
- Subway Cars
- Facilities

A summary of current service level KPIs is provided in Section 3.6, and details of the TTC's current performance levels are provided in Appendix B: KPIs.

Lifecycle Activities

Lifecycle activities are those carried out across the life of an asset, such as construction or acquisition, maintenance, operation, and decommissioning. Activities are required across the lifecycle to maintain levels of service and manage the risks associated with assets failing to meet defined levels of service. Aligned to the requirements in O.Reg 588 for 2024, this Asset Management Plan presents the lifecycle activities required across asset classes to maintain the TTC's current service levels.

Lifecycle activities themselves and the point at which they occur vary between assets according to their inherent nature, the required level of service, their operating context, use and condition. For example, for vehicles many of the maintenance lifecycle activities to maintain a state of good repair (SOGR) are at defined frequencies based on age and/or mileage aligned to the original equipment manufacturer's recommendations. As assets approach the end of their serviceable life, life extension programs may also be implemented to prolong service life ahead of replacement or renewal.

Details of the lifecycle activities applicable to each asset class and the sub-assets within each class are contained in the relevant named sections of this Plan.

Costs and Risks

Lifecycle costs for each asset class, both operating and capital investment, have been extracted directly from the TTC's Operating Budget, 10-Year Capital Budget and Plan, and 15-Year Capital Investment Plan (CIP) and the existing funding portfolios. Extracts from the CIP and budgets are included for information in Appendix E: Capital Investment Needs, and Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

The TTC's Operating Budget for 2024 is $2.6 billion, of which $164 million is allocated to Wheel-Trans service and $2.404 billion is the TTC's conventional service.

Funded capital investment over the next 10 years (from 2024) is $12.4 billion, with an additional $35.5 billion unfunded forecast to 2038 split across six capital investment programs:

- Modernizing the subway and expanding capacity
- Transforming and electrifying the bus fleet
- Supporting a larger streetcar fleet
- Facilities Maintenance
- Network-wide asset
- Transform TO

Within the 10-Year Capital Budget and Plan, 58% is maintaining the state of good repair, 34% is service improvement and growth, and 8% is health and safety legislative.

Significant risks to the achievement of existing levels of service have been presented within each asset class.

Response to Growth

This Plan also identifies how the TTC is responding to growth requirements, meeting the challenges of changing ridership demands and meeting the financial challenges of maintaining existing service levels and upholding the state of good repair.

Next Steps

While this Asset Management Plan meets the requirements of the O.Reg for 2024, the final phase of requirements due on July 1, 2025 requires the TTC to have a financial plan in place that identifies future levels of service and the lifecycle needs and costs of all assets to meet those levels of service.

The TTC is implementing an Enterprise Asset Management (EAM) program to improve its asset management maturity. This will deliver the requirements of the O.Reg for 2025 and go beyond regulatory compliance to fully align with transit asset management best practice.

Effective asset management ensures that an organization’s assets are managed in a way that balances the achievement of the required level of performance while managing risk and reducing whole-life cost. It involves the development of strategies and plans aligned to an organization’s corporate objectives that are based on lifecycle decision-making.

For the 2025 AMP, and in order to comply with the O.Reg, the TTC aims to:

1. Identify proposed levels of service as progression from those shown in this 2024 Plan;
2. Identify the lifecycle activities and costs associated with those levels of service;
3. Improve whole-life costing capabilities to facilitate investment options analysis; and
4. Improve risk identification and evaluation capabilities to allow more informed investment options analysis.

This will be achieved through the EAM program, which will assess the current state and project the future needs of existing capital assets to ensure informed and proactive decision-making. The outcome will be a revised Asset Management Plan and evidence-based investments and capital financing strategies to maintain the assets and services in a state of good repair.

2. Introduction

Originally named the Toronto Transportation Commission, the Toronto Transit Commission was established in 1921 as a public transit operator within the city of Toronto. After growing the network and later changing its name to the Toronto Transit Commission in 1954, it now has exclusive authority to establish, operate and maintain all local passenger transportation system within the city. The TTC is the largest public transit system in Canada and the third largest in North America. It is also integrated with neighbouring transit systems, such as Durham Region Transit in Durham Region, York Region Transit (YRT) in York Region, MiWay in Mississauga, and Ontario's interregional GO Transit system. The TTC functions as one of the agencies of the City of Toronto and is dependent upon the City for both operating and capital subsidies.

The TTC's comprehensive network of bus, streetcar and subway services spans Toronto's 630 km^2 geography (and beyond), moving more than 525 million customers annually, pre-pandemic. The TTC's mandate is to establish, operate and maintain the local transportation system in Canada's largest urban centre, playing an essential role in making the city, the province and the country inclusive, accessible and environmentally sustainable.

Figure 2-1: TTC's Subway and Streetcar Network.

2.1 Asset Management Plan Requirements

This TTC Asset Management Plan has been produced in accordance with Ontario Regulation 588/17: Asset Management Planning for Municipal Infrastructure (O.Reg 588). Publication of the O.Reg 588 reflected the Province's commitment to guide investments in municipal infrastructure and to standardize asset management practices throughout the municipal sector, providing a degree of consistency to Asset Management Plans, and leveraging Asset Management Planning to optimize infrastructure investment decisions and enable the collection of comparable data for long-term planning and budgeting.

This Plan addresses the requirements of the O.Reg (as amended in March 2021). It encompasses all assets owned and managed by the TTC, and includes information on inventory, age and condition data, asset lifecycle activities and the capital and operating costs required to maintain current service levels. It also includes how the TTC will respond to growth and how it will leverage increased asset management capabilities in the future to address asset-related challenges.

This Plan establishes a foundation that will enable the TTC to develop and mature its asset management capabilities to ensures that all assets are managed in a way that balances the achievement of required levels of performance while managing risk and reducing whole-life costs.

The City of Toronto's 2019 Corporate Asset Management Policy establishes a framework and an approach to asset management for assets that are managed by City Programs and other city-controlled entities, including the TTC. The TTC has worked with the City of Toronto to produce this Asset Management Plan to address the requirements of the O.Reg for approval by July 1, 2024, aligned to the City's Core Infrastructure Asset Management Report 2021.

The information presented within this Plan is aligned to the specific requirements of the O.Reg and includes:

1. **Asset Inventory –** provides the number of assets and sub-assets for each category that aligns to the requirements in O.Reg. section 5 (2) 3.i.
2. **Asset Valuation –** states the value of the assets at replacement that aligns to the requirements in O.Reg section 5 (2) 3.ii.
3. **Age –** average asset age by category that aligns to the requirements in O.Reg section 5 (2) 3.iii.
4. **Asset Condition –** examines the asset condition based on the information currently available and details approaches used for condition assessments by asset category that aligns to the requirements in O.Reg section 5 (2) 3.iv and section 5 (2) 3.v.
5. **Levels of Service –** provides qualitative descriptions of current levels of service, as well as technical metrics by asset category (where available). Provides the overall current performance of the TTC transit systems based on the past two years of historical data, in accordance with the performance measures established by the TTC, aligned to the requirements in O.Reg section 5 (2) 1.i and section 5 (2) 2.
6. **Lifecycle Activities, Costs and Risks –** describes the activities required across the whole lifecycle of assets to maintain the current levels of service over at least a 10-year time frame, and the risks associated with assets failing to meet current levels of service aligned to the requirements in O.Reg section 5 (2) 4i, section 5 (2) 4ii and section 5 (2) 4iii.
7. **Response to Growth –** identifies the impact and response to a growing population and ridership changes, including the estimated 10-year capital expenditures and significant operating costs related to capital projects and upgrading of existing TTC assets required to accommodate projected increases and changes in demand, aligned to the requirements in O.Reg section 5 (2) 6i and section 5 (2) 6.vi.

2.2 Asset Management Plan Structure

This document is structured around the TTC's five main asset classes:

Fleet	Revenue vehicles (buses, streetcars, and subway trains), non-revenue vehicles and the industrial equipment used to service those vehicles.
Linear Infrastructure	Subway track, Streetcar Way and overhead power.
Facilities	Garages and maintenance facilities, subway stations, administrative and operational buildings, bus and streetcar stops, and shelters.
Systems	Communications systems, signals, electrical systems, and mechanical systems.
Structures	Box structures, bored tunnels, station structures, bridges, Prince Edward Viaduct (track beams and sidewalks), culverts, retaining walls, and miscellaneous structures.

For each asset class, the Plan contains the information required by the O.Reg on inventory, average age, condition, lifecycle activities and costs, and risks. A summary of the replacement value of the TTC's entire asset portfolio is presented in Section 9: Replacement Costs.

A description of the TTC's current service level KPIs is contained in Section 3: Performance and Levels of Service, with details of the TTC's current performance levels in Appendix B: KPIs. The Plan also contains information on how the TTC will respond to changing service requirements, with details of future expansion plans and capital investment projects in Section 10: Response to Growth.

This Asset Management Plan sets the framework for future Plans, which will evolve as the TTC matures its asset management capability.

3. Performance and Levels of Service

3.1 5-Year Corporate Plan

In 2013, the TTC introduced its first 5-Year Corporate Plan with the vision: *To be a transit system that makes Toronto proud*.

The Corporate Plan seeks to align the broader policy vision of the City with the Board's priorities guiding the TTC as an agency, in the provision of mass transit services to meet the needs of Canada's largest city.

The mission statement for the organization was also established: *To provide a reliable, efficient, accessible and integrated bus, streetcar, and subway network that draw its high standards of customer care from our rich traditions of safety, service and courtesy.*

The inaugural Corporate Plan, and subsequent Corporate Plan introduced in 2018, have established the foundation and outlined key strategic directions and actions to support the organization in achieving this vision statement.

The Corporate Plan informs recommendations for the budget process by identifying key priorities for the allocation of resources (i.e., funding and staff). The Corporate Plan is reviewed annually to assess progress, respond to emerging priority directions, and to align recommendations for allocation of resources through the budget process. The next 5-Year Corporate Plan is due to be published in 2024.

3.2 Business Planning

Since 2018, the TTC has introduced key business planning documents, which serve as supporting second level plans to the Corporate Plan to further elaborate how key strategic directions will be followed.

Figure 3-1 demonstrates the alignment between the Corporate Plan and the following business functions:

- **Financial Planning** – the creation of multi-year capital and operating budgets and plans, including a 15-Year Capital Investment Plan to provide the funding to implement service and capital priorities.
- **Service Planning** – planning the service to be provided to TTC customers.
- **Asset Management Planning** – planning the activities required to achieve the TTC's long-term objectives.

Long-term planning is an iterative process that seeks to balance levels of service, funding, and risk. Levels of service include many factors, such as frequency of transit service, environmental targets, customer satisfaction, and state of good repair.

As the TTC continues to mature its enterprise asset management practices, it is expected that TTC's longer-term business planning capabilities will also continue to evolve.

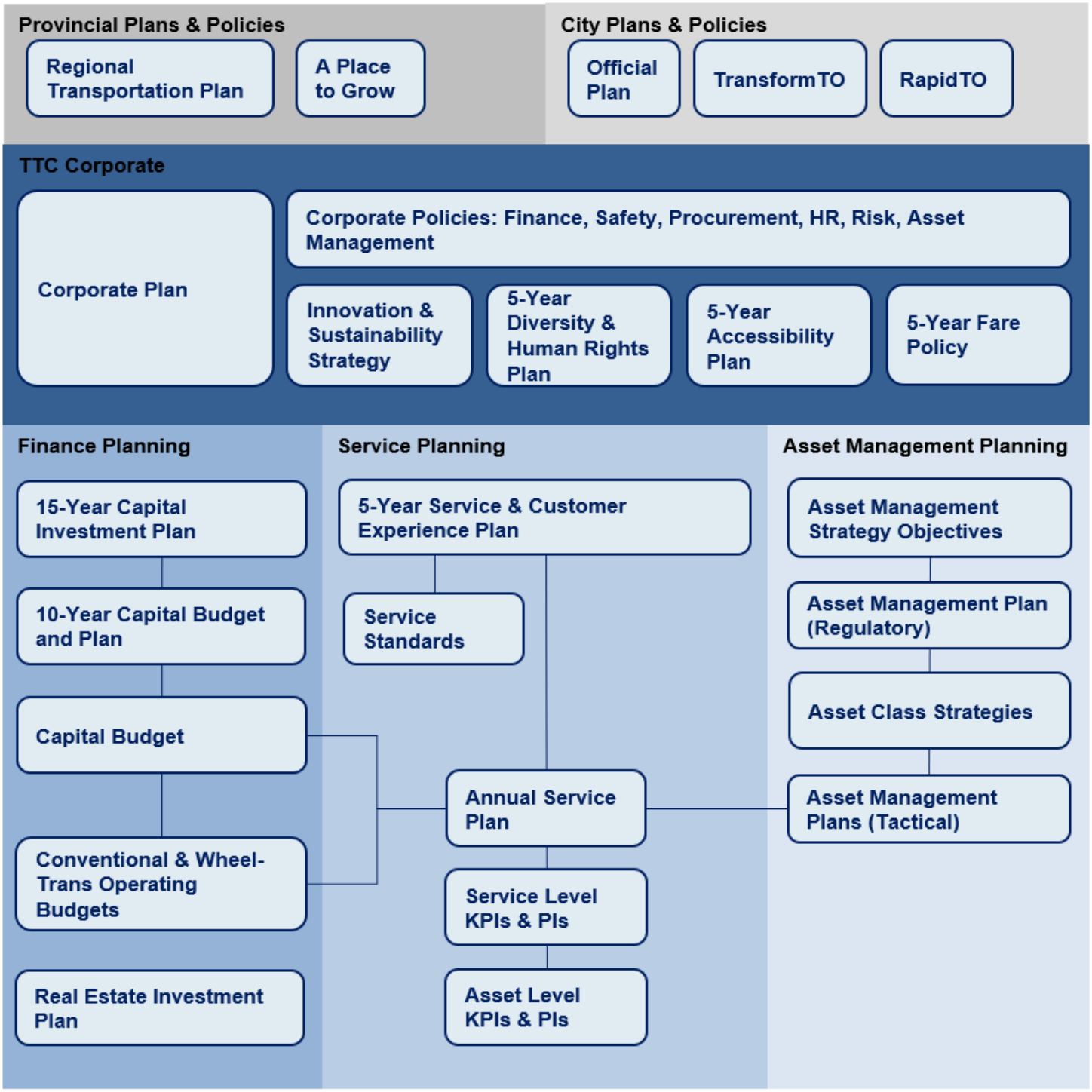


Figure 3-1: Business Planning Framework.

3.3 Financial Planning

Longer-term financial planning documents provide a view of the multi-year capital programs and projects necessary to maintain and build the assets. These include:

- **15-Year Capital Investment Plan**, first introduced in 2019 and updated annually thereafter, provides a comprehensive overview of capital needs, interdependencies and what is funded and not funded, as well as the key investment priorities and risks of not funding. The TTC's Asset Management Plan will be used in the future to inform the activities within the Capital Investment Plan
- **15-Year Real Estate Investment Plan**, a comprehensive set of principles, strategies and an implementation plan to achieve the TTC's strategic real estate goals and objectives.
- **10-Year Capital Budget & Plan**, guided by the CIP and REIP, outlines the funding and timing of acquisition, renewal and improvement of the TTC's assets that enable the TTC's delivery of a safe, reliable, and resilient integrated transit service.
- The annual **Staff Recommended Operating Budget and two-year outlook** to fund the TTC's current services, increase service to meet demand, operate transit expansion and conversion initiatives, and invest in safety, security and well-being initiatives.

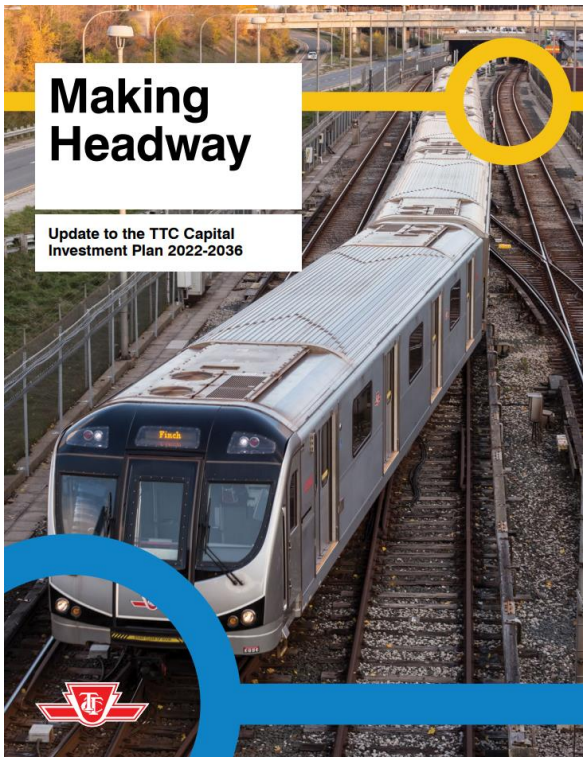


Figure 3-2: "Making Headway" Update to the TTC Capital Investment Plan 2022-2036.

3.4 Service Planning

3.4.1 5-Year Service & Customer Experience Plan

The first 5-Year Service Plan & 10-Year Outlook (2020-2024) identified service-related improvements to public transit service in the city of Toronto. An updated version, the 5-Year Service & Customer Experience Action Plan (2024-2028) is expected to be published in 2024.

Figure 3-3: 5-Year Service Plan & 10-Year Outlook (2020-2024).

The Plan is informed by the following supporting documents:

- Innovation & Sustainability Strategy.
- 5-Year Accessibility Plan.
- 5-Year Fare Policy.
- 5-Year Diversity & Human Rights Plan.

The Plan lays out anticipated growth and sets a vision to accommodate it, focusing on improvements that enhance the TTC's core-competency: mass transit – moving large volumes of customers safely, reliably and swiftly across Toronto.

The Plan is supported by five pillars of opportunity. Each pillar addresses a key step in a customer's journey using the transit system. The pillars are designed to:

1. Enhance the transit network.
2. Enhance customer experience at key surface stop areas.
3. Improve service reliability.
4. Prioritize surface transit.
5. Accelerate integration with regional transit partners and complementary modes of transport.

Each of these five pillars are accompanied with specific actions outlined in a multi-year 20-point action plan. The action plan is a blueprint that identifies major service-related initiatives to be implemented every year and the associated resources required.

Measuring performance is seen as being critical to ensuring investments in TTC services result in the benefits envisioned for customers. The Plan states that performance is measured in three ways: at the System level, at Route level, and at Plan level.

System Level

- Customer Satisfaction - Measured by overall customer satisfaction.
- Ridership - Measured by boardings.
- Service Reliability - Measured by on-time departures.
- Journey Time - Measured by travel time.

Route Level

- Productivity - Measured by boardings per revenue hour.

- Service Reliability - Measured by on-time departures.
- Crowding - Measured at the busiest stop on the route.
- Efficiency - Measured by net cost per passenger.

Plan Level

- Status - Measured by implementation of planned action items.

3.4.1.1 TTC Service Standards

The TTC's service standards provide a systematic and objective means of planning, monitoring, adjusting, and evaluating conventional transit services throughout the city of Toronto.

They include network design standards and performance targets. The standards provide a mechanism for measuring the trade-offs between the benefits achieved by providing more service in one location, the inconvenience caused by removing it from another, and the costs of providing those services.

The Service Standards cover:

- Service Coverage and Access
- Surface Stop Spacing
- Span of Service and Service Levels
- Vehicle Crowding
- Service Reliability – Surface Transit
- Service Reliability – Rapid Transit
- Service Productivity
- Economic Performance
- Annual Performance Review

Further details of the Service Standards are contained in Appendix A: Service Standards.

3.4.2 Annual Service Plan

The Annual Service Plans measure past performance, present actions for the upcoming year and identify resource requirements that will serve as the basis for the TTC's annual Operating Budget and 10-Year Capital Budget submission.

The TTC reviews and monitors customers' emerging travel patterns to learn about how to better serve them. Back Together: TTC's 2024 Annual Service Plan, provides a roadmap for service changes for the coming year – including recommendations for new and revised routes based on input and engagement with TTC customers, employees, and the community. It is the TTC's first annual plan under a more stable environment following the peak of the pandemic. It applies valuable lessons learned from recent years to enhance transit in Toronto, ensuring a more efficient and reliable system for all riders. There are three key themes of the 2024 Plan:

- **Improving on the basics:** Continuing to align service as ridership patterns stabilize across the network, reinforcing the role of TTC Service Standards in defining service quality, and improving existing processes to deliver better transit service.
- **Making stronger connections:** Preparing the transit system for major changes to the network with the future opening of Line 5 Eglinton and Line 6 Finch West; monitoring and adjusting the Line 3 Bus Replacement Network; adjusting other routes across the city to create better connections and respond to community growth and input; and preparing for future changes.

- **Doing disruptions differently:** Learning from recent years of construction and transit disruptions across the city to develop a service disruptions framework; piloting new approaches to maintain mobility during construction; and improving customer communication approaches and tactics.

In addition to the three key themes, there is more work that is ongoing as the TTC continues to develop and implement the 20-Point Action Plan, including the measures initially approved by the Board in the 5-Year Service Plan.

3.5 Asset Management Planning

The TTC has developed a specific Asset Management Policy that is aligned to the City of Toronto's Corporate Asset Management Policy. The policy states the TTC's commitment to adopting asset management, embedding it within the organization and improving organizational maturity in this area.

The policy forms the basis for a future Asset Management Strategy and Asset Management Plans by detailing the principles that the TTC will adopt for asset management delivery. It also acts as a means of communicating the TTC's commitment to asset management to both employees and external stakeholders.

Further details on the TTC's multi-year Asset Management Maturity Improvement Program are provided in Section 11: Improvement Plan.

3.6 Performance

In alignment with the 5-Year Service & Customer Experience Plan, a range of service level KPIs are utilized to track and monitor the service provided by the TTC. These performance measures are grouped under the following categories:

- Customer Experience
- Ridership and Finance
- Safety and Security
- Buses and Wheel-Trans
- Streetcars
- Subway Cars
- Facilities

As defined by the TTC's Innovation & Sustainability Strategy, envionmental performance will be reported on through annual envionmental sustainability reporting going forward.

A summary of service level KPIs is provided in Sections 3.6.2 to 3.6.9, with a full breakdown of each KPI score from the past two years is provided in Appendix B: KPIs. As per the O.Reg, service and performance levels are based on the previous two years of data available at the time of the AMP publication. This is reflected in the following figures, with historic performance data available on the TTC website.

3.6.1 Performance Management Framework

As the TTC matures its asset management practices, it will develop a performance management framework that will provide a clear line of sight from the Corporate Plan through to daily activities undertaken on the network.

This framework will enable the alignment of Corporate Objectives with:

- Asset Management Objectives.
- Wider Provincial and City Objectives.
- Climate-related objectives from the TTC's Innovation & Sustainablity Strategy and from the City's TransformTO Net Zero Strategy.
- 5-Year Service & Customer Experience Plan (and the supporting documents).
- Service Level KPIs & PIs.
- Asset Level KPIs & PIs.
- 15-Year Capital Investment Plan.
- 10-Year Capital Budget & Plan.
- Annual Capital Budget; and
- Annual Conventional & Wheel-Trans Operating Budgets.

In developing the framework, a review of all current performance measures will be undertaken.

3.6.2 Customer Experience

The following indicators are used to measure customer experience:

- **Customer Satisfaction:** This shows the results of a monthly survey of 500 TTC customers.
- **Customer Service Communications:** This shows the top 10 categories of customer communications to the TTC per 1 million boardings. Customers provide feedback to the TTC via the website, telephone, e-mail and X (formerly known as Twitter).
- **On-time Performance – Subway:** This shows the headway adherence of service trains at end terminals.
- **On-time Performance – Bus:** This shows on-time vehicle departures from end terminals.

  On-time Performance – Streetcar: This shows on time vehicle departures from end terminals.

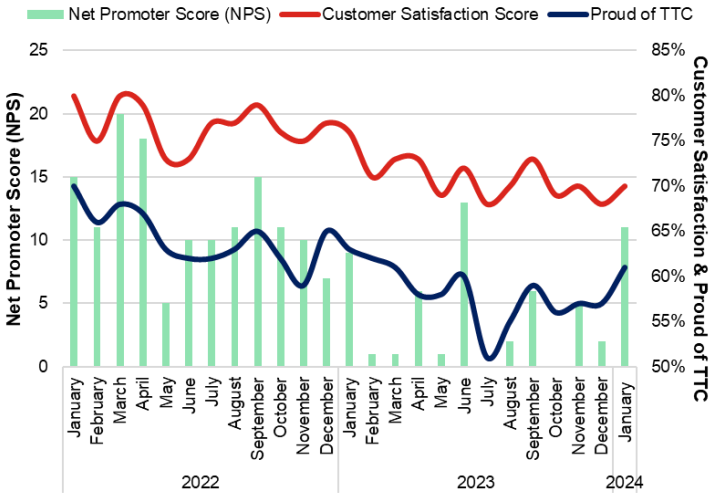


Figure 3-4: Customer satisfaction over time.

- **On-time Performance – Wheel-Trans:** This shows on-time performance.
- **Accessibility – Elevator and Escalator Availability:** This shows the percentage of total available elevator and escalator service hours during subway service.

3.6.3 Ridership and Finances

The following indicators are used to measure ridership and financial metrics:

- **Revenue Rides:** These represent a customer journey from origin to destination, including transfers.
- **Wheel-Trans Trips:** These are the average number of trips per week using both Wheel-Trans dedicated services and contracted services.
- **Customer Boardings:** This measures customer use of the system by mode and by location. Customers are counted each time they board a TTC vehicle.
- **Fare Revenue:** This measures the revenue generated through fares.

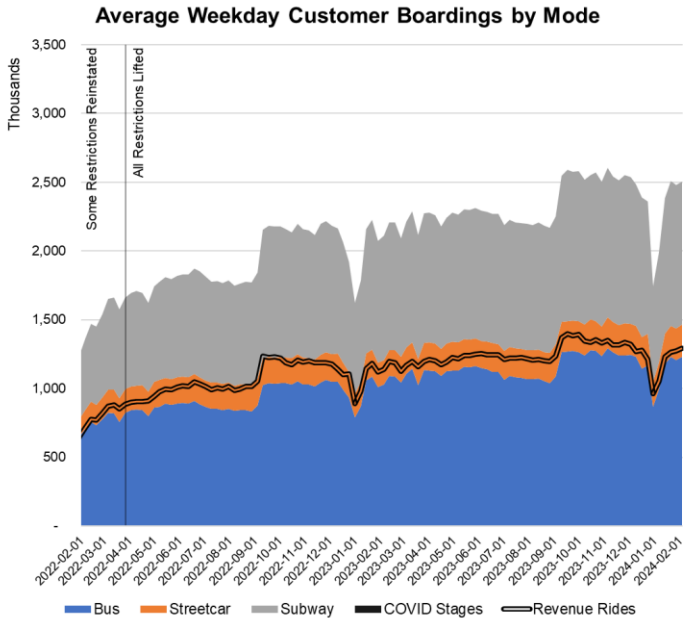


Figure 3-5: Customer boardings over time.

3.6.4 Safety and Security

The following indicators are used to measure safety and security metrics:

- **Lost-time Injuries Rate:** This measures the number of employee injuries resulting in missed work per 100 employees (annualized).
- **Customer Injury Incidents Rate**: This measures the number of customer injury incidents per 1 million boardings.
- **Offences against Customers:** This measures the number of offences against customers per 1 million boardings.
- **Offences against Employees:** This measures the number of offences against employees per 100 employees.

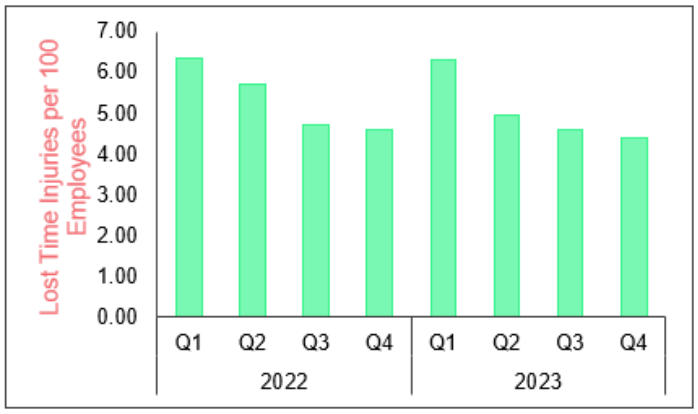


Figure 3-6: Lost-time injuries rate over time.

3.6.5 Bus Service

The following indicators are used to measure bus metrics:

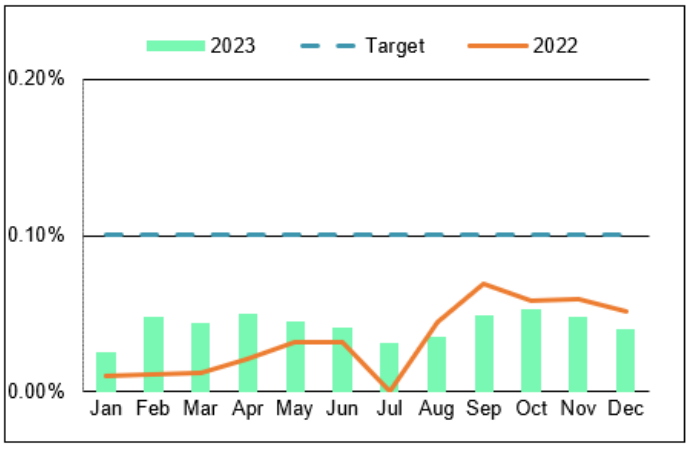


Figure 3-7: Bus short turns.

- **Bus Short Turns**: A short turn occurs when a vehicle is turned back and taken out of service before it can reach the end of its route (per 100 departures).
- **Bus Cleanliness:** This shows the results of a third-party audit.
- **Mean distance between failures:** This shows the total distance (km) accumulated per number of mechanical road calls. The metric is recorded for e-buses, hybrid buses, clean-diesel buses and Wheel-Trans vehicles.
- **Bus road calls and change offs:** This shows the average daily number of vehicle equipment failures requiring an on-road service repair or a change-off to a repair facility for a replacement vehicle.
- **Bus service availability:** This shows the daily weekday average number of buses put into service per the number of buses scheduled for the a.m. peak period.

3.6.6 Streetcar Service

The following indicators are used to measure streetcar metrics:

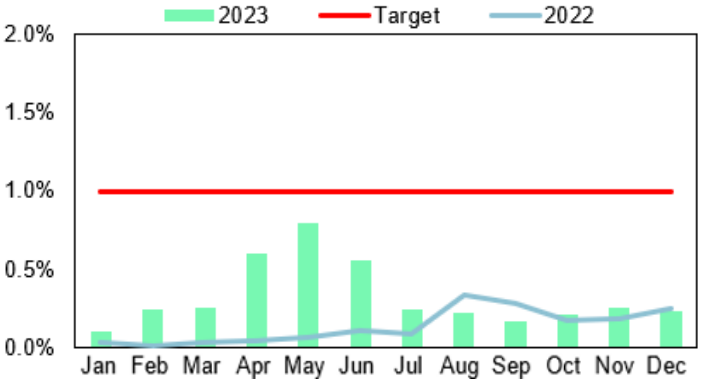


Figure 3-8 Streetcar short turns.

- **Streetcar Short Turns:** This shows when a vehicle is turned back and taken out of service before it can reach the end of its route (percentage of departures).
- **Streetcar Cleanliness:** This shows the results of a third-party audit.
- **Streetcar mean distance between failures:** This shows the total distance (km) accumulated per number of mechanical road calls.
- **Streetcar road calls and change-offs:** This shows the average daily number of vehicle equipment failures requiring a road call for service repair or a change-off to a repair facility for a replacement vehicle (weekday data).
- **Streetcar service availability:** This shows the daily weekday average number of streetcars put into service as a percentage of the number of streetcars scheduled for the a.m. peak period.

3.6.7 Subway Service

The following indicators are used to measure subway trains metrics:

- **Line Capacity:** This shows the total number of trains that travelled through key sampling points during a.m. and p.m. peaks as a percentage of trains scheduled. The metrics are shown for Line 1, Line 2 and Line 4. Line 3 was shut down in July 2023 and is closed permanently.
- **Subway Cleanliness:** This shows the results of a third-party audit.

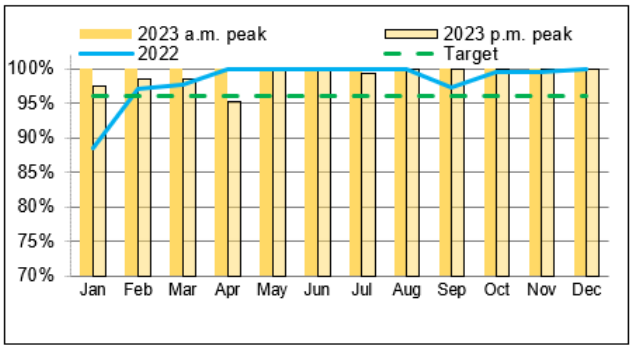


Figure 3-9: Line 1 capacity.

- **Subway Mean Distance Between Failures:** This shows the total distance (km) travelled per number of equipment incidents resulting in delays of five minutes or more. The metrics are shown for TR trains, which operate on Line 1 and Line 4, and for T1 trains, which operate on Line 2.
- **Subway Service Availability:** This shows the daily weekday average number of trains put into service as a percentage of the number of trains scheduled for the a.m. peak period.

3.6.8 Wheel-Trans Service

The following indicators are used to measure Wheel-Trans metrics:

- **Wheel-Trans Contact Centre Wait Time:** This shows the average amount of time a customer waits in the queue before their call is answered.
- **Wheel-Trans Mean Distance between Failures:** This shows the total distance accumulated by the Wheel-Trans fleet per number of mechanical on road service calls.

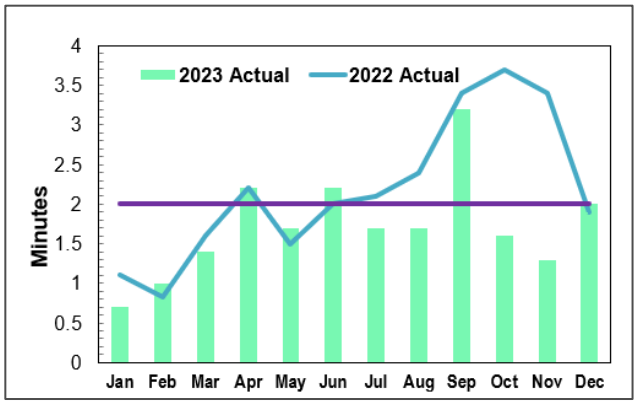


Figure 3-10: Wheel-Trans contact centre wait time.

3.6.9 Station Performance

The following indicators are used to measure station metrics:

- **Station Cleanliness:** This shows the results of a third-party audit.
- **Fare Gate Availability:** This shows the percentage of fare gates are available for use.
- **PRESTO Reader:** This shows the percentage of readers in working order.
- **PRESTO Devices:** This shows the availability of devices based on duration of fault to time of resolution. The metrics are shown for: Fares and Transfers Machines, Self-Serve Reload Machines, and Fare Vending Machines.

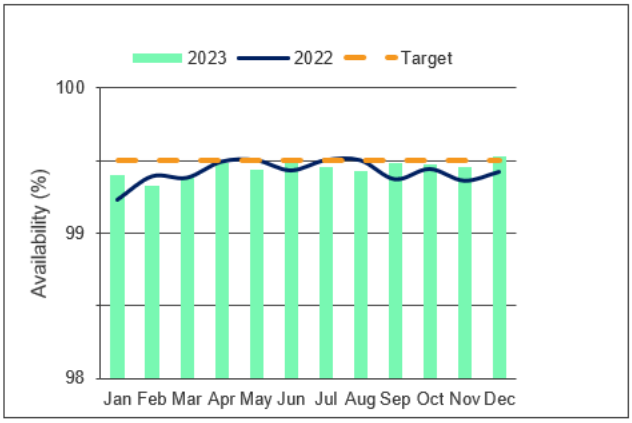


Figure 3-11 Fare gate availability.

- **Escalator and Elevator Availability:** These metrics show the percentage of total available elevator and escalator service hours during subway service.
- **Escalator and Elevator Reliability:** These metrics show the mean number of days between stoppages.

4. Fleet

The TTC vehicle fleet includes revenue vehicles and support (non-revenue) vehicles, as well as historic or heritage vehicles and industrial equipment.

Revenue vehicles owned and maintained by the TTC move passengers in the Greater Toronto Area. The fleet comprises of accessible buses, Wheel-Trans accessible vehicles, accessible streetcars, and accessible subway trains. The TTC owns 2,572 buses, including 250 Wheel-Trans vehicles, 204 streetcars, and 848 subway cars in their revenue fleet. However, the asset inventory changes regularly as new assets are commissioned and older assets are decommissioned at their end of life. All TTC revenue vehicles are accessible.

The TTC also owns and maintains a fleet of support vehicles used by its employees to undertake inspection and maintenance activities across the network, and a significant number of both small and large industrial equipment used for vehicle maintenance and repair.

Methodology for Condition Assessment

In 2022, the TTC undertook a vehicle condition assessment on its revenue vehicles and developed a tool capable of adapting existing corrective maintenance data into concise and meaningful condition scores. The tool's algorithm used three primary factors to assess the condition of the vehicles: age, accumulated distance, and vehicle work order history. To verify the accuracy and reliability of this approach, the algorithm outputs were compared to the results of a visual inspection performed on a subset of vehicles. This information has been used to represent the condition of revenue buses, streetcars and subway cars. However, this condition assessment did not include Wheel-Trans buses and so an alternative methodology has been adopted for these vehicles.

For non-revenue (on-road) vehicles, condition was assessed by comparing life expectancy against age and mileage, aligned to the condition scale contained in Appendix G: Condition Scoring Frameworks.

Figure 4-1: TTC accessible bus.

Figure 4-2: TTC Wheel-Trans accessible bus.

4.1 Buses (Revenue)

Through operating an extensive bus fleet made up of articulated, conventional, and smaller vehicles, the TTC can ensure a wide coverage of the metropolitan area and access to opportunities, amenities, and other modes of transport.

The bus fleet consists of 2,572 buses (including some articulated models) operating out of eight bus garages. The bus fleet is a mix of diesel, hybrid, and electric vehicles; and services 160 regular and 27 overnight routes. In addition to regular bus service, TTC buses are also used in special events and to support streetcar and subway disruptions, as well as city road management diversions and emergency shelters when people are displaced.

Wheel-Trans accessible buses are provided to customers as a specialized service for both ambulatory and non-ambulatory passengers. The Wheel-Trans bus fleet of 250 vehicles is also supplemented by approximately 1,700 taxis (comprising of sedans and around 200 accessible vehicles) which are under contract to the TTC, however, they are not operated or maintained by the TTC.

Table 4-1: TTC bus fleet size and age.

Type	Fleet size	Average age (years)	
Transit Bus Diesel	1,179 (standard) 152 (articulated)	10.5	
Transit Bus Hybrid	931	13.5	
Transit Bus Electric	60	5	
Wheel-Trans	250	6	

Data Source(s): TTC Transportation & Vehicles Group

4.1.1 Asset Condition

An average condition score was calculated for each of the asset types covered in Table 4-2, broken down by sub-asset type, aligned to the scoring framework in Appendix G: Condition Scoring Frameworks.

Table 4-2: TTC bus fleet condition.

Category	Type	Condition score
Transit Bus Diesel	Orion VII Clean Diesel	3..00
	Orion VII NG Clean Diesel	3.00
	Nova 60' Articulated Clean Diesel	2.19
	Nova 40' Clean Diesel	2.17
Transit Bus Hybrid	Orion VII Hybrid	3.00

Category	Type	Condition score
	Orion VII NG Hybrid	3.00
	Nova 40' Hybrid	2.08
Transit Bus Electric	New Flyer Electric Bus	2.00
	Proterra 40' Electric	2.00
	BYD Electric	2.00
Wheel-Trans Accessible	Pro-Master	2.00
	ARBOC Spirit of Independence	2.00
Data Source(s): TTC Transportation & Vehicles Group		

4.1.2 Lifecycle Activities

A program of maintenance and SOGR interventions ensures continuous operation of the bus fleet. Periodic maintenance activities on buses are based on mileage or age, in accordance with the original equipment manufacturers (OEM) recommendations or based on the requirements in *Ontario Regulation 199/07: Commercial Motor Vehicle Inspections* and *Ontario Regulation 629: Accessible Vehicles*.

Significant lifecycle interventions are included as part of the bus overhaul program, which includes the overhaul of major mechanical systems, such as the engine, transmission, suspension and door systems, along with the key overhaul of structures within the interior and exterior of the bus.

Table 4-3: Revenue buses lifecycle activities.

Asset class	**Buses**			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	Periodic	3, 6, 9 or 12 years	12-18 years
Intervention detail	Procurement	Service Check Inspection Program Lubrication and Inspection Program Semi Annual Safety Inspection Other recommended maintenance intervention.	System Maintenance Plans and major overhaul.	Decommissioning – as new buses arrive.
Frequency	One time	5,000 km, 10,000 km, 6-months	Every 3 years	One time
Data sources(s): TTC Transportation & Vehicles Group				

Table 4-4: Wheel-Trans vehicles lifecycle activities.

Asset class	**Wheel-Trans – Accessible vehicles**			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	Periodic	As required	5-7 years
Intervention detail	Procurement	Service check inspection program, minor inspection program, semi-annual safety inspection.	System Maintenance Plans, programs for electrical, powertrain, heating, ventilation and air conditioning (HVAC), body, air, ramp, etc. and other ad-hoc programs as needed based on failure data.	Decommissioning – as new buses arrive. Valuable components are salvaged.
Frequency	One time	10,000/12,000 km, 6 months	As required	One time
Data sources(s): TTC Transportation & Vehicles Group				

4.1.2.1 Maintenance and Inspection

For revenue buses, every 5,000 km the service check inspection program covers the drum brake slack adjusters, any requirements of O. Reg 199/07 and the OEM recommended less than 10,000 km and monthly inspections. Every 10,000 km, the lubrication and inspection program covers the required O. Reg 199/07 and OEM recommended less than five-month inspections and includes activities, such as lubrication, oil change, etc. The semi-annual safety inspection includes O. Reg 199/07 inspections and the OEM inspections recommended at intervals of greater than 25,000 km or between every five and eight months. Additional inspection and maintenance activities may also be required for those vehicles that have high mileage and/or age.

For Wheel-Trans vehicles, every 10,000-12,000 km maintenance activities alternate between the service check program and the semi-annual service inspection. Both include O. Reg 199/07 inspections and any requirements of O. Reg 629. The service check program also includes the OEM inspections recommended at less than 25,000 km and between one and five months, and activities, such as lubrication and oil changes. The semi-annual service Inspection includes the OEM inspections recommended at more than 25,000 km and between five and eight months.

4.1.2.2 Overhaul

At three and nine years, revenue buses undergo programs of overhaul for electrical, powertrain, HVAC, body, air and ramp systems, as well as other ad hoc systems based on analysis of failure data. A mid-life overhaul is implemented at six years to maintain state of good repair, aesthetically. This may also be implemented at 12 years as a life extension project to allow vehicles to continue to operate beyond their usual service life.

Overhaul activities for Wheel-Trans vehicles are undertaken as and when required.

4.1.2.3 Decommissioning

Vehicles are decommissioned, based on age and condition, as new vehicles are delivered and commissioned into the fleet. For revenue buses this is between 12 and 18 years and for Wheel-Trans vehicles between five

and seven years. In each case, any valuable and useable components are salvaged and added into the pool of spare parts.

4.1.3 Costs

For revenue buses, under the 'Transforming & Electrifying Bus Service' portfolio, $4 billion is needed for the purchase of new electric buses and $351.5 million for the purchase of Wheel-Trans buses up to 2038. The cost for upholding the state of good repair (bus overhaul) is $1.203 billion between 2024 and 2038.

Approved funding for lifecycle costs of buses are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan.* The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to buses.

Further details on funding requirements for buses can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

4.1.4 Risks

1. **If the planned procurements for electric buses and charging infrastructure post-2025 are not funded,** the TTC's bus service will be significantly impacted, and operating expenditures will escalate due to an increase in required maintenance activities. This may result in proper lifecycle management no longer being adhered to, leading to obsolescence and potential fix on fail maintenance routines.
2. **Limited funding for bus overhauls.** Insuffcicient funding for overhaul works will result in preventative maintenance programs no longer being implemented, leading to a reliance upon fix on fail maintenance and the subsequent impacts to service.
3. **Electrification will require modification, conceptual change, and a new maintenance approach** to delivering service that simultaneously affects our fleet, facilities, workforce skills, processes, service and support equipment. Such a significant change is unprecedented in the industry, and the TTC is not able to rely on industry knowledge, resulting in a high level of risk to all functions of the Bus Maintenance Department.
4. **The TTC is experiencing a surge of modernization** as it employs more sophisticated and intelligent equipment and systems in everyday operations. These modern equipment and systems are more expensive to operate, demand more of our workforce in terms of knowledge and competence, and require external support that brings a new dimension to our operating environment.
5. **The supply chain has little operating experience with supplied equipment** due to electrification and modernization, as they trial and assess products for suitability to their business model. Bus maintenance is experiencing longer lead times, higher costs, and lower reliability and availability of required materials to maintain the revenue bus fleet. Also, global supply chain disruption and lingering effects from the COVID pandemic have contributed to long lead times, sometimes over a year, for many critical spare parts. Bills of Materials are now typically submitted two years before work starts, which compresses design schedules, reduces resilience, and increases warehousing costs.
6. **The current heavy-duty mechanic knowledge and skillset are not able to meet the demands of a modern and electrified transit fleet.** The industry is aware of this knowledge gap and is working with various stakeholders to determine the scope and means to upskill the workforce. However, workforce

competence developments lag far behind the fleet technology change, which creates a high risk that the workforce will not be able to maintain the effectiveness and efficiency of diagnoses, repairs, and proactive maintenance methodology.

7. **The TTC is experiencing configuration inconsistencies across its fleet**, resulting in exponential complexity and difficulty in material management, training, diagnosing, and overall management of such a diverse fleet. There is a severe risk to maintaining current levels of service if more variations to the operating fleet continue to be introduced.

4.2 Streetcars (Revenue)

Streetcars have been a core component of Toronto's public transit system serving the people of Toronto and their communities since the 19th century. A capital program was delivered to replace the entire streetcar fleet with modern, fully accessible articulated Low Floor Light Rail Vehicles (LFLRV). The new LFLRV fleet has required complete transformation of the business due to upgraded technology on the vehicles and the need to adjust existing infrastructure to accommodate increased vehicle length, roof top equipment and the new pantograph system, among other things. The streetcar system is fully integrated with the other modes of transportation enabling transfer between different modes using a single payment.

Table 4-5: TTC streetcar fleet size and age.

Type	Fleet size	Average age	
Low Floor Light Rail Vehicle	204	5	

Data Source: TTC Transportation & Vehicles Group

4.2.1 Asset Condition

Recent procurement of new LFLRVs since 2013 has now resulted in complete replacement of the old Articulated Light Rail Vehicle (ALRV) and Canadian Light Rail Vehicle (CLRV) streetcar fleet after 35- and 40-years' service, respectively. Given the age of the fleet and the maintenance undertaken to date to achieve SOGR, the overall condition of the fleet is judged to be 'Good' against the scoring framework in Appendix G: Condition Scoring Frameworks.

Table 4-6: TTC streetcar fleet condition.

Category	Type	Condition score
Streetcars	Low Floor Light Rail Vehicles (LFLRV)	2.06

Data Source: TTC Transportation & Vehicles Group

4.2.2 Lifecycle Activities

The TTC is responsible for ensuring the fleet of 204 LFLRVs are available to provide a safe, clean, reliable, and efficient service across the network of streetcar routes in Toronto. The fleet is maintained in a state of good repair thorough a program that incorporates work recommended by the streetcar manufacturer and other maintenance tasks based on experience.

Table 4-7: TTC streetcar lifecycle activities.

Asset class	**Streetcars**			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	Continuous	8 years	30 years
Intervention detail	Purchase of new streetcars	Replacement, cleaning, inspection and service of components and equipment	Replacement, overhaul, inspection and service of components and equipment	Decommissioning – at the end of serviceable life as and when new vehicles become available.
Frequency	One time	Annually, Seasonal, 2 years and 4 years	As required	One time
Data sources(s): TTC Transportation & Vehicles Group				

Figure 4-3: Streetcar maintenance.

A variety of inspection and maintenance activities are completed on streetcars. Additional information in Table 4-8 below provides examples of the types of inspection and maintenance activities that are undertaken at the intervals in Table 4-7 above.

Table 4-8: Detailed maintenance and inspections frequency.

Inspection	**Frequency**
Pre-service inspection	Daily
Inspection of all equipment	Once every two months
Master controller service	Annual
Brake rate	Annual
Hydraulic system flushing	Annual

Inspection	Frequency
Inspection and cleaning of HVAC equipment	Seasonal

Additional maintenance activities are undertaken at four- and eight-year intervals, with overhaul of some components included at eight years.

4.2.3 Costs

Streetcar has $325 million funded for purchase of new vehicles and a further $493.0 million in funding required for streetcar overhaul to uphold state of good repair between 2024 and 2038.

Approved funding for lifecycle costs of streetcars are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to streetcars.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

4.2.4 Risks

1. **Major overhaul for the LFLRVs is within the next few years.** As the fleet approaches the age at which major overhaul is due, there is a risk that without proper funding for the overhaul program there will be a reliance upon fix-on-fail maintenance regimes leading to service disruption.
2. **Obsolete components.** Some of the equipment on streetcars currently has components that are now obsolete. This results in equipment failure with no possibility of replacement of the appropriate component.
3. **Single source supplier**. Many of the components on streetcars can only be obtained from a single supplier. If the component is out of stock with this supplier or they are unable to fulfill the request, then there are no alternative suppliers available with the current procurement arrangements. Having a single supplier also risks cost escalation and unaffordability.
4. **Contractual obligations with streetcar OEM**. Other suppliers who may be able to supply parts or components are being prevented from doing so due to contractual arrangements with the OEM. This risks delay in acquiring parts.
5. **Custom-made equipment that applies only to TTC vehicles**. Some equipment on TTC streetcars is bespoke to those vehicles and can be expensive to develop and replace. This also means that equipment is not readily available when required and streetcars may remain out of service for longer than is necessary.
6. **Workforce availability.** Due to increasing obsolescence and single-source suppliers there is a need to increase the technical workforce, but there is a risk that these technical resources will not be readily available. This may limit the ability of the Streetcar Maintenance team to undertake the work required to maintain service.

4.3 Subway (Revenue)

The subway fleet consists of 143 subway trains formed from a total 848 subway cars, split across two generations of vehicle: the Toronto Rocket and the T1 class. All subway trains are designed to be fully accessible.

Figure 4-4: Toronto Rocket subway train.

Table 4-9: TTC subway average age and fleet size.

Model	Fleet size	Average Age	
T1 Rapid Transit Car	61 Trains (368 Cars)	25	
TR Toronto Rocket Trainset	82 Trains (480 Cars)	10	

Data Source: TTC Transportation & Vehicles Group

4.3.1 Asset Condition

Subway cars are generally maintained to achieve a state of good repair, and the overall condition across the fleet is 'Good' against the scoring framework in Appendix G: Condition Scoring Frameworks. Condition for SRT cars is not included in the table below as these vehicles are due to be decommissioned in 2024 following the closure of Line 3.

Table 4-10 TTC subway revenue vehicles condition score.

Category	Type	Condition score
Subway Revenue Vehicles	T1 Rapid Transit Car	2.05
	TR – Toronto Rocket	2.12

Data Source: TTC Transportation & Vehicles Group

4.3.2 Lifecycle Activities

Subway vehicles are procured, designed, manufactured, and thoroughly tested before entering service. During their operating life, they go through daily, weekly, monthly, and annual cleaning, inspection, and functional testing to ensure they operate safely.

Table 4-11: Lifecycle activities subway vehicles.

Asset class	**Subway vehicles (T1 and TR)**			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	Continuous	Continuous	25-35 years
Intervention detail	Procure new subway trains	Daily and periodic preventive maintenance inspections, cleaning, testing, and replacement of consumables. As-required repairs.	Comprehensive refurbishment of various onboard systems	Disposal of vehicle when a replacement is available.
Frequency	One time	Periodic	Every 5-15 years	One time

Data Source: TTC Transportation & Vehicles Group

At various intervals, typically five-to15 years, critical vehicle components and systems are refurbished to ensure continued reliability throughout the train's design life. At the end of a vehicle's design life, typically 25-35 years, vehicles might undergo a life extension overhaul to extend their safe operating life (should this be necessary), replace obsolete systems, and/or introduce new modern features. Upon retirement, a vehicle might be converted to a work car to assist in subway infrastructure maintenance or sold off after salvaging useful components.

The T1 trains on Line 2 are scheduled to be replaced by new trains from 2029 onwards, but the oldest of the T1 trains will reach the end of its design life by 2026. Life extension works are therefore being planned for the oldest T1 trains, which as a minimum will consist of:

- Redesign of obsolete electronics.
- Upgrades of related testing equipment.
- Necessary corrosion repairs on trucks and other vehicles structures.

Figure 4-5: Completed overhaul of TR non-powered truck.

- Routine and mechanical refurbishments.

4.3.3 Costs

Subway has $918.8 million funded for purchase of new subway cars and a further $460.2 million for subway car overhaul to uphold state of good repair between 2024 and 2038. An additional $2.3 billion for the purchase of new subway cars and $252.8 million for subway car overhaul to 2038 is currently unfunded.

Approved funding for lifecycle costs of subway trains are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to subway trains.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

4.3.4 Risks

1. **Aging assets.** Aging assets require increased maintenance to counteract the higher fault rate. As a greater number of assets move towards end-of-life, the increased maintenance demand poses a risk of reduced service, as more vehicles are taken for repair at a given time.
2. **Technology obsolescence.** An aging fleet has the resultant impact that much of the technology on board the vehicles is obsolete or nearing obsolescence. This removes access to spare components, causing difficulty with maintenance and subsequently impacting service.
3. **Supply chain challenges.** Global supply chain disruption and lingering effects from the COVID pandemic have contributed to very long lead times (greater than one year) for many critical spare parts. Bills of Materials are now typically submitted two years before work starts, which compresses design schedules, reduces resilience, and increases warehousing costs.
4. **Long-term funding stability.** TR SOGR funding interruption in 2026-2028 risks inability to deliver SOGR work, which elevates risk of service disruptions. T1 vehicles are also approaching the end of design life with no fully funded replacement program. Funding interruptions prevent development of long-term relationships with supply partners, increasing supply chain challenges and costs.
5. **Lack of resources.** Challenges around retention and recruitment of appropriate talent risks a shortfall in the required numbers of personnel to undertake the activities required to maintain service and SOGR. An increase in rail construction has led to a decrease in the talent pool available locally.
6. **Lack of funding for new trains or life extension works**.There is a risk to the available capacity on both Line 1 and Line 2 if funding is not received for new trains or life extension programs.

4.4 Heritage Fleet

The heritage fleet consists of a small number of vintage and historic vehicles that played a significant role in the history of the TTC, and the evolution of Toronto's transportation network. These streetcars and buses are

owned by the TTC, but are no longer in regular service; some are occasionally used in service on special occasions, some are charter vehicles, some are public relations vehicles, and some are used for parts.

The TTC is committed to preserving these non-service assets, which hold historical and educational value, and as such restoration work and maintenance will still be required.

Table 4-12: Heritage fleet size and average age.

Model	Fleet size	Average Age	
Presidents Conference Committee (PCC)	2	82	
Peter Witt	1	99	
Legacy Bus GM	1	42	
Articulated Light Rail Vehicle (ALRV)	1	40	
Canadian Light Rail Vehicle (CLRV)	1	40	

Data Source: TTC Transportation & Vehicles Group

Figure 4-6: Legacy Bus GM.

4.5 Surface Vehicles and Equipment (Non-revenue)

The non-revenue vehicles and equipment fleet is essential to the operation and maintenance of the network. The fleet consists of automotive on-road vehicles, off-road equipment and trailers. Standard automotive vehicles are used alongside custom fabricated units for specific purposes, such as overhead streetcar wire de-icing, rail equipment, snow clearing, vacuum trucks, sweepers, rail sanding trailers, revenue support vehicles and many more.

Surface vehicles are used by various departments across the TTC in support of subway, streetcar and overhead electrical repairs as well as infrastructure maintenance of all the TTC bus and streetcar facilities, in addition to supporting customer service areas, such as stations, loops, transfer points and buildings.

Wherever possible, the TTC is adjusting the fleet to more fuel-efficient-sized vehicles, as part of the *Sustainable City of Toronto Fleets Plan.*

Figure 4-7: Wheel loader.

Figure 4-8: Garage Service Truck.

Table 4-13: TTC surface vehicles and equipment (non-revenue vehicles) fleet size and average age.

Group	Fleet size	Average age (years)
Non-Revenue On-Road Vehicles	509	7.1
Non-Revenue Off-Road Equipment	341	9.7
Trailers	77	13.9
Data Source: TTC Transportation & Vehicles Group		

4.5.1 Asset Condition

The only available data to measure the condition of non-revenue vehicles is age and mileage, and the relation of vehicle age and mileage to serviceable life expectancy. To align this methodology to the five-point scale adopted for other assets, the mileage of the vehicles will be measured against the expected serviceable mileage according to the criteria in Appendix G: Condition Scoring Frameworks.

At the time of publication, the condition scores were not available for non-revenue vehicles.

4.5.2 Lifecycle Activities

For maintenance, non-revenue vehicles are considered as either rubber-tired equipment or road vehicles. Maintenance activities are broadly similar, but the different assets may have a different expected life.

Table 4-14 Lifecycle activities for rubber-tired equipment.

Asset class	**Rubber-Tired Equipment**		
Lifecycle intervention	Acquisition	Maintenance	Disposal
Year (of life)	0	Continuous	10 years
Intervention detail	Define end use requirements to facilitate acquisition of a vehicle which can then be adapted to meet these requirements.	Daily and periodic preventive maintenance inspections, cleaning, testing, and replacement of consumables. As-required repairs.	Disposal of vehicle when a replacement is available. Disposal when damage occurs, and the repair cost exceeds the value of the unit.
Frequency	One time	Periodic	One time
Data Source: TTC Transportation & Vehicles Group			

Table 4-15 Lifecycle activities Road Vehicles.

Asset class	**Road Vehicles**		
Lifecycle intervention	Acquisition	Maintenance	Disposal
Year (of life)	0	Continuous	7 years
Intervention detail	Define end use requirements to facilitate acquisition of a vehicle, which can then be adapted to meet these requirements.	Daily and periodic preventive maintenance inspections, cleaning, testing, and replacement of consumables. As-required repairs.	Disposal of vehicle when a replacement is available. Disposal when damage occurs, and the repair cost exceeds the value of the unit.
Frequency	One time	Periodic	One time
Data Source: TTC Transportation & Vehicles Group			

4.5.3 Costs

$37.3 million is funded for shop equipment purchases, with an additional $14.6 million funded for other maintenance equipment. A further $79.5 million for the purchase of Non-revenue vehicles is also funded between 2024 and 2033.

Approved funding for lifecycle costs of surface non-revenue vehicles are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to surface non-revenue vehicles.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

4.5.4 Risks

1. **Funding required to procure more aggressively, to bring support vehicle fleet age down to midlife**. Current funding levels will not facilitate a fleet that has an average age of 'mid-life', so certain vehicles are exceeding their life expectancy. Funding is required for vehicle purchase, but also for resources to produce vehicle specifications. There is a risk of an increase in associated maintenance costs and faults and that service levels cannot be maintained as the fleet requires additional maintenance and repair.

2. **Growth of EV infrastructure does not keep pace with acquisition of vehicles.** There is currently a low-medium risk that as the number of EV vehicles in service increases (as the TTC transition to an EV fleet) they not supported by an appropriate level of EV charging facilities and other infrastructure to support effective maintenance and repair activities. The performance and reliability of this new evolving technology is also not yet well understood. This may lead to delays and a reduction in the availability of the non-revenue fleet, and adversely impact the service levels of these vehicles.

4.6 Rail Vehicles (Non-revenue)

The non-revenue rail fleet is used for maintenance of the subway system. Some of the equipment is purchased new, others are unique vehicles, which have been converted from decommissioned revenue service cars.

There are 77 rail service vehicles that include, but are not limited to, tunnel leak cars, asbestos crew cars, ballast cars, snow blowers, flatcars, and inspection vehicles.

These vehicles and equipment are used by various departments across the TTC in support of subway maintenance activities, such as track, structure, and signal maintenance.

Figure 4-9: Rail maintenance vehicles

Table 4-16: TTC Rail vehicles (non-revenue) fleet size and average age.

Model	Fleet size	Average age (years)
Locomotives	3	21
Trailers	16	23
Snow Clearing	6	25
Self-Propelled Electric	39	11
Self-Propelled Diesel/Hybrid	13	11
Data Source: TTC Transportation & Vehicles Group		

4.6.1 Asset Condition

There are no comprehensive condition inspections undertaken on non-revenue rail cars. The condition scores below are based on the expert judgment of the Rail Cars and Shops Department, aligned to the scoring framework in Appendix G: Condition Scoring Frameworks.

Table 4-17 Asset condition score for non-revenue rail vehicles and equipment.

Category	Type	Condition Score
Rail vehicles and Equipment	Locomotives	3.7
	Trailers	3.2
	Snow Clearing	3.0
	Self-Propelled Electric	2.8
	Self-Propelled Diesel/Hybrid	2.5
Data Source: TTC Transportation & Vehicles Group		

4.6.2 Lifecyle Activities

Table 4-18: Rail Vehicles (non-revenue) lifecycle costs.

Asset class	**Non-Revenue Rail Vehicles**			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	Continuous	Continuous	As required
Intervention detail	Procure new non-revenue work cars, or convert retired revenue vehicle into non-revenue work car.	Daily and periodic preventive maintenance inspections, cleaning, testing, and replacement of consumables. As-required repairs.	Comprehensive refurbishment of various on-board systems. May involve vehicle rebuild.	Disposal of vehicle when a replacement is available or when vehicle is no longer required by end-user.
Frequency	One time	Periodic	Periodic	One time
Data Source: TTC Transportation & Vehicles Group				

4.6.3 Costs

Rail non revenue has $58.2 million funded for purchase of new rail non-revenue vehicles and a further $33.8 million for rail non-revenue vehicle overhauls to uphold state of good repair between 2024 and 2033.

Approved funding for lifecycle costs of rail non-revenue vehicles are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to rail non-revenue vehicles.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

4.6.4 Risks

1. **Long lead time with respect to vehicle repairs, modifications, and procurement.** Delays to the repair and modification of existing vehicles and the acquisition of new vehicles may result in a shortfall of necessary resources to undertake essential repairs and maintenance to subway infrastructure, resulting in a reduction in perfomance of the subway service.
2. **Resources required to improve preventative maintenace programs.** The non-revenue rail fleet has grown over the years, but the resources available to maintain the fleet has remained constant, leading to a lack of resources to implement and improve preventative maintenance programs.

4.7 Industrial Equipment

Industrial equipment is categorized into small handheld equipment and large equipment stored in carhouses and shops. This equipment is critical to the effective maintenance of buses, streetcars, rail cars, and non-revenue vehicles. There are more than 6,400 small and 1,900 large industrial equipment items stored in carhouses and shops.

Condition data across the large range of industrial equipment is not available and the TTC does not routinely undertake condition inspections on this equipment. Reactive assessment and disposal of this equipment is appropriate as there are sufficient spares readily available, such that there are no significant impacts on operations. Small handheld devices are disposed of and replaced (if necessary) when they break or are no longer fit for purpose.

Costs for Industrial equipment in the CIP are split across bus and subway 'Upholding the State of Good Repair' portfolios, with $217.2 million and $574.5 million, respectively, between 2024 and 2038. Further details of funding on the 'Upholding the State of Good Repair' portfolio for buses and subway cars can be found in extracts from the *2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

4.7.1 Risks

1. **High-cost industrial equipment has limited redundancy.** Equipment, such as train washers, vehicle hoists and wheel turn machines are critical to service delivery. Long-term loss of this equipment risks affecting service availability and/or quality.
2. **Critical industrial equipment is under-invested.** The criticality of industrial equipment to maintaining service delivery is not always well understood or documented and therefore it is difficult to prioritize investment and link this to service delivery.
3. **Procurement can be challenging.** Lack of suitable vendors to design, build and manufacture the industrial equipment needed by the TTC risks delays in obtaining the equipment necessary to maintain service delivery.
4. **Lack of sufficiently skilled resources** to support the process of procuring and specifying equipment risks delays in obtaining the equipment necessary to maintain service delivery.

5. Linear Infrastructure

5.1 Subway Track

Subway linear infrastructure is the track and other track-related assets on which the TTC operates its rolling stock. Track infrastructure typically consists of rails, ties, fasteners, ballast or slab track, and the underlying subgrade. The TTC currently has four rail lines across Toronto, three of which are operational following the closure of Line 3 in 2023.

- Line 1 (Yonge-University) is a 'U-shaped' route serving 38 stations from the Vaughan Metropolitan Centre to Finch, via the Spadina, St George, Bloor-Yonge and Sheppard-Yonge interchange stations. The track provides access to the north of the city.
- Line 2 (Bloor-Danforth) operates east-west between Kipling and Kennedy with 31 stations. Running through the Spadina, St George, and Bloor-Yonge interchanges, this line is also a key link between the city and the Airport Express bus service to Pearson Airport.
- Line 3 (Scarborough) was in operation until July 2023, serving the district of Scarborough through six stations connecting Line 2 at Kennedy all the way to McCowan.
- Line 4 (Sheppard) is the shortest line in the city, with five stations, running between the Sheppard-Yonge interchange to Don Mills.

Figure 5-1: Underground subway track.

Figure 5-2: Overground subway track.

Subway Track is considered in two categories based on its location:

- **Mainline** refers to the track network on which subway cars travel between stations, for the primary purpose of transporting passengers around the city. The track is considered in terms of tangents (straight portions of the track) and curves, and are comprised of the other sub-asset categories below. Non-revenue vehicles, such as inspection and cleaning machines also traverse the mainline for maintenance purposes, however, this is typically done outside of service hours.

Figure 5-3: Greenwood Yard.

- **Yard** refers to the track found specifically within a yard, which have the purpose of storing subway cars when non-operational and allowing efficient movement of the cars between inspection and maintenance areas of the site. Yards have many tracks in parallel to allow cars to move unobstructed past one another, however, they converge to a single connection point to the mainline.

Track located on both the mainline and within yards is constructed from the following sub-asset categories:

- **Rail** refers to the steel rails on which the subway car wheels roll along, providing a flat, consistent surface. A continuous line of rail is achieved through welding shorter sections together. Ties and fasteners maintain the correct gauge, or spacing, between each rail.
- **Ties** are supports that sit directly underneath the rails and connect to each rail using fasteners. They sit perpendicular to the direction of the rails and traditionally have been made of wood. However, the TTC now installs a composite material for greater durability, and a large proportion of the network utilizes double concrete ties. The purpose of the ties is to spread the load of subway cars from the rails to the supporting ballast and sub-grade beneath, and to maintain the correct track gauge. A large number of ties are required to support the network, with more than 34,000 installed across all lines.
- **Ballast** refers to the material underneath the ties, which bears the load of the vehicles above. Consisting of stone and/or gravel, ballast is packed beneath, between and around the ties to hold the track in place and reduce movement as subway cars pass. The geometry of the ballast also allows for effective drainage. Ballast is found in the overground portion of the subway network a shown in Figure 5-2.
- **Slab track** is used as an alternative design method to the traditional construction of ballast and ties. With this installation, the rails are fastened directly on top of a reinforced concrete slab, which sits directly on the underlying subgrade, without the need for ties or ballast. This design is used by the TTC in tunnels and on bridges. Figure 5-1 above displays an example of slab track.
- **Fasteners** are components, which join the rails to the ties or slab track underneath.
- **Switches,** or turnouts, are features that allow subway cars to switch tracks, such as at a junction. They comprise of rails that overlap and can be adjusted to direct the wheels of a car onto the desired path. They are found throughout the mainline, with a large number also found in each yard due to the number of parallel tracks found in yards.

The following tables show the counts and average ages of assets within the track mainline and yards. Please note that Table 5-1 below lists the length and average age of the rail and switches along the subway mainline, and the average age does not include ties, ballast, slab track or fasteners.

Table 5-1: TTC Mainline rail and switches average age and length.

Line	Description	Length (km)	Average age (years)
1	Line 1 (Yonge-University)	38.4	69
2	Line 2 (Bloor-Danforth)	26.2	57
4	Line 4 (Sheppard)	5.5	21
All	Switches – Mainline	Count: 207	31
Data Source: TTC Operations & Infrastructure Group			

Table 5-2: TTC subway yard rail length and average age.

Asset type	Yard	Length (km)	Average age (years)
Yards – Rail Length	Wilson	30.1	18
	Keele	1.3	61
	Greenwood	20.9	49
	Davisville	7.3	27
Data Source: TTC Operations & Infrastructure			

Table 5-3: TTC subway yard switches count and average age.

Asset type	Yard	Count	Average age (years)
Yards – Switches	Wilson	92	19
	Keele	3	61
	Greenwood	77	46
	Davisville	35	25
Data Source: TTC Operations & Infrastructure Group			

5.1.1 Asset Condition

Condition scores for rail are determined based on the amount of horizontal and vertical wear, using the criteria outlined in Table 5-4.

Table 5-4: TTC subway rail condition score criteria.

Rail Wear (mm)	Condition Rating	Description
0 - 3	1	Excellent
3.1 - 6	2	Good
6.1 - 9	3	Adequate
9.1 - 11	4	Marginal
>11	5	Critical/Poor

Table 5-5 shows the condition scores for mainline rail only and does not include the other sub-asset categories, which comprise the track asset class. Similarly, Table 5-6 shows the condition scores for yard rail only without the other sub-asset classes.

Table 5-5: TTC subway mainline rail condition score.

Line		Proportion of Rail at each Condition Score				
		1	2	3	4	5
1	Line 1 (Yonge-University)	31%	40%	27%	1%	0%
2	Line 2 (Bloor-Danforth)	32%	14%	49%	5%	0%
4	Line 4 (Sheppard)	Not yet available				
Data Source: TTC Operations & Infrastructure Group						

**Please note that due to rounding, the total % may not equal 100%*

Table 5-6: TTC subway yard rail condition score.

Yard	Proportion of Rail at each Condition Score				
	1	2	3	4	5
Wilson	48%	17%	33%	2%	0%
Keele	48%	52%	0%	0%	0%
Greenwood	17%	15%	40%	16%	11%
Davisville	56%	13%	31%	0%	0%

Data Source: TTC Operations & Infrastructure Group

**Please note that due to rounding, the total % may not equal 100%*

Condition of ties is determined by asset deterioration and present defects.

Ballast can move slightly over time, due to the movement and load of railcars, so it is possible for the levels to become too high or too low for optimum operation as the ballast spreads out or bunches together. The ballast material can also become fouled in a short period of time depending on the drainage levels, so there is no standard deterioration rate for ballast on the whole subway system. The amount of deviation to the required ballast level, or level of fouling, determines the condition rating.

Line 4 rail scores are not yet available for publication.

5.1.2 Lifecycle Activities

Table 5-7: Summary of subway track mainline lifecycle activities.

Asset class	**Subway Track Mainline**				
Lifecycle intervention	Acquisition	Inspection	Maintenance	Overhaul	Disposal
Year (of life)	0	All	10-25 years	20-50 years	50+ years
Intervention detail	New track infrastructure install/ commissioning.	Visual inspection of entire track network, annual detailed inspection.	Tamping, replacing of steel components, such as rails, replacing fasteners and ties.	Full switch replacement, which includes replacement of all steel, ties, and ballast.	Decommissioning of old rail infrastructure.
Frequency	One-off	Every 3 days (visual), or annually (detailed)	As needed	As needed	One-off

Track patrol crews perform a walked visual inspection of the entire system every three days to identify, classify and record all track defects found on the rails, ties, ballast and fasteners.

Once a year detailed measurements of vertical and horizontal wear of the tracks are taken by specialized, vehicle-mounted measuring equipment, which photographs track components and uses algorithms to detect defects. Rail wear rate is calculated and used to plan rail replacement as part of the SOGR program, ensuring the highest risk sections of the network are replaced first.

In the case of ties and ballast, when assets reach a condition rating of Priority and Urgent, they will be maintained. For ties, this requires a replacement of the asset and an upgrade to a composite material if the

current tie is wooden. A composite material increases the life of a tie, providing an average life expectancy of 40-60 years, as compared with 37-48 years for wooden ties. Double concrete ties are also installed on the network, which have an average life expectancy of 50-plus years.

For ballast, maintenance requires replacement of material if the levels have been depleted, or transfer from under the tracks if levels are too high. The material will also require replacement if it has fouled; higher risk areas are those with reduced drainage and will therefore require replacement more frequently. Tamping is also performed by a specialized non-revenue rail vehicle when the ballast has moved unevenly beneath the ties and rail. This involves the packing of ballast evenly underneath the track to reproduce an even surface.

5.1.3 Costs

The 'Upholding the State of Good Repair' portfolio for subway includes $338 million capital funding to be spent on upholding the state of good repair of subway track between 2024 and 2033, with an additional $197.9 million required from 2034-2038.

Approved funding for lifecycle costs of the subway track are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to subway track.

Figure 5-4: T1 Subway train.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

5.1.4 Risks

1. **Dependencies on new subway train funding and their procurement for multiple projects and associated benefits**: Investment in new trains for Line 1 and Line 2 is a prerequisite for capacity expansion projects and ATC (Automatic Train Control) implementation. If funding and procurement of new trains is delayed, this 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.
2. **Aging infrastructure and track components:** Aging assets require a more intense maintenance regime and more frequent replacements. Additionally, the rate of wear on the track asset has increased since the track was first installed with increased train frequencies made possible by the Automatic Train Control System. These factors contribute to a large volume of track requiring replacement in the coming years, resulting in the need for a significantly higher volume of repair and replacement work annually than is currently delivered. To mitigate the risk of having insufficient resource to deliver this required workload, an increased rate of rail replacement will be implemented each year to renew the track before failure.
3. **Decommissioning of Line 3:** Following the Line 3 closure in 2023 there is some uncertainty about the future of the land and infrastructure along the route, and timescales to deliver any capital works required.

There is a risk of performing maintenance and decommissioning activities, which do not align with future requirements for Line 3, resulting in excess cost. This risk can be mitigated through careful decision-making with respect to maintenance, ensuring that the line is kept in an appropriate condition while future works are planned.

4. **Short time window to perform track maintenance:** Track maintenance must be performed during non-revenue hours, which limits the extent of work that can be completed in any given shift. In some cases, this may be limited to around 1.5 hours on the busiest sections of the network, such as at major yard or dispatch sites.

5.2 Streetcar Way

Streetcar Way is made up of the following sub-asset categories:

- **Mainline:** Refers to the primary track or route used by streetcars for regular services. It is the main track that connects different stops and serves as the primary path for the streetcar system. Mainlines are crucial components of streetcar networks, facilitating the movement of vehicle and passengers along designated routes.
- **Tangents:** Straight and level sections of the track, they are the portions without any curves or bends. Tangents are essential for smooth and efficient operation of streetcars, providing a straight path that allows for higher speeds and a more predictable track alignment. They are interspersed with curved sections to accommodate the layout of urban environment and provide a balance between straight stretches and curves in the overall track design.
- **Curves:** Sections of the track that deviates from a straight path and follow a curved or bending trajectory. Curves are designed to navigate around obstacles, follow the layout of city streets, or achieve specific urban planning objectives. Streetcar tracks incorporate curves to accommodate the geometry of the urban environment, while providing a smooth and controlled transition for the streetcar vehicles. The design of curves considers factors, such as vehicle speed, track alignment, and passenger comfort. Curves are essential elements in creating flexible and adaptable streetcar network that can navigate through various city landscapes and intersections.
- **Intersection:** Refers to point where two or more streetcar tracks cross or meet. This is a critical element in the layout of streetcar networks, allowing for the convergence or divergence of tracks to facilitate different routes and connections. Intersections are typically designed to enable smooth transitions between different tracks, allowing streetcars to change direction or continue along different paths. Design considerations for streetcar intersections include track alignment, signalling systems, and safety features to ensure efficient and safe movement of streetcars through these junctions.

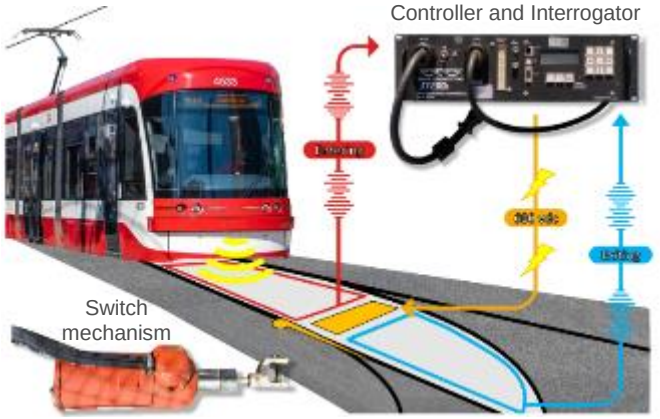


Figure 5-5: Streetcar intersection and switch mechanism.

- **Controller and interrogator:** A unit that receives a wireless signal from a streetcar transponder, containing information on the desired direction of travel at an intersection. The unit then sends a signal to a cylinder, which powers a switch mechanism, moving the track switch, as required. After this point the controller and interrogator locks itself to prevent any unwanted operation of the switch point. The unit will become unlocked after receiving a signal from the streetcar rear transponder once it has exited the intersection.
- **Switches,** or turnouts: Features that allow streetcars to switch tracks, for example at an intersection. They comprise of tracks, which overlap and can be adjusted to direct the streetcar onto the desired path through the use of a switch mechanism in communication with a controller and interrogator unit.

- **Loop:** Refers to a track arrangement that forms a closed or circular path. Loops are designed to allow streetcars to turn around and change direction without the need for complex manoeuvres. They are commonly used at the end of streetcar lines or in locations where a change in direction is required. Streetcar loops facilitate efficient and continuous service by eliminating the need for backing up or turning around on a single-track line.

Figure 5-6: Streetcar intersection.

The TTC has 387.9 kilometres of Streetcar Way.

Table 5-8: Streetcar way inventory and average age.

Type	Inventory	Average age (years)
Mainline	184 km	15
Tangent	184 km	15
Curve	Count: 35	15
Intersections	28.8 km	15
Loops	11.8 km	15

Data Source: TTC Operations & Infrastructure Group

The Streetcar Way Department collaborates with external stakeholders to co-ordinate maintenance, infrastructure sharing and safety measures regarding Streetcar Way assets, due to its proximity and interface with other municipal assets. This includes organizations, such as:

- Telecommunication organizations.
- Power distribution companies.
- Electrical installations and services.
- Transportation services.
- Traffic control and Safety departments.
- Municipal services, including water management and permits.
- Platform facilities and services department.
- Police services (for paid duty)
- Network configuration services.
- Overhead Department.

The Overhead, Communications and Wiring and Service departments within the TTC share responsibility for some maintenance activities of the Streetcar Way and contractors are used for management of some assets, such as the drainage and platforms.

5.2.1 Asset Condition

The condition of Streetcar Way is based on inspections. The approach to the inspections varies according to the type of streetcar track, and is described below:

- **Tangent Track**: These are conducted annually. The inspection includes a combination of walking and on-vehicle visual inspection of pavement condition, floor wear and corrugation. In addition, localized specialist ultrasonics measurement of the rail height are undertaken to calculate vertical wear.
- **Curve Track:** There is an inspection program in progress to capture the condition of curve tracks by measuring rail flangeway width and depth, vertical rail wear, infill and margin condition.
- **Special Trackwork**: These inspections are conducted annually, usually at night. They evaluate the condition of switch and mate horizontal/vertical wear, vertical/horizontal misalignments, switch machine/box assembly(throwing), drainage, switch drainage, corrugation, margin and infill condition, broken/loose joints (hammering of rail joints looking for “ping” or hollow sound), and cupped welds. There may be additional inspections to review the intersection condition for any upcoming planned work.
- **Car stops**: There is an annual inspection program in place to assess the head loss at the car stops. Eight car stops a year are replaced based on the resulting information, when triggering thresholds are met.
- **Real-time condition assessments:** Since 2022, the TTC has been making investments and collaborating with industry partners in the field of railway inspection technology and condition monitoring to develop the TTC’s ability to monitor asset condition and better forecast replacement needs for Streetcar Way. Real-time monitoring exercises (i.e. track vibration monitoring) and automated geometry line scans (by a third-party service provider) will be a greater part of the quantitative data that the TTC will take advantage of when evaluating renewal priority.

A summary of the condition scores for Streetcar Way linear assets is found below. The overall condition of the mainline Streetcar Way has been amalgamated using condition scores resulting from inspections. Condition scores for carhouses, yards and shops are based on engineering judgment and the overall age of the linear infrastructure within those facilities, aligned to the scoring framework in Appendix G: Condition Scoring Frameworks.

Table 5-9: TTC Streetcar Ways asset condition.

Category	Type	Condition score
Mainline	Tangents	2
	Curves	2-3
	Intersections and Loops	2
	Bridges	2
Carhouses, Yards and Shops	Leslie Barns Carhouse	1
	Harvey Shop	4
	Russell Carhouse	1
	Roncesvalles Carhouse	1

Data Source: TTC Operations & Infrastructure Group

5.2.2 Lifecycle Activities

The TTC is responsible for maintaining approximately 388 kilmometres of double-track length and 83 locations with special (curved) track. Table 5-10 summarizes the types of intervention required to maintain the track across its lifecycle.

Table 5-10: Summary of Streetcar Way lifecycle activities.

Asset class	**Streetcar Way Mainline**				
Lifecycle intervention	Acquisition	Maintenance	Overhaul*	Maintenance	Disposal**
Year (of life)	0	0 - 20	15-20	20 - 25	25+
Intervention detail	New rail infrastructure installation/ commissioning	Cleaning, inspection, and minor repairs	Inspection and major repairs/ construction	Cleaning, inspection, and minor repairs	Decommissioning or replacement of old rail infrastructure***
Frequency	One-off	Monthly throughout the year	One-off	Monthly throughout the years	One-off
Data Source: TTC Operations & Infrastructure Group					

**For the mainline located within the carhouse, yards and shops, the overhaul is undertaken after 35-40 years.*
***The lifecycle of the mainline located in the streetcar stops is significantly shorter, with disposal happening at 10 years.*
****Streetcar Way is only decommissioned if the route is taken out of service. In most cases, it is replaced to retain the service*.

5.2.2.1 Track construction

Lifecycle activities in this category include constructing and installing the relevant element of the Streetcar Way.

Activities range from constructing embedded rail sections and direct fixation of track in tunnel and open cut sections, to installing the bonds, track drains and switch drains. Construction activities are undertaken every 30 to 40 years. However, installations of new elements are also completed every time a broken element is discovered during an inspections. The Streetcar Way sections located in car stops are replaced more often as they wear more quickly than the mainline track.

5.2.2.2 Rehabilitation

The rehabilitation activities include a series of repairs and replacements that are triggered when defects are found during inspections. These can include:

- Replacing embedded rail(s).
- Direct fixation repairs to a rail section, which has been condemned.
- Open cut repairs.
- Grout pad replacement.
- Anchor bolt drilling.
- Fastener re-insulation.

5.2.2.3 Inspections and maintenance

A variety of inspection and maintenance activities are completed on the Streetcar Way assets. Additional information below provides examples of the types of inspection and maintenance that are undertaken at the intervals in Table 5-11.

Table 5-11: Detailed track inspections frequency.

Inspection	Frequency
Special trackwork – visual switch inspection	Daily
Special trackwork – electric switch inspection	Weekly
Mainline tangent track – visual mainline walking inspection	Once every two months
Special trackwork – switch inspection	Semi-annual
Walking Inspection (All track except for yards)	Annual
Carstop inspection	Annual
Yard and Carhouse Track Inspection	Annual
Tangent track visual inspection	Annual
Tangent track NDT inspection	Once every 18 months

Additionally, newly installed manganese castings subjected to rail traffic are inspected for metal flow during the work hardening process at intervals of one month, three months and six months. Once the manganese work hardening inspections are concluded and all required grinding completed, manganese casting shall be inspected annually.

Switches are inspected on a seven-day cycle. All switches are serviced twice as a minimum within this seven-day cycle, with certification at 12 months, 24 months or 48 months based on the switch type, location and frequency of use.

5.2.2.4 Automated condition inspections

Streetcar Infrastructure has undertaken pilots to collect data in an automated way to provide real-time condition assessments, using artificial intelligence (AI). Streetcar Infrastructure has also introduced system audits to highlight data quality issues in Maximo.

5.2.3 Costs

The ‘Upholding the State of Good Repair’ portfolio includes $679.0 million to be spent on streetcar surface track between 2024 and 2038, of which $402.7 million is currently funded.

Approved funding for lifecycle costs of the streetcar way are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC’s 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to the streetcar way.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC’s 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

5.2.4 Risks

1. **Aging rail infrastructure** poses several risks, including increased maintenance needs, higher likelihood of failures, and potential safety concerns. Wear and tear over time can lead to structural issues, compromising the reliability and efficiency of rail system. Regular inspections and timely upgrades need to be undertaken to mitigate these risks and ensure the safety of both passengers and rail vehicle.
2. **Reduction in asset life for tangent tracks:** Based on historical trends and operating experience, the performance of modern-day tangent track is realizing (on average) a 20-year lifecycle against an expected useful life of 25 years. The reduction in asset life can likely be attributed to a number of changing variables and demands placed on the infrastructure system, such as a 24/7 schedule, increased passenger loads and increased loading from non-streetcar vehicles where routes are shared with other heavy traffic. This may result in a need for additional funding for track to compensate for the reduced life expectancy.
3. **Lack of approved funding for tangent track assets:** An additional $276 million is required in the 15-Year CIP. Results of an insufficient renewal rate could include restricted speed zones/slow orders, weekend/multi-day service diversions or closures, and emergency service interruptions. Even when attempting to utilize more operating resources within preventive or corrective maintenance programs, the TTC may find it necessary to plan and prioritize the renewal of some rail corridors at the expense of others. While additional funding for track rehabilitation and replacement work is the most critical need, it should be noted that even when funding is available, the TTC is challenged to undertake the work as planned given the interdependencies track work has with other right-of-way projects in the city.
4. **Lack of manufacturers for manganese casting:** The specialist nature of Streetcar Way assets can result in risks related to the supply of materials. In the case of manganese casting used for Streetcar Way, the TTC risks a monopoly from one supplier, which in turn risks service in the event that this supplier cannot provide the required materials.
5. **Right of way access**: There is a significant risk that right-of-way access problems will prevent our teams from delivering the required work to keep Streetcar Way and overhead power assets in a state of good repair. This is because streetcar assets are located in shared City space, and to deliver most works requires extensive forward planning with the City of Toronto, its inhabitants, and other services. While we have good relationships and work continuously with these third parties, there remains a risk that the TTC will not be able to obtain sufficient access to deliver all the required works.

5.3 Overhead Power

The overhead wiring is divided into the following asset categories:

- **Overhead/traction power feeder** is the system that supplies electrical power to the streetcar through overhead wires or a traction power system. It is responsible for delivering the necessary electrical energy to operate the streetcar. The feeder system often includes power supply lines, substations and other components to ensure a reliable power supply for the streetcar's operation.
- **Overhead Contact System (OCS)** is the system of wires and components installed above the tracks to supply electrical power to the streetcars. The system includes catenary wires, which are suspended from poles or other support structures, and the necessary hardware to maintain a continuous electrical connection between the streetcar and the power source. Streetcars use a pantograph or trolley pole to make contact with the overhead wires, allowing them to draw the electrical energy needed for propulsion. The OCS is a fundamental part of the streetcar network.
- **Poles** or overhead wiring poles, also known as catenary poles, are structures erected along streetcar tracks to support the overhead wires that provide electrical power to the streetcars. These poles typically consist of

a vertical mast attached to a base, and an arm extending horizontally over the tracks. The overhead wires, also called catenary wires, are suspended from these arms.

The design of these poles ensure that the catenary wires are positioned at the correct height and alignment for the streetcar's pantograph or trolley pole to make contact and draw power. The poles are spaced along the tracks to maintain consistent power distribution.

Materials used for these poles vary, but commonly include steel or concrete for durability. The overall goal is to create a reliable and stable support system for the overhead wires, enabling efficient and safe operation of the streetcar network.

- **Positive feeder distribution** refers to the distribution of electrical power to the positive side of the streetcar's traction system. The power is supplied through an OCS, and the positive feeder distribution ensures that the correct voltage and current are delivered to the streetcar's positive power bus.
- **Negative feeder distribution** refers to the distribution of electrical power to the negative side of the streetcar's traction system. The power is supplied through an OCS, and the negative feeder distribution ensures that the correct voltage and current are delivered to the streetcar's negative power bus.

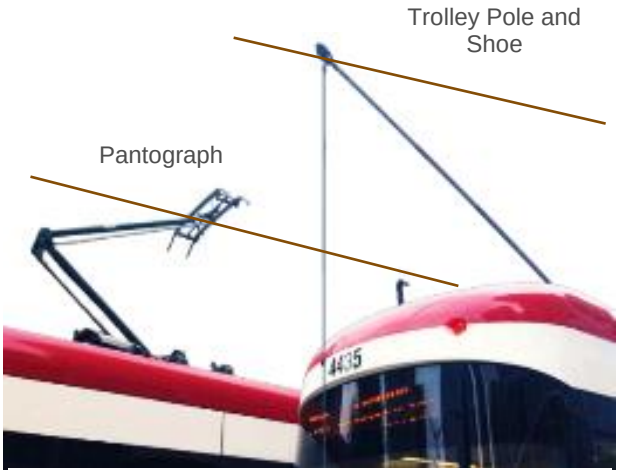


Figure 5-7: Example of both types of OCS: Pantograph and Trolley Pole.

- **Duct banks** are underground structures or conduit systems designed to house and protect electrical cables and other utility lines. They are a method of organizing and routing various cables, including those for power distribution, communication and other purposes, in a compact and organized manner. The duct banks for streetcar infrastructure may contain cables related to the traction power system, signalling, communication, or other utilities needed for the operation and maintenance of the streetcar system. The use of duct banks helps to protect the cables from environmental elements and physical damage, while facilitating organized maintenance and potential future upgrades to the underground infrastructure.
- **Cable chambers** are an underground enclosure that houses cables and provides access for maintenance. Essentially, the chamber is a space, while the duct bank is a system of conduits within that space.
- **Mainline tangent** is the straight and level section of the OCS or catenary wires.
- **Intersection** is the point where two or more streetcar overhead wires cross or intersect.
- **Loop** refers to a track arrangement that forms a closed or circular path. Loops are designed to allow streetcars to turn around and change direction without the need for complex manoeuvres. They are commonly used at the end of streetcar lines or in locations where a change in direction is required. Streetcar loops facilitate efficient and continuous service by eliminating the need for backing up or turning around on a single-track line.

Table 5-12: Overhead Lines inventory and average age.

Type	Length (km)	Average age (years)
Overhead/ traction power feeder	454	55
Overhead Contact System (OCS)	368 (double track)	8.5
Positive feeder distribution	403	38

Negative feeder distribution	51	48
Duct bank		80
Mainline tangent	184	10
Intersections and Loops	40.6	8

Although the following two assets sit within the linear asset class, they support the overhead power lines:

Table 5-13: Other assets that support the overhead power lines.

Type	Count	Average age (years)
Poles	5,120	22
Cable chambers	250	45

Streetcar Overhead co-ordinate with the departments and third parties listed below to provide maintenance, infrastructure sharing and safety measures:

- Power distribution companies.
- Police services cameras.
- Telecommunications department.
- Electrical installations/wiring and cable services including Street Lights and Traffic Lights.
- Municipal permits for Light Standards and Traffic Signal Heads.
- Various guy wires and poles contractors.

Figure 5-8: Traditional 90 deg. fixed X-over.

5.3.1 Asset Condition

A summary of the condition scores for overhead assets is in Table 5-14, aligned to the scoring framework in Appendix G: Condition Scoring Frameworks.

Table 5-14: Asset Condition Ratings.

Category	Type	Condition score
Feeder	Positive Feeder Distribution	3
	Negative Feeder Distribution	4
	Duct Bank	3
OCS	Tangent	2
	Intersections and loops	2
	Underpasses and Tunnels	1
	Yards	1
Overhead Power Line	Poles	3
	Cable Chambers	4

The TTC has piloted automated condition inspection for the entire overhead/traction power network, which will inform future inspection strategies. The automated inspection technology will be used to create an annual snapshot of asset condition. This will be combined with real-time monitoring technology to develop the understanding of asset condition and its deterioration rate. This holistic approach will allow for a more accurate evaluation of the asset maintenance frequency as well as a better estimation of when an asset will reach its end of life.

5.3.2 Lifecycle activities

Table 5-15: Summary of Overhead Power lifecycle activities.

Asset class	**Overhead/Traction Power**				
Lifecycle intervention	Construction	Routine and corrective maintenance.	Rehabilitation	Routine and corrective maintenance.	Re-construction
Year (of life)	0	0-10	10	10 to 20	20+
Intervention detail	New OCS infrastructure install/ commissioning.	Cleaning, inspection and minor repairs.	Wire replacement and major repairs.	Cleaning, inspection and minor repairs.	Decommissioning of old OCS infrastructure (full replacement).
Frequency	One-off	Every year	One-off	Every year	One-off

Table 5-16: Summary of pole lifecycle activities.

Asset class	**Poles**		
Lifecycle intervention	Acquisition	Maintenance	Disposal
Year (of life)	0	0-40	35-40
Intervention detail	New install.	Minor Inspections/Repairs.	Total Replacement.
Frequency	One-off	Every 2 years	One-off

Table 5-17: Summary of cable chamber lifecycle activities.

Asset class	**Cable Chambers**				
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Maintenance	Disposal
Year (of life)	0	0-30	30	30-50	50
Intervention detail	New install.	Minor inspections/Repairs.	Major Repair.	Minor inspections/Repairs.	Total Replacement.
Frequency	One-off	Every 2 years	One-off	Every 2 years	One-off

5.3.2.1 Inspections and routine maintenance

A variety of inspection and maintenance activities are completed on the overhead power assets. Additional information below provides examples of the types of inspection and maintenance that are undertaken at the intervals in Table 5-15, Table 5-16, and Table 5-17.

Monthly inspections: Ground-level visual inspections performed by a patrolled walk or a vehicle.

1. **Semi-annual structural inspections:** Track access may be required to perform these inspections, detailed visual inspections.
2. **Bi-annual inspection and maintenance:** Extensive inspections of the OCS Structures take place on a bi-annual basis and are be carried out by suitably trained and experienced maintenance personnel. These inspections check for consistency and reliability of the OCS Structures.
3. **Automated condition inspections:** The TTC has piloted an automated condition inspection for the entire network to inform future inspection strategies. In general, the automated inspection technology will be used to create a snapshot of asset condition on a yearly basis. It will combine with real-time monitoring technology to form an understanding of the absolute condition of the asset, and also the rate at which it is deteriorating over time. This holistic approach will allow for a more accurate evaluation of the asset maintenance frequency as well as a better estimation of when an asset will reach its end of life.

For each OCS item that is within this inspection, the Inspector provides an assessment of the item based on a rating scale of 1-5, with 1 being “like new” and 5 being “needing immediate repair or replacement”.

The crew takes pictures of each OCS structure to visualise the change in the structures over time, as well as pictures of all defects that result in a rating of 3 or higher.

There are four types of inspections:

- Structural inspections and maintenance.
- Component inspections and maintenance.
- STP inspections and maintenance.
- Bridge and tunnel inspections and maintenance.

Figure 5-9: Trolley wire wear inspection.

5.3.2.2 Corrective maintenance

Even with regular maintenance of the OCS, malfunctions cannot always be prevented, but most of the faults are due to external causes. These causes could include damage to contact and support wires due to excessive vehicle loads, crane equipment, damage to poles by road vehicles, or weather/natural events.

- Section insulators are used to separate the OCS into multiple electrical sections, while maintaining a continuous path for the pantograph to operate on. The testing and occasional replacement of parts on a section insulator is part of the maintenance cycle.
- As the OCS is designed for a maximum contact wire wear of 30%, a planning and removal procedure is implemented when the average contact wire wear of a section is more than 20%.
- A good current collecting assembly is needed to minimize long-term contact wire wear. Arcing is usually caused by a poor interface between the current collector and contact wire, which causes excessive wear. Poor current collection is caused by either improper contact wire positioning or the poor condition of pantograph carbon strips. Therefore, both must be kept in good condition. Bad current collectors must be identified as soon as possible, and remedial actions applied immediately to prevent additional damage.

5.3.2.3 Lifecycle maintenance and replacement

The life of the OCS is typically 30 years, but due to the complex nature of the system, there are certain parts that will degrade more quickly. The table below provides the approximate lifespan of basic OCS components.

Table 5-18: Lifespan of PCS components.

OCS Component	Approximate Lifespan (years)
Section insulators (mainline)	5
OCS small parts	10
Synthetic insulatoros	15
Contact wire (mainline)	10
Contact wire (yards)	15-20
Conductor rail	10
Span wire	20-30
STP Cable (OH)	30
Spring tensioner assemblies	30
OCS Moveable fittings	30
OCS poles and foundations	30+

**if provided, use manufacturer's recommended lifespan.*

Transition from pole to pantograph

The streetcar network is currently transitioning from pole operation to pantograph operation. Both the pantograph and the trolley and pole provide the means of connecting the streetcar vehicle to the overhead power supply (see Figure 5-7 and Figure 5-8 for images). Pantographs allow a vehicle to maintain more consistent contact with the power supply at different speeds and directions. Figure 5-10 below shows the state of the transition to pantograph operation form the previous trolley and pole. The fact that this transition is mid-way through at the time of writing presents some risk, which is explained in the Risk section below.

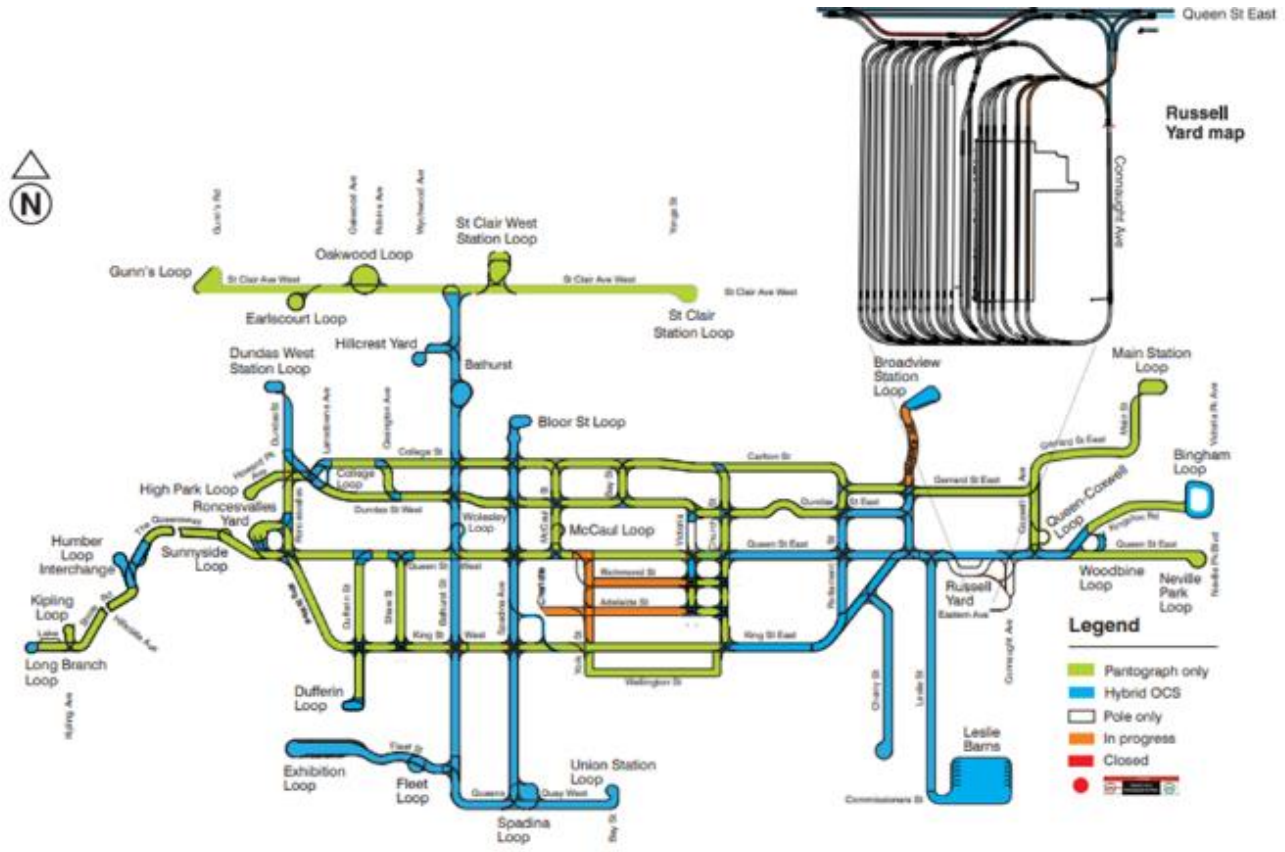


Figure 5-10: Network map of the transitions of Pole operation to Pantograph operation.

5.3.3 Costs

The 'Supporting a Larger Streetcar Portfolio' includes $179.3 million capital funding requirements to be spent on upgrading overhead power, of which, $94.9 million is currently funded. This program is dedicated to the complete replacement of the pantograph Overhead Contact System (OCS) as a necessary action due to critical assets reaching the end of their lifespan. The primary objective is to enhance system reliability by minimizing pantograph damage and reducing service disruptions, resulting in a safer and more dependable streetcar service. This is in conjunction with the 'Overhead Pole Replacement', and 'Replace Surface Traction Power Distribution' projects, forming a comprehensive effort to restore and uphold the entire streetcar overhead system to a state of good repair.

There is an additional $60.4 million budgeted to upholding the state of good repair of traction power between 2024 and 2038, with additional funding required of $44.8 million over the same period.

Approved funding for lifecycle costs of overhead power assets are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to overhead power assets.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-*

2033 Capital Budget and Plan. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

5.3.4 Risks

The risks below are those that would affect the delivery of agreed programs of work, funded by the CIP/ Operational budgets. They do not include the operational risks that are managed on a day-to-day basis. Please note that the Auditor General completed an audit to strengthen the maintenance and repair program for overhead assets in 2023. Some of the recommendations are referenced in the risk section below and form part of the asset management improvement program.

1) **Capital budget shortfall**: Overhead power assets are essential to the safe and reliable delivery of the TTC's streetcar service. In the 2024 budget process, efforts were made to accelerate and reprioritize funding for this program. There remains an unfunded amount of $16 million in the 2024-2033 Capital Budget and Plan, but the shortfall does not become apparent until 2031. If the planned funds are not ultimately allocated to the streetcar service, these budget constraints would affect the delivery of the following programs:

Table 5-19: Funding programs affected by budget constraints.

Program	Impact of underfunding
Alternate traction power feeds and switching for streetcar lines	Risk of more frequent and prolonged delays. When an issue arises with the streetcar power feeds, alternate bus service may be necessary, affecting all streetcar lines. If delivered, this work would minimize the extent of necessary diversions and enable unaffected operation for approximately 85% of service and alternative routes.
Maintaining state of good repair of diode section insulators and surface traction power cables	Several additional interventions, such as route closures or diversions, would be required if the budget is not allocated. This would result in indirect costs, including revenue loss and inconvenience to customers. Neglecting the maintenance of the section isolators and traction power cables would compromise worker safety and create risks of electrocution to the public.
Enhancing and isolating the negative return systems of streetcar traction power	Without additional funding for effective control measures, underground metallic infrastructure will deteriorate, leading to shorter service life and potential damage to neighbouring facilities. Public and worker safety is also at risk.
Complete replacement of the pantograph OCS	The delay in completing the full pantograph conversion will extend the project timeline, which results in: • Persistent pantograph carbon/wire wear and auto drop incidents, resulting in higher corrective maintenance costs. • Costs of diversion will escalate in the later years, affecting the overall budget and project expenses. • Risks to the pantograph and its hardware, leading to higher operating costs. • Difficulty in procuring legacy parts for pole operation. This may result in longer and costlier intersection downtime and higher materials costs. • Multi-day closures may necessitate increased utilization of corrective maintenance programs and emergency interventions.
Installation of new poles to support the streetcar electrical overhead system	Without a program to replace overhead poles, there are risks of structural collapse resulting in service disruption and impacts to public and worker

	safety. Some of the existing 5,480 poles have surpassed the 60-year mark and urgently require replacement.
Maintaining 250 TTC-owned cable chambers and 50 kilometres of duct bank	In the absence of adequate funding, there is a risk of service interruptions, a risk of road collapse, and an inability to comply with the mandatory requirements and standards. Some chambers have surpassed their 50-year lifespan and require an immediate rebuild to ensure the safety and reliability of the electrical system.
Managing deteriorated electrical feeds, lighting, and equipment	Underfunding will result in safety risks for workers and the public, impacts productivity, efficiency, compliance risks, environmental impacts and risks to equipment longevity. Loop and yard lighting as well as fixtures in service and convenience rooms have deteriorated beyond repair and they do not conform to the current specifications and standards.
Asset data management	Failing to fund ongoing work to deliver the transition risks delay in recording, documenting, and mapping our assets. This is essential for analysis, planned maintenance, operational tasks (including those involving co-ordination with third parties) and emergency response. The effective management and use of data was an area for improvement identified by the Auditor General.
Failing track switch controllers	Although rare, issues with the switches could lead to streetcar derailment or collisions. Without funding beyond 2032, route closures or diversions may be necessary. These interventions would result in revenue loss and customer inconvenience. Neglecting the replacement of Streetcar Track Switches and Controllers compromises worker safety, and the risk of accidents for the public also increases.

2) **Operating budget risk**: To preserve the assets until their full lifespan, provide consistent service, and meet the requirements outlined in the recent report completed by the Auditor General (AG), it is crucial to implement timely interventions. However, there exists a budgetary risk – the current operating budgets may fall short of meeting these objectives:
    a) Insufficient funding for operational expenses may cause service interruptions, reduced maintenance, and delayed issue resolution. Consequently, reliability may decrease, breakdowns could occur more frequently, and safety risks may arise, ultimately affecting the overall efficiency of the commuter system.
    b) The team is currently operating with a shortage of 19 positions, which poses a significant threat to the service levels of the Streetcar Overhead Department. The strain on personnel resources could result in a decline in the quality and efficiency of operations, potentially affecting the department's ability to meet service demands and maintain optimal performance. An underfunded operating budget could lead to service disruptions, reduced maintenance, and slower response time to issues. This might result in decreased reliability, more frequent breakdowns, and potential safety concerns, negatively impacting the overall service level for commuters and affecting the system's efficiency. Addressing this staffing shortage and budgetary gap is imperative to ensure the continued smooth operation of the Overhead Department and will help to address the Auditor General's recent findings.
3) **Right of way access**: There is a significant risk that right of way access problems will prevent the TTC from delivering the required work to keep Streetcar Way and overhead power assets in a state of good repair. This is because streetcar assets are located in shared City space, and to deliver most works requires extensive forward planning with the City of Toronto, its inhabitants, and other services. While the TTC have

good relationships and work continuously with these third parties, there remains a risk that the TTC will not be able to obtain sufficient access to deliver all the required works.

4) **Extreme weather events**: Severe weather conditions, such as strong winds, heavy snow, or lightning, can damage overhead wires. Ice accumulation can add weight and stress, potentially causing wires to sag or break. As longer winters and hotter summers create additional risk, the window for maintenance becomes smaller and means that essential works cannot be carried out without safety risks to workers. This leads to essential preventative maintenance work not being carried out.
5) **Changing nature of the asset**: Various asset types, such as pantographs and trolley poles, consist of numerous complex and inter-related components. While transitioning from trolley and pole to pantograph, the overhead asset shifts to a hybrid model, the condition profile of which is not as well-understood. This makes interventions to maintain condition and service harder to plan. This hybrid scenario also impacts both personnel and parts. The longer the hybrid mode is retained, the harder it is to obtain the parts for the older assets. This can also lead to supply chain issues driving up costs as suppliers raise prices due to scarcity.
6) **Power surges and electrical issues**: Voltage spikes or power surges caused by external grid management issues, or other electrical issues can damage the overhead wire system. Proper grounding, surge protection, and regular inspections are essential to prevent such failures.
7) **Workforce availability and expertise**: Employee turnover and retaining experienced staff can significantly impact an organization's performance. There is a risk of shortage of workers, affecting critical roles and organization. Given the highly competitive job market, the inability to attract and retain skilled talent poses a significant risk. This also affects our ability to maintain sufficient training for staff and monitoring activities for assurance. The AG recently reported that a lack of formalized processes and procedures in the department results in variability in the performance and documentation of preventative inspections. An adequate workforce allows time to be spent on improving asset management maturity in this area.
8) **Equipment:** The tools and vehicles used for work on overhead lines are custom-made, have a long lead time to procure and are expensive. The risk of these tools not being readily available can risk the delivery of maintenance and programmed work.
9) **Alignment of AM plans for efficient delivery**: Ensuring alignment between Asset Management Plans (AMPs) and stakeholders is crucial for strategic planning. When there is a lack of alignment with key stakeholders, it can disrupt the delivery of work. For instance, assets, such as cable chambers and duct banks are shared with Toronto Hydro, which introduces the risk of misalignment in End of Life (EOL) timings. It is essential that all utilities within the right of way should align with the AMP to ensure effectiveness.

6. Facilities

The TTC owns and maintains multiple facilities, including offices, maintenance buildings and yards, stations, training facilities, etc. The assets included within this section have been grouped as follows:

- **Building assets:** Assets that make up the building itself, including elements, such as building fabric, benches, dispensers, doors, signage, stairs, track level equipment, etc.
- **Building services:** Assets required for the day-to-day functioning of the building, including storm water systems, etc.
- **Elevating devices:** Includes all the elevators and escalators.
- **Tunnel equipment:** Assets required to maintain the tunnels for the vehicle fleet, including portal doors, dampers, fans, pumps, etc.
- **Ancillary assets:** These are other assets that can be found on or around the maintenance building, including bollards, curbs/sidewalks/walkways, gates, railing/fencing, signage, etc.
- **On-grade paving:** Asphalt, concrete and gravel.

6.1 Maintenance and Administrative Buildings

The TTC require numerous facilities to effectively store, maintain and operate its vehicle fleet. The maintenance facilities are at the core TTC assets offering coverage for the entire fleet. To support the procurement, maintenance, and servicing of vehicles, the TTC has multiple garages, shops, carhouses and yards across the city providing maintenance and repairs. These facilities operate 24 hours a day, seven days a week, dispatching and returning vehicles for inspections, preventative and corrective maintenance programs as well as to be fueled and cleaned for service.

- A garage is a building specifically designed to house and maintain buses and Wheel-Trans vehicles. It serves as a secure storage facility for vehicles when they are not in use.
- A carhouse is a building specifically designed to house and maintain streetcars and subway vehicles. It serves as a secure storage facility for vehicles when they are not in use.
- A yard is an outdoor area typically adjacent to the tracks or the carhouse/shop, used for the storage of streetcars and subway vehicles when they are not in service.
- A shop is a facility equipped for the maintenance, overhaul repairs and rebuild of vehicle components, such as HVAC, traction convertor, APS unit, etc.
- A substation is a part of an electrical transmission and distribution system. Substations transform voltage from high to low allowing the flow of electric power required to move the fleet and power all facilities.

Table 6-1: Number of maintenance facilities by mode and their age.

System	Building type	Quantity	Average age (years)
Bus maintenance	Garages	9	38
	Shops	1	37
Streetcars maintenance	Carhouses	3	78
Subway maintenance	Carhouses	4	54
	Yards	5	Not available
	Substations	58	Not available

Data Source: Transportation & Vehicles Group

Note that the average age is calculated from the date the facility was first built or opened. However, it does not represent the average age of all the assets contained within it.

The total replacement value of maintenance facilities is approximately $2.9 billion. This figure is inclusive of maintenance facility 'contents' for insurance reporting purposes.

6.1.1 Bus maintenance

Bus maintenance facilities include garages and shops located at various locations across the bus network, as shown in Figure 6-1. Equipment contained within these facilities typically consists of:

- Eight-metre and 12-metre hoists
- Mobile hoists
- Jack stands
- Wash racks
- Fuelling stations
- Inspection pit stations
- Steam-cleaning rooms
- Eurovac systems
- Bus-only bridge
- Above ground fuel tanks and associated piping
- eBus charging stations
- Overhead gantry and jib cranes

Duncan Shop, located within the Hillcrest Complex is the bus heavy maintenance facility. It is responsible for providing overhauled components, performing major power plant work and brake overhauls to meet the needs of the city garages. This facility also maintains a fleet of specialized non-revenue support vehicles and miscellaneous equipment, which are used by all TTC departments to manage the overall transit system infrastructure.

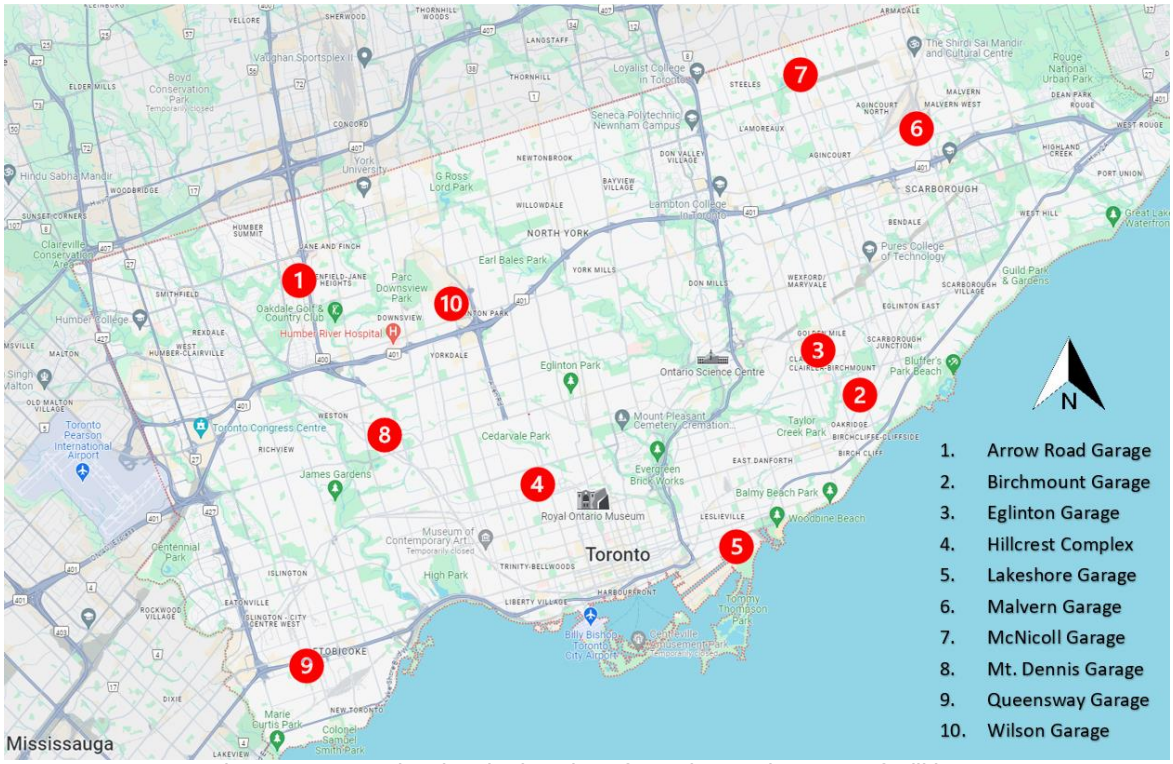


Figure 6-1: Map showing the location of TTC bus maintenance facilities.

6.1.2 Streetcar maintenance

Streetcar storage and maintenance is underaken at three carhouses located as shown in Figure 6-2. Carhouses, such as Leslie Barns, are typically equipped with a pit area to work underneath the streetcar, mezzanine access to work on the roof of the streetcar, a wash bay for exterior wash, sanding stations for refilling the streetcar sanding system, and hydraulic hoists to raise the entire streetcar for additional special repair work. Other critical equipment includes overhead and gantry jib cranes and wheel-turn lathes.

In addition to the regular maintenance, the streetcar carhouses are the places where vehicles are filled with sand, carbon inserts are replaced, and streetcars are cleaned and prepared for service on a daily basis.

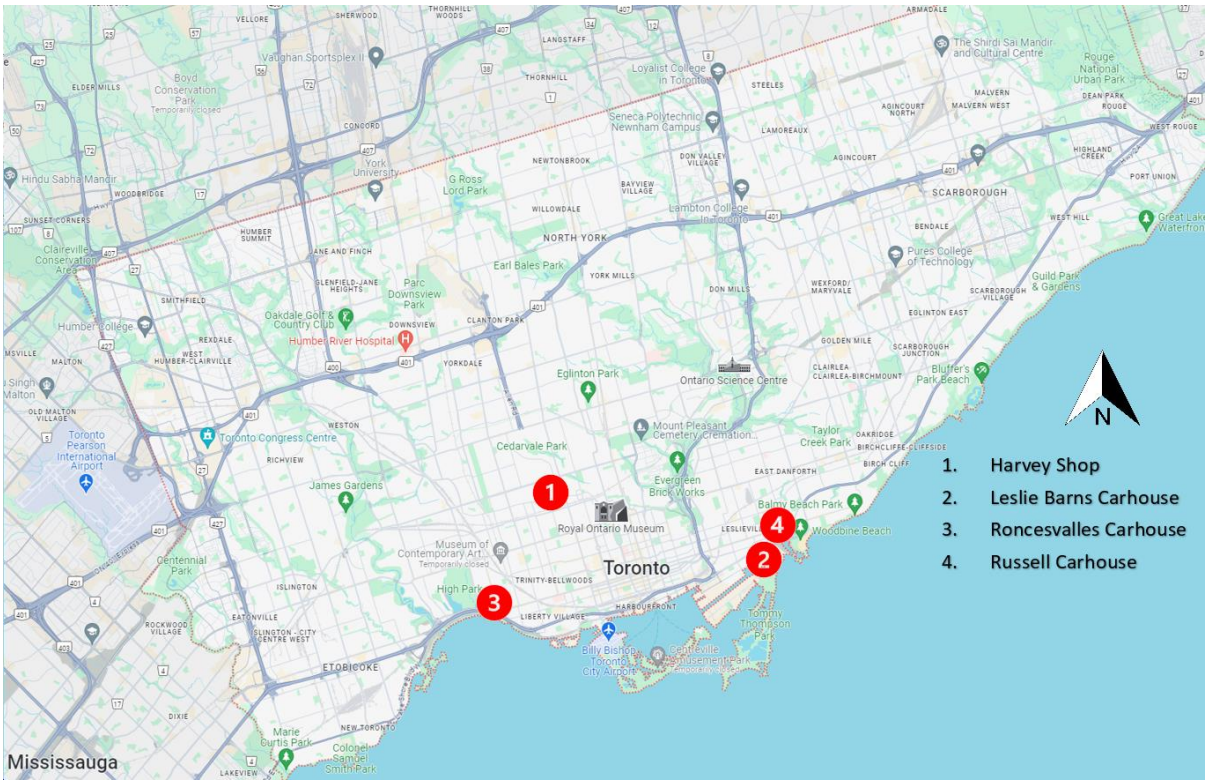


Figure 6-2: Map showing the location of TTC streetcar maintenance facilities.

6.1.3 Rail maintenance

Rail maintenance facilities include carhouses, barns, interior and exterior storage tracks and power substations as well as one component and heavy repair shop.

The Greenwood Overhaul and Repair Shop is responsible for major repair and overhaul work on all aspects of subway vehicles. The shop also manufactures and overhauls a variety of components for specialized inventory required for other departments at their request. It is the only location that accepts the delivery of new cars by rail.

Critical equipment within rail maintenance carhouses includes:

- Wheel-turn lathes
- In-Ground hoists
- Mobile hoists
- Jack stands
- Overhead gantry and jib cranes
- Under car wash pits

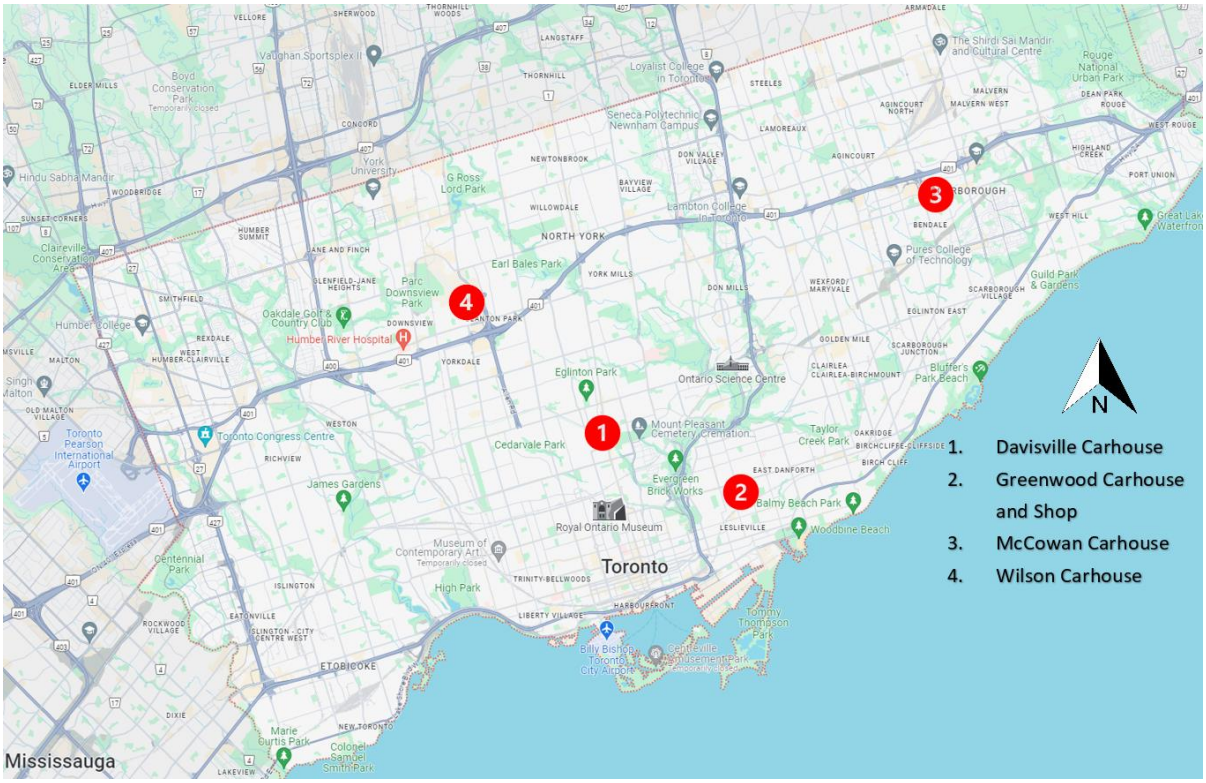


Figure 6-3: Map showing the location of TTC subway maintenance facilities.

6.2 Passenger Facilities

6.2.1 Subway stations

A subway station is the structure that primarily facilitates passenger movement. The TTC subway has both surface and subsurface stations along its route. Stations consist of at least one track-side platform and a station building providing such services as ticket sales and waiting rooms. Subsurface stations are either built as a single station box or through one or more shafts with tunnel platforms linking into the shaft. All stations incorporate drainage, lighting and other mechanical, electrical, public health and architectural assets.

Figure 6-4: TTC Subway Station.

The subway network is comprised of 75 stations across the four lines, with the majority of the stations being fully accessible with features such as ramps, elevators and spaces for customers with disabilities. Due to the closure of Line 3 in 2023, there are a total of 70 active stations. The stations also act as spaces for the community, with some central stations receiving some of the highest footfall across all of Canada.

Table 6-2: Number of subway stations by line and their average age.

Line	No. of stations	Average age (years)
Line 1 (Yonge-University)	38	69
Line 2 (Bloor-Danforth)	31	57
Line 3	5	39
Line 4 (Sheppard)	6	21

Data Source: TTC Transportation & Vehicles Group

Note that the average age is calculated from the date the facility was first built or opened. However, it does not represent the average age of all the assets contained within it.

The count of stations includes interchanges, which serve multiple lines. There are 70 distinct operational stations.

In addition to the stations, the TTC owns and maintains five passenger pick-up and drop-off points (PPUDO), 72 third-party entrance connections, and 32 emergency exits.

6.2.2 Elevating devices

There three types of elevating devices in the TTC network: passenger elevators, freight elevators, and escalators.

- Elevators transport people or goods between floors of a building and are generally powered by electric motors that drive traction cables or counterweight systems like a hoist. Elevators are maintained by a contracting company.
- Escalators are conveyor transport devices carrying people between floors of a building. They consist of a motor-driven chain of individual, linked steps that move up or down on tracks, allowing the step treads to remain horizontal. Escalators are maintained internally by the TTC Plant Maintenance Department.

Table 6-3: Number of elevating devices and their average age.

Device	Quantity	Average age (years)
Passenger elevators	157	15
Freight elevators	7	12
Escalators	329	21

Data Source(s): TTC Operations & Infrastructure Group

6.2.3 Bus and streetcar stops

With 160 bus routes and 11 streetcar routes running across the city, the TTC is responsible for operating and maintaining multiple bus coach terminals as well as bus and streetcar stops serving communities across Toronto. Bus and streetcar stops are the designated points where vehicless make scheduled stops to pick up or drop off passengers. These stops are strategically located at key points along the routes, such as major intersections, commercial areas, or other points of interest. Typically, these stops are equipped with platforms, shelters, and other amenities to enhance the comfort and safety of passengers using the bus and streetcar

services. Nearly half of all bus and streetcar stop facilities have a shelter, and only a fifth of facilities are not accessible.

Table 6-4: Number of bus/streetcar stops, terminals and shelters and their average age.

Type	Quantity	Average age
Bus coach terminals	2	Not available
Wheel-Trans hubs	9	5
Bus stops/shelters	8,889	Not available
Streetcar stops/shelters	620	Not available
Shelters	9	Not available
Data Source: TTC Transportation & Vehicles Group		

6.3 Other Facilities

The TTC corporate and professional services operate from multiple sites across the city. These locations are important in the planning and operating of transport network, and as such are important assets within the TTC's portfolio.

Table 6-5: Number of corporate and professional services facilities and their average age.

Building Type	Quantity	Average age (years)
Office Space	440,000 sq. ft.	Not available
Industrial Space	17.4 million sq. ft.	Not available
Emergency service buildings	17	Not available
Operators Convenience	8	Not available
Waiting Rooms (with Concessions)	4	Not available
Parking lots	Not available	Not available
Data Source: TTC Engineering, Construction & Expansion Group		

6.4 Facilities Data

6.4.1 Asset Condition

There is no condition data available for facilities and it has not been possible to assign an overall condition score. Facilities generally comprise a number of separate assets and while the assets are inspected, their condition is not formally recorded against a common scale.

6.4.2 Lifecycle Activities

The following subsections will provide some detailed examples of the type of lifecycle activities that are undertaken in the different assets located within the TTC maintenance facilities.

6.4.2.1 Building assets

Table 6-6: Example of building assets lifecycle activities.

Asset class	Building fabric			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	0-25	15	25+
Intervention detail	Installations or renovations of ceilings, walls and floor finishes based on factors, such as safety, aesthetics and infrastructure upgrades.	Annual inspections are conducted. Repairs are carried out to address issues, such as cracks, peeling paint, or damage due to environment factors. Cleaning to remove dust, dirt or stains.	Undergo renovations or refurbishments due to wear and tear, including removal and repainting, replacing worn-out sections, or applying protective coatings.	Disposal of old or damaged materials, when e.g. ceilings reach the end of their life cycle or become outdated. Complete replacement due to aging or damage.
Frequency	One-off	Annual / Monthly	One-off	One-off
Data source: TTC Operations & Infrastructure Group				

6.4.2.2 Building equipment

Table 6-7: Example of building equipment lifecycle activities.

Asset class	**Dust collecting systems**			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	1-30	6, 12, 18 and 24	30+
Intervention detail	Hand over from Engineering, Construction and Expansion (EC&E).	Follow manufacturer manual/job plan for preventative maintenance, overhaul and repairs as well as all applicable legislative codes, requirements and TTC policies and procedures.	Follow manufacturer manual/job plan for preventative maintenance, overhaul and repairs as well as all applicable legislative codes, requirements and TTC policies and procedures.	Normally included as part of end-of-life replacement under capital program.
Frequency	One time	Quarterly	6 Years (4 times)	One-off
Data source: TTC Operations & Infrastructure Group				

6.4.2.3 Tunnel equipment

Table 6-8: Example of tunnel equipment lifecycle activities.

Asset class	**Dampers**			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	1-20	N/A	20+
Intervention detail	Hand over from EC&E	Follow manufacturer manual/job plan for preventative maintenance, overhaul and repairs as well as all applicable legislative codes, requirements and TTC policies and procedures.	N/A	Normally included as part of end-of-life replacement under capital program.
Frequency	One time	Annually	N/A	One time
Data source: TTC Operations & Infrastructure Group				

6.4.2.4 Elevating devices

Table 6-9: Example of elevating devices lifecycle activities.

Asset class	**Escalators**		
Lifecycle intervention	Acquisition	Maintenance	Overhaul
Year (of life)	1	1-25	25
Intervention detail	Newly installed escalator.	Routine maintenance as defined by legislation.	Replacement or rebuild of motors, gearboxes, electrical controller, panels, decking, steps, step chain, tracks and wiring.
Frequency	One-off	Monthly	One-off
Data source: TTC Operations & Infrastructure Group			

6.4.2.5 Ancillary assets

Table 6-10: Example of ancillary assets lifecycle activities.

Asset class	**Bike Storage/Racks**			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	1 - 20	20	20+
Intervention detail	The TTC identifies locations within its premises suitable for bike repair stations based on cyclist traffic, accessibility, and convenience.	Old bikes are collected and removed from bike storage to uplift the environment. Loose or damaged parts are corrected ensuring the safety and functionality. Removal of graffiti by painting.	Replacing worn out components, repainting, or reinforcing racks to maintain structural integrity. Improving the design for better space utilization of incorporating technology for enhancing usability.	When bike storage racks reach the end of their useful life or become obsolete. (Records indicate no bike storage locations have been disposed).
Frequency	One-off	Monthly	One-off	One-off
Data source: TTC Operations & Infrastructure Group				

6.4.2.6 On-grade paving

Table 6-11: Example of on-grade paving lifecycle activities.

Asset class	**Pavements**		
Lifecycle intervention	Acquisition	Maintenance	Disposal
Year (of life)	0	5-20 Years	25-30 Years
Intervention detail	Construction and Commissioning through EC&E.	Patch repair, minor and major repairs, as requested.	End of life decommissioning.
Frequency	One-off	One-off	One-off
Data source: TTC Operations & Infrastructure Group			

6.4.3 Costs

Approved funding for lifecycle costs of facilities assets are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to facilities assets.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

6.4.4 Risks

The following risks are applicable for all the above mentioned TTC facilities.

1. **If the planned procurements for electric buses and charging infrastructure post-2025 are not funded,** the TTC's bus service will be significantly impacted, and operating expenditure will escalate due to an increase in required maintenance activities. Without the procurement of additional charge points to support a move towards an all-electric fleet (to meet the climate goals set out in the Green Fleet Plan and the City's Net Zero 2040 Strategy), impacts on service would begin as early as 2027.
2. **The Facilities Maintenance investment program includes garages, yards, carhouses and various other buildings.** These assets all require facility renewal programs to ensure building assets, such as HVAC, boilers, roofs and structures are functional and maintained in a state of good repair, but can also contribute to achieving Net Zero 2040 through retrofitting to reduce energy consumption. The CIP identifies $892 million in unfunded requirements for the facility renewal programs, and if not undertaken in a timely manner, will pose a number of risks that range from Occupational Health and Safety violations, works refusals and/or partial to full closure of facilities, which could effect service depending on the impacted facility.
3. **Ongoing significant capital investment is required to address the current SOGR for elevators and escalators that are past their designed life expectancy.** Current levels of funding fall well short of the steady state SOGR requirements, which has increased the SOGR backlog. Across the 15-Year CIP, $348 million is required to ensure these assets are renewed on a consistent basis and the SOGR backlog is addressed. Failure to address the funding requirements could have the following consequences:
    - Aging components requiring additional maintenance, adding pressure to the operating budget.
    - Parts will become obsolete, which may lead to decreased reliability and increased asset downtime.
    - Potential non-compliance with the Accessibility for Ontarians with Disabilities Act.
    - Crowding in stations and platforms causing a safety concerns and negatively impacting service delivery and customer experience.
4. **Investment is required in existing infrastructure to re-design plumbing layouts** as often elevating devices can be impacted by flooding resulting in costly repairs, lengthy downtimes and accelerated deterioration. New construction must follow the TTC design specifications, which keeps the plumbing separate from the elevating devices.
5. **Insufficient funding for the 'Decarbonization of Facilities' program,** which includes activities and projects to reduce GHG emissions from TTC buildings. By investing in retrofits that make buildings more energy efficient, energy costs and maintenance requirements can be decreased. The CIP currently identifies $128 million in investments required for these programs. However, all costing estimates are Stage Gate 0 placeholders to be refined and confirmed and will likely increase in total estimated cost. An inability to fund these programs will mean that the TTC may fall short of the Net Zero targets.
6. **Many of the roof assets at TTC facilities (including subway and rapid transit stations, garages, car-houses, shops, substations, office buildings and other facilities) exceed the normal life expectancy.** There is a need for a sustained replacement and rehabilitation program to avoid excessive maintenance costs, deterioration of building structures and detrimental effects on mechanical and electrical equipment through prolonged exposure to moisture. The program is currently under-funded as the CIP identifies a need for $229 million in the first 10 years and a further $54 million in the five years post. If replacement of roofing systems are not carried out, then deterioration will continue; leakage will increase, damage to the underlying building structures and equipment will increase and slippery conditions will be created at floor levels will result in unsafe conditions, operational delays, and increased annual maintenance costs.

7. Systems

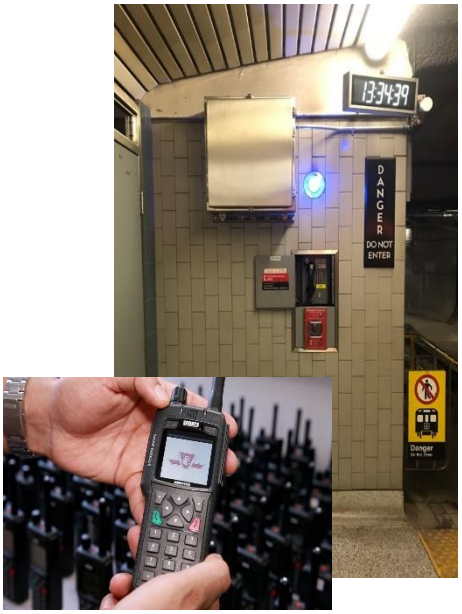
A system is a group of interacting or interrelated elements that act according to a set of rules form a unified whole. A system, surrounded and influenced by its environment, is described by its boundaries, structure, and purpose, and is expressed by the function it is fulfilling. The main categories of systems currently utilized within the TTC are:

- Communications
- Signalling
- Electrical/Traction Power
- Mechanical

Other systems do exist within the TTC, but are either covered in other sections of this Plan or are not sufficiently critical to service deliver to be included.

7.1 Communication Systems

Communication systems have a vital role in the day-to-day operation of the TTC. They include:



- Transit Control Centre network
- Radio systems
- Operations local area network
- Emergency trip system
- Supervisory Control and Data Acquisition (SCADA) systems
- Permanent work area warning system
- CCTV system
- Train Door Monitoring (TDM) system
- Public address system
- Passenger assistance intercom
- Elevator/escalator remote monitoring system
- Fire signal receiving systems

A communications system is an engineered network or arrangement of components that enables the transmission, reception and exchange of information between two or more entities. These systems typically involve the use of various devices, such as transmitters, receivers, channels, and protocols to facilitate the transfer of data or signals.

The primary goal of a communications system is to establish an effective and reliable means of conveying information over a distance, overcoming challenges, such as noise, interference, and signal degradation.

Key elements of a communications system include encoding and modulation techniques, transmission mediums (such as cables or wireless channels), and protocols for organizing and managing data transmission. The design and optimization of communications systems involve considerations of bandwidth, data rates, error handling, and security to ensure efficient and accurate information exchange.

Table 7-1: Number of communication systems assets and sub-assets and their average age.

Asset Class	Sub-Asset Class	Quantity	Average age (years)
Safety & Control Systems	Radio Systems (SCRS, SRAS, DAS, TETRA)	8,036	12
	SCADA Systems	569	14-15
	Permanent Work Area Warning (PWAW)	169	1-2
Passenger Interface & Security Systems	PA/Intercom (PAI)	1,129	12-13
	Intrusion Access & Control (IAC) System	100	5
	CCTV	5,378	4-5
Operational & Backbone Systems	Real Time Monitoring System (RTMS)	3	3
	Fire Signal Receiving Centre (FSRC) System	10	10
	Operations Local Area Network (OPSLAN)	900	8
	Integrated Communication Systems (ICS)	175	5
	Train Door Monitoring (TDM)	1,403	4-5
	Backbone and Infrastructure System (BCN)	87	20
	Transit Control Centre (TCC) Integration	50	5
Cable	Communications Cable	*	*
Data source: TTC Operations & Infrastructure Group			

**Currently unable to provide an estimation of length of cable because it is combined into many different communication services, including cabling to equipment, in-station cabling, and telephone cabling.*

7.1.1 Asset Condition

The asset condition scores provided in Table 7-2 below have been produced from qualitative assessment by a subject matter expert or utilization of a proxy, such as age against expectations for serviceable life, aligned to the scoring framework in Appendix G: Condition Scoring Frameworks.

Table 7-2: Condition score of the communication systems asset.

Asset Class	Sub-Asset Class	Condition Score
Safety & Control Systems	Radio Systems (SCRS, SRAS, DAS, TETRA)	3.7
	SCADA Systems	3.9
	Permanent Work Area Warning (PWAW)	1.0
Passenger Interface & Security Systems	PA/Intercom (PAI)	3.4
	Intrusion Access & Control (IAC) System	2.0
	CCTV	3.0
Operational & Backbone Systems	Real-Time Monitoring System (RTMS)	1.0
	Fire Signal Receiving Centre (FSRC) System	5.0
	Operations Local Area Network (OPSLAN)	2.0
	Integrated Communication Systems (ICS)	2.0
	Train Door Monitoring (TDM)	2.4
	Backbone and Infrastructure System (BCN)	5.0
	Transit Control Centre (TCC) Integration	2.0

Data Source: TTC Operations & Infrastructure Group

7.1.2 Lifecycle Activities

The lifecycle activities of the communication systems vary according to the subasset category. The following tables provide examples of the type of lifecycle activities that are undertaken to different systems.

7.1.2.1 Safety and Control Systems

Table 7-3: Summary of Radio Systems lifecycle activities.

Asset class	**Radio Systems**			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	0-20	10	20+
Intervention detail	Design, procurement, and installation of subway car radio systems.	Manage software upgrades, security patches, database backups, memory consumption. Annual maintenance/ testing of core functions. Perform vendor recommended	Replacement of core servers, software. Upgrade of network equipment.	Replacement based on technology obsolescence, ending of vendor support, inability to expand/replace network, or better technology for business. Highly dependent on lifecycle replacement of trains.

		maintenance schedule. Co-ordinate system, expansions, radio additions, configurations changes, frequency changes		
Frequency	One-off	Ongoing	One-off	One-off
Data Source: TTC Operations & Infrastructure Group				

Notes:

- *Lifecycle replacement partially driven by train replacement program.*
- *Lifecycle different for T1 and TR trains.*
- *New trains will have different lifecycles.*

7.1.2.2 Passenger Interface & Security systems

Table 7-4: Summary of CCTV lifecycle activities

Asset class	**CCTV – Field devices and headend VMS**				
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Maintenance	Disposal
Year (of life)	0	1-4 years	Year 5	6-9 years	Year 10
Intervention detail	Equipment purchase.	Annual inspection (server temperature, fan noise etc.) Routine remote monitoring server performance, storage etc. Upgrade software yearly or depend on new software release availability. Backup of databases.	Evaluate servers' performance (speed, capacity etc.). Servers may require replacement due to higher demand for speed and capacity.	Annual inspection (server temperature, fan noise etc.) Routine remote monitoring server performance, storage etc. Upgrade software yearly or depend on new software release availability. Replace headend equipment, as required – Low performance.	Equipment/System (software) replacement based on technical obsolescence, end of vendor support, inability to expand/make changes, incompatibility with new systems, better technology available for business.
Frequency	One-off	Annual/Ongoing	One-off	Annual Ongoing	One-off
Data Source: TTC Operations & Infrastructure Group					

Ongoing projects underway to upgrade cameras to 360-degree, analogue to digital, and Digital Video Recorders to Networked Video recorders.

7.1.2.3 Operational & Backbone systems

Table 7-5: Summary of Real-Time Monitoring System (RTMS) lifecycle activities

Asset class	**Real Time Monitoring System (RTMS)**				
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Maintenance	Disposal
Year (of life)	0	1-4 years	Year 5	Year 6-9	Year 10
Intervention detail	Head end hardware and software acquired	Routine remote monitoring. Maintenance of spare hardware pool. Routine backups of software/databases. Programming of PLCs and Wonderware as new elevating devices come online, or old ones replaced.	Update software to latest supported versions. Schedule dependent on vendor software release schedule.	Routine remote monitoring. Maintenance of spare hardware pool. Routine backups of software/databases. Programming of PLCs and Wonderware as new elevating devices come online, or old ones replaced.	Replacement of hardware based on hardware obsolescence, software requirements. Disposed equipment transfers to development environment.
Frequency	One-off	Annual/Ongoing	One-off	Annual/Ongoing	One-off
Data Source: TTC Operations & Infrastructure Group					

7.1.3 Costs

$236.5 million is to be spent on upholding the state of good repair of communications systems between 2024 and 2033, of which $90.2 million is currently unfunded. Approved funding for lifecycle costs of communication systems assets are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to communication systems assets.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

7.1.4 Risks

Many of the TTC's communications assets are outdated and showing signs of deterioation. Failure of one or more of these systems can lead to service disruptions and/or closures. The most substantial risks identified are:

- **JMUX/JPAX:** Obsolescence of oldest equipment and delays in procuring modern replacement may impact reliability for Fire Alarm and SCADA, as well as train control on Lines 2 and 4.

- **Asset Upgrades:** Upgrades to NMS software for OPSLAN and TCN being delayed by PCM result in inability to monitor the growing systems conveniently. Funding is required to advance the SOGR programs for these assets to ensure service reliability.

7.2 Signal Systems

The TTC signals assets are a system of devices, equipment, and protocols used to control the movement of the subway trains, ensuring safe and efficient operations on rail networks. The primary objective of signalling assets is to prevent collisions, manage traffic, and facilitate the safe and orderly movement of rolling stock along railway tracks.

This system includes 77 various components all working together to regulate train movements, provide information to train Operators, and enhance overall railway safety and efficiency.

Table 7-6: Number of signalling systems assets and sub-assets and their average age.

Asset Class	Sub-Asset Class	Quantity	Average Age (years)
Signalling Systems	Fixed Block Relay Based	7,033	58
	Fixed Block CBI	1,780	22
	Wilson Yard CBI	1,314	7
	SI ATC CBTC	15,960	7
	SI CSS	38	16
Signalling Support	SI Ancillary System	761	58
	SI Relay Shop	61	58
	SI SCS	7,203	16
	SI SAMS	448	9
	SI Training Facilities	110	9
Cable	Signalling Cable	*	*

Data Source: TTC Operations & Infrastructure Group

**Cables are currently captured within the individual systems, so it is difficult to verify the actual quantities.*

7.2.1 Asset Condition

The asset condition scores provided in

Table 7-7 below have been produced from qualitative assessment by a subject matter expert or utilization of a proxy, such as age against expectations for serviceable life, aligned to the scoring framework in Appendix G: Condition Scoring Frameworks.

Table 7-7: Condition score of the signal systems asset.

Asset Class	Sub-Asset Class	Condition Score
Signalling Systems	Fixed Block Relay Based	3.0
	Fixed Block CBI	2.8
	Wilson Yard CBI	2.1
	SI ATC CBTC	1.8
	SI CSS	1.4
Signalling Support	SI Ancillary System	2.7
	SI Relay Shop	2.7
	SI SCS	3.0
	SI SAMS	3.0
	SI Training Facilities	2.3

Data Source: TTC Operations & Infrastructure Group

7.2.2 Lifecycle Activities

The lifecycle activities of the signalling systems vary according to the subasset category. The following table will provide some detailed examples of the type of lifecycle activities that are undertaken in the different systems.

Table 7-8: Summary of Signalling Systems lifecycle activities.

Asset class		**Signalling Systems – Fixed Block Relay Base**		
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	1-60+	5-60+	60+
Intervention detail	Commissioning of first systems, which are currently still in operation on Line 2.	Preventative Maintenance (PM - planned) Emergency Maintenance (EM - unplanned)	Corrective Maintenance (CM - planned - SOGR projects - Unplanned following PM or EM).	Decommissioning when fixed block relay base signalling on subway Line 2 gets replaced with ATC.
Frequency	One time	Periodic: monthly, quarterly or annually	As required, typically every 5-10 years	One-off

Data Source: TTC Operations & Infrastructure Group

7.2.3 Costs

$342.9 million is to be spent on upholding the state of good repair of signalling systems between 2024 and 2033, of which $196.1 million is currently unfunded. Approved funding for lifecycle costs of signal systems assets are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to signal systems assets.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

7.2.4 Risks

Signalling systems control the movement on the subway lines to ensure all trains maintain a safe distance between each other, electrical assets feed the power to the system, and communications assets provide a direct link between Operators, Transit Control, platforms, and emergency services. In many cases, if one of these assets were to fail, service cannot operate.

The Line 2 fixed-block system has been in service in most sections for up to 58 years (commissioned between 1966 and 1980). Several SOGR programs have been implemented, which have either replaced or refurbished much of the replaceable signalling system assets, contributing to a life extension of 28 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 7-9: 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 & Woodbine to Warden	1968	1998	55	67	72
Islington to Kipling & Warden to Kennedy	1980	2010	43	55	60
*Assumption: ATC cutover achieved by 2035 under NST scenario 1 and 2. ** Assumption: ATC cutover can be achieved by 2040 under NST scenario 3 (under review)					

A delay in the train procurement directly impacts the ability to operationalize ATC on Line 2, requiring the existing fixed-block system to be maintained. Current challenges of the signalling infrastructure include, but are not limited to, expected deterioration of cabling, component obsolescence and discontinuation of parts. A feasibility study will be completed to determine scope and one-time costs required to keep the current signal system in operation, but given its age, it should be replaced. However, ATC should only be installed if the T1 trains operating on Line 2 are replaced. The most substantial risks identified are:

1. **Monitoring Performance and Allocating Funds:** Keeping signal assets and systems in a fail-safe operating condition and in a state of good repair is critical to reducing duration and frequency of occasional impacts on overall subway corridor availability. Crucial data regarding the performance of the signalling system and status changes will be unavailable or limited due to the absence of adequate recording of essential events, performance monitoring, and preventative diagnostic of signal assets failures – this results in increased troubleshooting time due to the lack of data to pinpoint the root cause of malfunctioning system as well as the lack of data available for analysis at a remote location prior to intervention crews being dispatched to the field. This information is a critical need to maintain adequate capital reserves to fund the Signals State of Good Repair Program. Failing to secure required funding will result in further assets deterioration and unmanageable backlog of Capital work.
2. **Modernization and Obsolescence:** Legacy and CBI signalling equipment has been discontinued by their original manufacturer – their replacement requires engineering and manufacturing efforts to design, test and certify they are safe to use for their application and to secure an adequate quantity of spares until the signalling system gets decommissioned. This will result in higher operating and maintenance costs, and could result in a drop off in performance of the subway line through delays and line closures.
3. **Aging Infrastructure:** Ongoing significant capital investment is required to address and maximize efficiency of SOGR activities for conventional and computer-based signalling systems.

7.3 Electrical Systems

An electrical system refers to a network of interconnected components and devices designed to generate, transmit, distribute, control, and utilize electrical energy. These systems can vary widely in scale and complexity, encompassing anything from small electronic circuits to large-scale power distribution networks.

The TTC operates a vast and complex, multi-faceted alternating current (AC) electrical system, which provides power for lighting, heating, ventilation, pumps, elevators, escalators, signals, and communications systems for various facilities, such as subway stations and tunnels, garages, yards, carhouses and office buildings. The system is an integration of various asset categories comprising of Emergency Power Systems, AC Switchboard, AC Transformers, AC Distribution, Cables, Poles, and Lighting. Much of the electrical assets involved are as originally supplied during the initial construction of the subway and the various expansion projects. Some of these original assets are between 30 and 50 years old. The typical expected service life of AC equipment ranges from 25 to 50 years.

The TTC also operates a complex traction power distribution system, which provides the electrical power to move subway trains and streetcars. The system is an integration of various asset categories comprising of AC Switchgear, Transformers (Substations, Auxiliary and Rectifier), Direct Current (DC) Switchgear, Battery Banks/Chargers and Cables. Each category of asset can further be defined into various asset families and assets. The useful life of the traction power equipment ranges from 12 years for electronic devices to up to 50 years for items, such as power transformers, circuit breakers and distribution cables. Much of the electrical assets involved are as originally supplied during the initial construction of the subway and the various expansion projects. Some of these original assets, such as traction power feeder cables, are more than 50 years old and in the event of failure, pose a significant risk to the operation of the system.

Table 7-10: Number of electrical systems assets and sub-assets and their average age.

Asset Class	Sub-Asset Class	Quantity	Average Age (years)
AC Power Systems	Emergency Power System	74	11-12
	AC Switchboard	296	15-16
	AC Transformer	87	23-24
	AC Distribution	148	22-23
	Poles	1,161	40
	Lighting	59,600	40
	Electrical Cable	*	*
Traction Power Systems	AC Switchgear	479	27-28
	Rectifier Transformer	144	22-23
	Auxiliary Transformer	105	35-36
	Substation Transformer	41	26
	Rectifier	144	28-29
	DC Switchgear	530	25-26
	Battery Banks/Chargers	128	10-16
	Traction Power Cable	**	**

Data Source: TTC Operations & Infrastructure Group

*Difficult to verify the actual quantities because the cables sit within different systems. However, the following dates have been given as estimates for installation: 1954 for Line 1, 1966 for Line 2, 2002 for Line 4).

**Difficult to verify the actual quantities because the cables sit within different systems. However the cabling originates from 41 substations. In addition, the following dates have been given as estimates for installation: 1954 for Line 1, 1966 for Line 2, 2002 for Line 4).

7.3.1 Asset Condition

The asset condition scores provided in Table 7-11 below have been produced from qualitative assessment by a subject matter expert or utilization of a proxy, such as age against expectations for serviceable life, aligned to the scoring framework in Appendix G: Condition Scoring Frameworks.

Table 7-11: Condition score of the electrical systems asset.

Asset Class	Sub-Asset Class	Condition Score
AC Power Systems	Emergency Power System	2.0
	AC Switchboard	2.0
	AC Transformer	2.8
	AC Distribution	2.0
	Poles	3.5
	Lighting	3.0
Traction Power Systems	AC Switchgear	2.4
	Rectifier Transformer	2.2
	Auxiliary Transformer	2.9
	Substation Transformer	2.5
	Rectifier	2.6
	DC Switchgear	2.3
	Battery Banks / Chargers	2.6-3.3

Data Source: TTC Operations & Infrastructure Group

7.3.2 Lifecycle Activities

The lifecycle activities of the electrical systems vary according to the subasset category. The following tables provide examples of the type of lifecycle activities that are undertaken on different systems.

7.3.2.1 AC Power Systems

Table 7-12: Summary of Emergency Power System lifecycle activities.

Asset class	**Emergency Power System**		
Lifecycle intervention	Acquisition	Maintenance	Disposal
Year (of life)	0 years	Throughout lifecycle	20 years
Intervention detail	Purchase and install new equipment.	Inspect battery, water levels, take sample of electrolyte, inspect battery posts and terminals, inspect battery charger, perform transfer/remote indication test, perform station walkabout and confirm emergency lighting functioning.	Dispose of equipment. Care to be taken for hazardous material.
Frequency	One-off	Monthly	One-off
Data Source: TTC Operations & Infrastructure Group			

7.3.2.2 Traction Power Systems

Table 7-13: Summary of Rectifier Transformer lifecycle activities.

Asset class	**Rectifier Transformer**			
Lifecycle intervention	Acquisition	Maintenance	Maintenance	Disposal
Year (of life)	0 years	Throughout lifecycle	Throughout lifecycle	50 years
Intervention detail	Purchase and install new equipment.	Oil sample analysis.	Inspect gauges and control box. Test alarms and indications. Check oil filter and oil containment pan.	Dispose of equipment. Care to be taken for hazardous material.
Frequency	One-off	Periodic: every 3 months to every 3 years	Annually	One-off
Data Source: TTC Operations & Infrastructure Group				

7.3.3 Costs

$218.9 million is to be spent on upholding the state of good repair of electrical systems between 2024 and 2033, of which $67.3 million is currently unfunded. Approved funding for lifecycle costs of electrical systems assets are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to electrical systems assets.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

7.3.4 Risks

Table 7-14: Priority Locations for Electrical System.

Priority Locations	
Substation Electrical Rebuild	• York Mills • Sheppard • Wilson
Replace LV Feeder Cables	• Lawrence • Glenayr • Casa Loma
Cable Replacement	• St Andrew to St George • Islington to Royal York
Replace Subway Station Breakers	• Davisville • Bathurst • Islington
UPS Replacement	• Bayview • Bessarion • Leslie

The TTC operates a complex traction power distribution system, from substations to track and everything in between, to provide the electrical power to move subway trains. While these assets have ongoing funding in the Capital Plan, the present levels are insufficient given the rate at which the assets require replacement. Critical SOGR projects with funding shortfalls of $319 million in the CIP include, but are not limited to, Substation Electrical Rebuild, Cable Replacement, Subway Station Breaker Replacement, and Uninterruptable Power Supply Replacement.

The TTC operates multiple substations that have outdoor electrical switchgear enclosures. The reliability of the substation equipment is critical for daily operations and revenue service. Some of this equipment was originally installed in the 1950s and 1960s. The Cable Replacement program is designed to replace deteriorated or damaged cabling throughout the tunnels to ensure safe and continuous delivery of power to the network. Subway station breakers control various station equipment, such as communication systems, escalators, elevators, fans, lighting, and critical emergency lighting. These breakers are becoming unreliable due to age, wear and tear. Backup power systems (UPS, Inverters, Motor Alternator/DC) that provide emergency power to stations, shops, carhouses, and buildings during power outages typically have a lifecycle of 10-to-15 years. However, many of the existing units are 20-plus years old and are becoming unreliable.

The maintenance and repair of this equipment is difficult as the necessary spare parts are often not available. In addition, due to recent inflation in pricing of parts, equipment is not being replaced at the appropriate pace in relation to its age and condition. As the assets deteriorate, so too does the reliability of the network. The pressure on the operating budget also rises as maintenance activities increase in the absence of a fully funded capital replacement program. The most substantial risks identified are:

1. **Aging Infrastructure:** Consistent replacement and maintenance of aging substation equipment as part of our state of good repair is required. If an appropriate pace is not maintained, a backlog of aging and potentially unreliable equipment will develop.
2. **Insufficient Funding:** Significant shortfalls in funding to replace key sub-asset groups.

7.4 Mechanical Systems

Mechanical systems have a vital role in the day-to-day operation of the TTC and include, but are not limited to:

- Heating, Ventilation and Air Conditioning (HVAC) Equipment.
- Building Automation Control Systems (BACS).
- Boilers.
- Fire Sprinkler Systems.
- Fire Standpipe Systems.
- Fire Prevention Suppression Lines.

HVAC Equipment is typically related to general building HVAC systems. This item consists of various asset families combined for better clarity of this report (excluding Boilers and BACS). Building Automation Control Systems (BACS) are used to remotely control and monitor major HVAC/mechanical equipment, and various types/brands of BACS are utilized at various TTC locations.

Fire Protection Sprinkler and Standpipe Systems consist of associated assets/components in various buildings, facilities, garages, carhouses, shops and stations. In addition to this, Automatic Fire Suppression Systems use a clean agent gas in selected critical rooms, in lieu of ordinary Fire Alarm/Fire Sprinkler Systems.

Table 7-15: Number of mechanical systems assets and sub-assets and their average age.

Asset	Quantity	Average age
HVAC Equipment	6,027	29
Building Automation Control System	26	11
Boilers	59	38
Fire Sprinkler System	275	38
Fire Stand Pipe System	1,474	*
Fire Prevention Suppression Line	53	13

Data Source: TTC Operations & Infrastructure Group

*Average age unknown because they are not currently included in the 2023 Asset Condemnation Charts.

7.4.1 Asset Condition

The asset condition scores provided in Table 6-19 below has been produced from qualitative assessment by a subject matter expert or utilization of a proxy, such as age against expectations for serviceable life, aligned to the scoring framework in Appendix G: Condition Scoring Frameworks.

Table 7-16: Condition score of the electrical systems asset.

Sub-Asset Class	Condition Score
HVAC Equipment	3.5
Building Automation Control System	3.7
Boilers	4.5
Fire Sprinkler System	2.1
Fire Prevention Suppression Line	2.1

Data Source: TTC Operations & Infrastructure Group

7.4.2 Lifecycle Activities

The lifecycle activities of the mechanical systems vary according to the subasset category. The following tables will provide some detailed examples of the type of lifecycle activities that are undertaken in the different systems.

7.4.2.1 Heating, Ventilation, and Air Conditioning

Table 7-17: Summary of HVAC equipment lifecycle activities.

Asset Type	HVAC Equipment			
Lifecycle intervention	Acquisition	Maintenance	Overhaul	Disposal
Year (of life)	0	1-5	Annually	25 Years
Intervention detail	Hand over from EC&E.	Follow manufacturer manual/job plan for preventative maintenance, overhaul and repairs as well as all applicable legislative codes, requirements and TTC policies and procedures.	Follow manufacturer manual/job plan for preventative maintenance, overhaul and repairs as well as all applicable legislative codes, requirements and TTC policies and procedures.	Normally included as part of end-of-life replacement under capital program.
Frequency	One Time	Weekly, Monthly, 4-Month, Annually	Annually	One-off

Data Source: TTC Operations & Infrastructure Group

7.4.2.2 Building Automation Controls

Table 7-18: Summary of Building Automation Control System lifecycle activities.

Asset Type	Building Automation Control System		
Lifecycle intervention	Acquisition	Maintenance	Disposal
Year (of life)	0	1-12	12 Years
Intervention detail	Hand over from EC&E.	Follow manufacturer manual/job plan for preventative maintenance, overhaul and repairs, and all applicable legislative codes, requirements and TTC policies and procedures.	Normally included as part of end-of-life replacement under capital program.
Frequency	One time	Monthly	One-off

7.4.2.3 Fire Systems

Table 7-19: Summary of Fire Sprinkler System lifecycle activities.

Asset Type	Fire Sprinkler System		
Lifecycle intervention	Acquisition	Maintenance	Disposal
Year (of life)	0	Years 1 through 40	40 Years
Intervention detail	Hand over from EC&E.	Follow Building Reports Forms/NFPA for the Sprinkler/Fire Alarm Monthly Inspection Test and the Sprinkler Annual Test.	Normally included as part of end-of-life replacement under capital program.
Frequency	One time	Monthly, Annual, 10 Years	One time

Table 7-20: Summary of Fire Stand Pipe System lifecycle activities.

Asset Type	Fire Stand Pipe System		
Lifecycle intervention	Acquisition	Maintenance	Disposal
Year (of life)	0	1-40	40 Years
Intervention detail	Hand over from EC&E.	Follow manufacturer manual/job plan for preventative maintenance, overhaul and repairs as well as all applicable legislative codes, requirements and TTC policies and procedures.	Normally included as part of end-of-life replacement under capital program.
Frequency	One time	Annually	One time

Table 7-21: Summary of Fire Prevention Suppression lifecycle activities.

Asset Type	Fire Prevention Suppression Line		
Lifecycle intervention	Acquisition	Maintenance	Disposal
Year (of life)	0	1-end of life	TBD
Intervention detail	Hand over from EC&E.	Inspection and maintenance via service contract.	Normally included as part of end-of-life replacement under capital program.
Frequency	One time	Semi-Annually	One time

7.4.3 Costs

Approved funding for lifecycle costs of mechanical systems assets are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to mechanical systems assets.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

7.4.4 Risks

The most substantial risks to mechanical assets identified are:

1. **Service delivery:** If one or more of these systems fail, there is a risk of service disruptions and/or closures of both network and office locations.
2. **Safety sensitive:** If one of more of these systems fail, there is potential for the safety of both TTC employees and customers to be at risk. The reputational damaged caused by potential loss of life events would be extremely high.
3. **Legislative:** It is important that these systems comply (especially safety critical assets, such as Fire Systems) with all current laws and regulations. System failure could lead to prosecution and/or other legal proceedings.
4. **Customer experience:** Customer and employee satisfaction is likely to decrease if environmental conditions, such as air quality and temperature are negatively impacted by systems that are not functioning correctly or have failed.

Funding is required to advance the SOGR programs for these assets to ensure service reliability.

7.5 Other Systems

Additional systems, such as IT systems, financial systems, and Energy Storage Systems (ESS) have been identified as part of this work. However, there is currently insufficient information available to include them in this Plan, and they will be included in future interations.

8. Structures

8.1 Overview

Structures are required to enable all modes of transport to navigate the city of Toronto. The TTC maintains the structures required for the operation of the subway and streetcar network. These include box structures, bored tunnels, stations, bridges, culverts, retaining walls and miscellaneous structures. The TTC is not responsible for the maintenance of overhead structures.

The categorization of miscellaneous structures may evolve over time as the TTC conducts thorough inspections and integrates them into station facilities, necessitating periodic updates to asset records and management strategies.

Table 8-1 provides a summary of the structures maintained by TTC Structure Maintenance teams.

Other structures (i.e. the above grade portions of subway stations, all structures inside yards as well other complexes) are included within the Facilities section of this Plan.

Table 8-1: Structure Types found on the subway network.

Structure Types	Quantity	Length (km)	Years of Construction	Age Range (years)
Box Structures	74	33.2 km	1954-2017	7-70
Bored Tunnels	43	18.1 km	1963-2017	7-61
Stations	76	~	1954-2017	7-70
Bridges	72	~	1954-2002	22-70
Prince Edward Viaduct (Beams & Sidewalks)	1	~	1962-2023	1-62
Culverts	4	~	1940-1981	43-84
Retaining Walls	160	11.6 km	1954-2002	22-70
Misc. Structures	459	~	1954-2017	7-70

Table 8-2: Structure types in non-subway system but connected to subway.

Structure Types	Quantity	Length (km)	Years of Construction	Age Range (years)
Box Structures	3	0.9 km	1990	34
Stations	2	~	1990	34
Bridges	3	~	1990	34
Retaining Walls	10	0.9 km	1990	34
Misc. Structures	15	~	1990	34

8.2 Structural Types

The section describes the different structural types found on the subway network.

8.2.1 Box Structures

Box structures are typically underground structures built by excavating a trench and constructing a reinforced concrete tunnel from the top down or bottom up. The site is accessed from the surface and this method of construction is commonly referred to as “cut and cover”.

This type of tunnel construction is the oldest method of tunnel construction. It is used where geotechnical conditions are demanding, at shallow depths or where ancillary structures, rooms and shafts are needed and therefore bored tunnels are not sufficient. Typical elements of box structures include: the overhead slab, exterior walls, interior walls, invert slab, catwalk, and drainage. They are built in longitudinal sections (units) separated by unit expansion joints.

Figure 8-1: Box tunnel for Line 4.

Due to the age of the TTC subway tunnels and the constant seepage of road run off with salt, many box structures have developed water ingress through failed expansion joints and concrete cracks, delaminations and various forms of concrete deterioration. They require continuous rehabilitation, removal of loose concrete, leak remediation and concrete rehabilitation. As the age of the tunnels is increasing, rehabilitation is increasing in scale.

8.2.2 Bored Tunnels

Bored tunnels are created by excavating or drilling tunnels in situ without disturbance of the soil above or activities on the surface. They are therefore preferred for tunnelling under urban areas, bodies of water, and for deep tunnels. This type of tunnel construction was first successfully deployed during the construction of tunnels under the River Thames in London, UK, during the late 19th century. Today, modern Tunnel Boring Machines (TBMs) are used for making accurate tunnels at high production rates, and offer the safest form of construction.

Figure 8-2: Tunnel Boring Machine for Line 1 Toronto-York Spadina Subway Extension.

In the TTC subway network, bored tunnels are lined with either precast concrete liner rings (4.9 m, 5.2 m or 5.4 m internal diameter) or cast iron liner rings (4.9 m, 5.5 m, 6.1 m or 9.1 m internal diameter). Components within bored tunnels include liners, bolts, joints, catwalks, inverts, and drainage.

Concrete liner segments are locked in the circular shape using bolts and “key” elements, which require a specific type of maintenance. Cast iron liners are locked together with bolted flanges.

As with any tunnel, bored tunnels can also develop leaks, deterioration, and delamination and some locations require monitoring for shape changes due to their thinner walls and overall tunnel behaviour. Leak remediation of circular tunnel liners is more sensitive because of thin walls, which are at risk of deformation due to the back pressure of pumped grout.

Figure 8-3: Bored Tunnel.

8.2.3 Stations

Stations are typically box structures that provide vertical mobility and access for the public to the subway trains. They can be above, below, or partially below grade. In addition to public areas there are many ancillary structures that are often parts of the stations, which create complex structures, either functionally or structurally, due to connections to the surrounding buildings. Various supporting rooms, shafts, escalator structures and ventilation shafts add to complexity of each station’s construction.

Five TTC stations are classified as exchange stations where the public can transfer from one subway line to another. These are Sheppard-Yonge, Bloor-Yonge, St George, Spadina, and until recently, Kennedy. A further three stations enable transfers directly from a subway line to a streetcar line; Broadview, St Clair and St Clair West. Union Station enables transfers to a variety of other transportation providers as well as the TTC streetcar network via Queens Quay station. As new subway lines are constructed, more stations are planned to be modified to become exchange stations (i.e. Eglinton West and Eglinton).

In addition, there are two stations that are not used by the public. The construction of Queen Lower was never completed and Bay Lower has not been used (other than for special occasions) since 1966.

An additional complication with new exchange stations is the interface between TTC maintenance teams, who are responsible for maintaining the structures and existing stations, and future Metrolinx contractors, responsible for maintaining the new stations.

As with other reinforced concrete structures, the presence of leaks and loose concrete in the stations necessitates the need for ongoing maintenance. Due to the presence of the public, it is important to ensure the safety and good repair of public areas of stations without interfering with public access.

Figure 8-4: York Mills Station.

8.2.4 Bridges & Culverts

As the City of Toronto has evolved, the history of bridge ownership has become complex. The TTC and City of Toronto have negotiated agreements, which outline the responsibilities for inspection and maintenance on each structure on the TTC's network. The TTC is typically responsible for the inspection and maintenance of all bridges that support the operation of the subway.

TTC's bridges typically consist of the construction types shown in the table below.

Table 8-3: Types of bridges on the TTC network.

Arch: Concrete Open Spandrel	Arch: Steel Bowstring
	
Girder Bridge: Box	Girder Bridge: Concrete
	

Girder Bridge: Steel

Rigid Frame: Concrete Box

Rigid Frame Bridge

Slab Bridge: Concrete

Slab Bridge: Post-Tensioned or Prestressed

Slab Bridge: Voided

8.2.4.1 Prince Edward Viaduct

The Prince Edward Viaduct (PEV) is a unique structure, which requires a unique type of maintenance due to its construction and interface with the subway track.

The bridge itself is not owned by TTC nor is TTC responsible for its overall maintenance. It existed prior to the construction of Line 2. On the upper deck the PEV is a public road for vehicular traffic, and the lower deck supports the subway track between Broadview and Castle Frank stations in both directions.

The TTC is not responsible for the overall inspection and maintenance of the bridge as it is a City of Toronto asset. However, the TTC does maintain the portion of the structure on the lower deck on which the tracks are laid (the beams), as well as the adjacent steel sidewalk panels and inspection platforms.

Figure 8-5: Prince Edward Viaduct.

The track across the bridge is supported by a series of concrete beams with each rail directly fixed on to the beams. The length of the beams varies with location, but they are typically 6.4 metres long and span between the bridge's girders supported on bearings at each end of the beam. Rails are attached to the beams by elastic clips and the weight of the beams keeps the rail in place. Annually, around six-to-12 beams are replaced to ensure good track support.

Figure 8-6: Prince Edward Viaduct beams.

8.2.5 Overhead Structures

Overhead structures are any structures that carry loads over the subway network – such as buildings, bridges, streets, and urban green spaces that are not owned by TTC. In addition to being an overburden transferring its weight to the subway through sometimes complex structural design, overhead structures can pose various challenging interfaces for the subway structure maintenance.

Typically contracts and legal agreements regulate the relationship between the TTC and the owners of adjacent and overhead structures. The TTC needs to be assured that overhead structures are inspected and maintained by their owners and are not posing an undue risk or liability to the TTC. This assurance is achieved through the TTC's Property, Planning and Development Department, which represents the TTC in such agreements with owners.

Figure 8-7: Ridelle Avenue Bridge

Incidents, such as burst water mains in adjacent buildings, can cause flooding of the track, therefore the TTC works closely with adjacent building inspection and maintenance teams. New buildings being built above the subway go through extensive consultations and reviews with the TTC to ensure inspection and maintenance of TTC assets can be continued after construction. Conversely, the noise and vibration from subway cars travel through walls, the ground and foundations, therefore designers of new structures have to take into consideration design features to protect their tenants from those vibrations, which can pose a nuisance problem even when the track and structure are in optimum condition.

Structures that are over the subway are inspected for falling objects, loose concrete and high-level overall condition.

Streets and green spaces above the subways pose a risk in terms of salt and water run-off finding a route into the tunnels. Construction activities on the surface can occasionally drill into, or close to, subway tunnels causing issues. There are processes and laws in place that third parties shall follow to prevent such incidents, but they still occur. The use of Ontario One Call is mandatory for those undertaking construction activities involving excavators.

8.2.6 Retaining Walls

Retaining walls are vertical walls designed to keep a large mass of soil on one side, sometimes at a steep angle. They are often present in subway "open cut" sections where the track is deeper than the soil around it or when the track is above the surrounding soil. In addition, the TTC is monitoring retaining walls above the subway where it is determined that their deteriorating condition may affect subway structures or the track. Retaining walls are critical as they may be supporting the track itself or protecting the track from nearby soil at a higher level.

Figure 8-8: Retaining wall adjacent to Wilson Yard tracks.

The TTC inspects and maintains the retaining walls to ensure they remain in state of good repair. Some retaining walls that are not

the TTC's property, but can affect the TTC, are monitored in collaboration with third-party owners as required to ensure the safety of the TTC's property.

8.2.7 Miscellaneous Structures

Miscellaneous structures are classified as all other structures on the track level not belonging to previously defined structure types, such as:

- Emergency exits.
- Ventilation and access shafts.
- Pump and breaker rooms, and chambers along main subway lines.
- Hostler platforms.
- Carhouse pit support columns.

Figure 8-9: Emergency exit on Line 1 south of Eglinton West Station.

8.2.8 Inventory

The following tables provide a summary of the structures stock on each line. A map showing the location of the structures is included in Appendix C: Structures Network Map.

The stations referenced below are for underground portions of stations as well as elevated portions of stations up to the platform level. Station areas above grade and platform level are the responsibility of Plant Maintenance and are included in Facilities section of this Plan. Additionally, overhead structures are typically not TTC property so they are only indicated as a potential risk and with regard to their effect on the TTC structures located underneath them.

8.2.8.1 Line 1: Yonge-University

Table 8-4: Summary of Line 1 Structures Stock.

Location	Year of Construction	Structure Type	Qty	Age (years)	Condition
Yonge North	1973-1974	Box Structures	6	50-51	55% good, 32% fair, 11% poor, 2% very poor
		Bored Tunnels	7		54% good, 46% fair
		Stations	5		77% good, 23% fair
		Overhead Structures	17		Not TTC assets
		Retaining Walls	27		2% very good, 75% good, 23% fair
		Misc. Structures	55		57% good, 38% fair, 5% poor
Yonge	1954	Box Structures	11	70	50% good, 50% fair
		Stations	12		65% good, 35% fair
		Bridges	5		Average BCI: 78 (min of 75 & max of 81)
		Overhead Structures	3		Not TTC assets

Location	Year of Construction	Structure Type	Qty	Age (years)	Condition
		Retaining Walls	10		1% very good, 92% good, 7% fair
		Misc. Structures	65		25% good, 72% fair, 3% poor
University	1963	Box Structures	5	61	45% good, 50% fair, 5% poor
		Bored Tunnels	6		76% good, 24% fair
		Stations	5		60% good, 40% fair
		Misc. Structures	31		29% good, 58% fair, 13% poor
Spadina	1978	Box Structures	4	46	68% good, 31% fair, 1% poor
		Bored Tunnels	2		64% good, 36% fair
		Stations	8		74% good, 26% fair
		Bridges	25		Average BCI: 76 (min of 65 & max of 83)
		Overhead Structures	10		Not TTC assets
		Retaining Walls	27		1% very good, 86% good, 13% fair
		Misc. Structures	25		48% good, 52% fair
Sheppard West	1996	Box Structures	2	28	28% very good, 71% good, 1% fair
		Stations	1		94% good, 6% fair
		Misc. Structures	15		7% very good, 60% good, 27% fair, 6% not accessible
TYSSE	2017	Box Structures	7	7	43% very good, 57% good
		Bored Tunnels	12		28% very good, 72% good
		Stations	6		48% good, 51% very good, 48% good, 1% fair
		Misc. Structures	71		11% very good, 88% good, 1% not accessible

Table 8-5: Line 1 Location Descriptions.

Location	Description
Yonge North	Finch to Eglinton
Yonge	Eglinton to Union
University	Union to Spadina
Spadina	Spadina to Wilson Yard
Sheppard West	Wilson Yard to Sheppard West
TYSSE	Sheppard West to Vaughan Metropolitan Centre

8.2.8.2 Line 2: Bloor-Danforth

Table 8-6: Summary of Line 2 Structures Stock

Location	Year of Construction	Structure Type	Qty	Age (yrs.)	Condition
Bloor: Kipling to Islington	1980	Box Structures	1	44	60% good, 35% fair, 5% poor
		Stations	1		76% good, 24% fair
		Bridges	3		Average BCI is 81
		Overhead Structures	1		Not TTC assets
		Retaining Walls	8		88% good, 12% very poor
		Misc. Structures	1		100% fair
Bloor: Islington to Keele	1968	Box Structures	6	56	73% good, 24% fair, 3% poor
		Stations	6		74% good, 26% fair
		Bridges	3		Average BCI: 80 (min 78 & max 81)
		Retaining Walls	20		5% very good, 91% good, 4% fair
		Misc. Structures	17		53% fair, 41% good, 53% fair, 6% poor
Bloor: Keele to Yonge	1966	Box Structures	11	58	62% good, 26% fair, 12% poor
		Bored Tunnels	4		54% good, 46% fair
		Stations	10		76% good, 24% fair
		Bridges	4		Average BCI: 78 (min 73 & max 80)
		Retaining Walls	3		100% good
		Misc. Structures	34		15% good, 76% fair, 9% poor
Danforth: Yonge to Woodbine	1966	Box Structures	9	58	54% good, 44% fair, 2% poor
		Bored Tunnels	2		94% good, 6% fair
		Stations	8		67% good, 33% fair
		Bridges	2		Average BCI is 68 (min 61 and max 76)
		Special Bridges (PEV)	1		29% very good, 53% good, 17% fair, 1% poor
		Overhead Structures	1		Not TTC assets
		Retaining Walls	3		20% very good, 72% good, 8% fair
		Misc. Structures	42		29% good, 62% fair, 9% poor
Danforth: Woodbine to Warden	1968	Box Structures	2	56	85% good, 14% fair, 1% poor
		Bored Tunnels	2		99% good,1% fair
		Stations	3		1% very good, 77% good, 22% fair
		Bridges	3		Average BCI: 75 (min 66 and max 81)
		Culverts	1		BCI: 81
		Overhead Structures	2		Not TTC assets

Location	Year of Construction	Structure Type	Qty	Age (yrs.)	Condition
		Retaining Walls	29		98% good, 2% fair
		Misc. Structures	15		60% good, 33% fair, 7% poor
Danforth: Warden to Kennedy	1980	Box Structures	2	44	48% good, 52% fair
		Stations	2		73% good, 27% fair
		Bridges	4		Average BCI: 76 (min 69 & max 81)
		Culverts	2		Average BCI: 46 (min 36 & max 56)
		Retaining Walls	7		4% very good, 94% good, 2% fair
		Misc. Structures	5		20% good, 80% fair

8.2.8.3 Line 3: Scarborough

Table 8-7: Summary of Line 3 Structures Stock.

Location	Year of Construction	Structure Type	Qty	Age (yrs.)	Condition
Scarbor-ough	1985	Stations	5	39	82% good, 18% fair
		Bridges	16		Average BCI: 74 (min 64 & max 81)
		Special Bridges	4		Average BCI: 77 (min 74 & max 79)
		Culverts	1		BCI is 81
		Overhead Structures	4		Not TTC assets
		Retaining Walls	20		16% very good, 81% good, 3% fair
		Misc. Structures	1		100% fair

Line 3 is currently not in use. However, structural safety inspections continue until further notice.

8.2.8.4 Line 4: Sheppard

Table 8-8: Summary of Line 4 Structures Stock.

Location	Year of Construction	Structure Type	Qty	Age (yrs.)	Condition
Sheppard	2002	Box Structures	8	22	1% very good, 92% good, 7% fair
		Bored Tunnels	8		98% good, 2% fair
		Stations	4		92% good, 8% fair
		Bridges	3		Average BCI: 79 (min 75 & max 81)
		Retaining Walls	1		50% very good, 50% good
		Misc. Structures	82		6% very good, 77% good, 17% fair

8.2.8.5 Harbourfront Streetcar Route

Table 8-9: Summary of Harbourfront Streetcar Route Structures Stock.

Location	Year of Construction	Structure Type	Qty	Age (yrs.)	Condition
Harbourfront and Spadina LRT	1990	Box Structures	3	34	64% good, 36% fair
		Stations	2		63% good, 37% fair
		Bridges	3		Average BCI: 81 (min 77 & max 84)
		Retaining Walls	15		82% good, 18% fair
		Misc. Structures	15		27% good, 73% fair

8.2.9 Asset Condition

8.2.9.1 Structural Inspections

As required by Ontario Regulation 472/10: Standard for Bridges (O.Reg 472), made under the Public Transportation and Highway Improvement Act, 1990, the TTC operates a comprehensive structural inspection program. This program covers the inspection of all structures and plays an important role in providing a safe network of elevated and underground structures.

The TTC's subway system continues to age and deteriorate and so an accurate and thorough inspection of each structure is critical in maintaining safe and efficient operation.

The main objectives of structural inspections are to:

- Ensure safe operational use;
- Determine the condition of the structures;
- Protect and prolong the useful life of the structures;
- Identify repair and rehabilitation needs of the structures;
- Provide a basis for a structure management system for the planning and funding of the maintenance, repair and rehabilitation; and
- Help identify trends and predict future life expectancy of structures.

The goal of the structural inspection program is to maintain structures to an acceptable standard in terms of structure safety, public safety, comfort, convenience and reliability.

Most of the structural inspections of existing subway-related structures are carried out by TTC inspection crews. Each inspection crew is led by a Professional Engineer with a background in structural inspections, design or construction, or by trained structural inspectors under the supervision of a Professional Engineer.

Experience has shown that some structure types, their components or structural material and even their locations, make them more susceptible to deterioration than others. To account for this, the intervals of TTC routine inspections are as specified in Table 8-4 alongside the guidance provided by other organizations and standards.

Inspections are usually undertaken every two years, depending on the structure. Condition ratings for each structure are entered into the asset register following established guidelines. The stated intervals of TTC routine inspections are regarded as the minimum requirement. They are supplemented with additional inspections/monitoring as recommended by inspectors/engineers based on the observed condition of structural elements and the risks associated with safe operational use (in the case of structural or functional failure).

Table 8-10: Structure Inspection Frequencies in years.

Asset Type	TTC	OSIM[1]	APTA[2]	TOMIE[3]
Box Structures	2	2	2-4 (condition based)	2
Bored Tunnels	2	2	2-4 (condition based)	2
Stations	2	-	0.1 to 1 (age & condition based)	-
Bridges / Elevated Structures (SRT)	2	2	2	-
PEV (Special Beams)	2	2	2	-
Culverts	2	2	5 or less (condition based)	-
Retaining Walls	4	2-4 (condition based)	5 or less (condition based)	-
Misc. Structures	4	-	2-4 (condition based)	2

[1] - Ontario Structure Inspection Manual.
[2] - American Public Transport Association.
[3] - Tunnel Operations, Maintenance, Inspection and Evaluation Manual – U.S. Department of Transportation.

8.2.9.2 Bridge Condition Index

Worldwide, there are several methods used to rank the condition of structures by inspection authorities and each has advantages and drawbacks.

The Ontario Ministry of Transport uses the *Ratio Based* methodology for condition rating of provincial bridges and culverts, and to calculate the Bridge Condition Index (BCI). The TTC also utilizes this approach to determine BCI scores for their bridges and culverts.

For all other structure types, the TTC uses a combination of the *Customized Weighted Average* methodology and the *Worst-Conditioned Component* methodology to generate a condition rating score, which is then used to prioritize maintenance activities. These methods are common in the industry and are further customized to meet the TTC's needs, operating environment, funding sources and organizational structure.

Many large organizations are adopting the *Ratio Based* Approach, which offers some advantages, such as automated defect detection and recording. The *Ratio Based* approach is also more suitable for organizations with large bridge inventories where inspection, maintenance, and repair is frequently contracted out, sometimes to different contractors, both external and in-house. However, as the TTC maintains a relatively small number of structures and has significant in-house engineering expertise, a hybrid approach is currently utilized.

The TTC is monitoring the latest developments in the industry and is preparing to trial the *Ratio Based* methodology across all structure types to further evaluate its benefits. This would enable alignment with the methodologies utilized by the City of Toronto and the Ontario Ministry of Transportation.

Table 8-11 summarises the key features of the *Ratio Based* methodology and the *Weighted Average/Worst Conditioned Component* methodology.

Table 8-11: Structure Inspection Frequencies in years

Feature	Ratio Based (Bridges & Culverts)	Weighted Average/Worst Conditioned Component (All Other Structure Types)
Method	• Treats the condition of all elements the same regardless of their criticality. Places more emphasis on replacement value of each element. • Requires detailed recording of visible defects to rate structure elements by apportioning percentage of their surface to different condition ratings (for example: 40% good, 50% fair, 10% poor). • Requires recording of surface conditions by either manual defect mapping/surface estimating, or automated (drone) inspection and computer processing of that information.	• Places more weight to the condition of rated structure elements proportionate on their importance to the overall structure stability. • Relies more on engineering judgment, and engineer's access and familiarity with structure's history, design, and construction, to give a condition rating to each element.
Analysis	• Puts more importance on recording the condition than on analysis and troubleshooting shifting the need from high-skilled engineering inspection workforce to non-engineering workforce equipped to only accurately record ratio of each condition, which is later processed by a computer program to obtain a BCI.	• The TTC utilize engineering skill, judgment, and training to assess different structures while maintaining the same criteria across them. The weighted average approach is suitable for that because it uses different weighting factors to compensate for the differences in structure types.
Suitability	• More suitable to frequent outsourcing of structure inspections to different contractors and to outsourcing the maintenance. • Not suitable as a means of assessing the condition of the subway tunnels because this method does not work well when it needs to recognize the criticality of a defect or an element. This method only identifies the surface area of the defect, and not the criticality of the defect.	• Works better with smaller number of structures, a skilled inspection workforce, familiar with the structures' history and maintenance that is consistently using the same criteria when applying condition ratings. This approach identifies structural elements that usually need to be repaired using short, non-revenue operating windows. • Suitable as a means of assessing the condition of the subway tunnels. The condition of the worst critical component automatically becomes the overall condition of the inspected ring or structural unit.

8.2.9.3 State of Good Repair

As required by O.Reg 472, the TTC ensures that '*every bridge shall be kept safe and in good repair*'. This approach is applied to all structures for which the TTC is responsible.

As described previously, the TTC undertake regular structural inspections from which a BCI score is generated for each bridge and culvert. The BCI score is a rating system where a number from 0 to 100 is assigned to each structure, with zero correlating to the worst condition. The TTC uses the BCI ranges shown in Table 8-12 to define four levels of service as good, fair, poor and very poor.

Table 8-12: TTC BCI Ranges.

BCI	Condition State	General timelines to address needs
90 to 100	Very Good	Usually not required in next 5 years.
75 to 90	Good	Usually not required in next 5 years.
60 to 75	Fair	May be required within 5 years.
40 to 60	Poor	The structure is scheduled for a detailed condition survey. The scope and timeline for rehabilitation works is then determined by engineering judgment and the results of the detailed condition survey.
0 to 40	Very Poor	As above for 'Poor'.

8.2.9.4 Structural Condition Assessment

The condition of the structures stock per line and per asset type is summarized in the table below. Table 8-13 provides the proportion of structures falling into the very good, good, fair, poor and very poor categories. Figure 8-10 illustrates the distribution of structures falling into each of the five categories.

Note that the structures condition ratings may change should the changes to the structural condition assessment methodology outlined in Section 8.2.9.2 be implemented.

Table 8-13: TTC Structures Condition Ratings.

Structure Type	Qty	Very Good (%)	Good (%)	Fair (%)	Poor (%)	Very Poor (%)
Box Structures	77	3.2	62.4	30.3	3.9	0.2
Bored Tunnels	43	9.6	73.0	17.4	0.0	0.0
Stations	78	5.1	71.5	23.3	0.1	0.0
Bridges	75	0.0	77.3	22.7	0.0	0.0
Culverts	4	0.0	50.0	0.0	25.0	25.0
Prince Edward Viaduct (Beams)	1	29.3	52.9	17.1	0.7	0.0
Retaining Walls	170	4.0	86.5	8.9	0.0	0.6
Misc. Structures	474	3.0	51.0	42.0	4.0	0.0

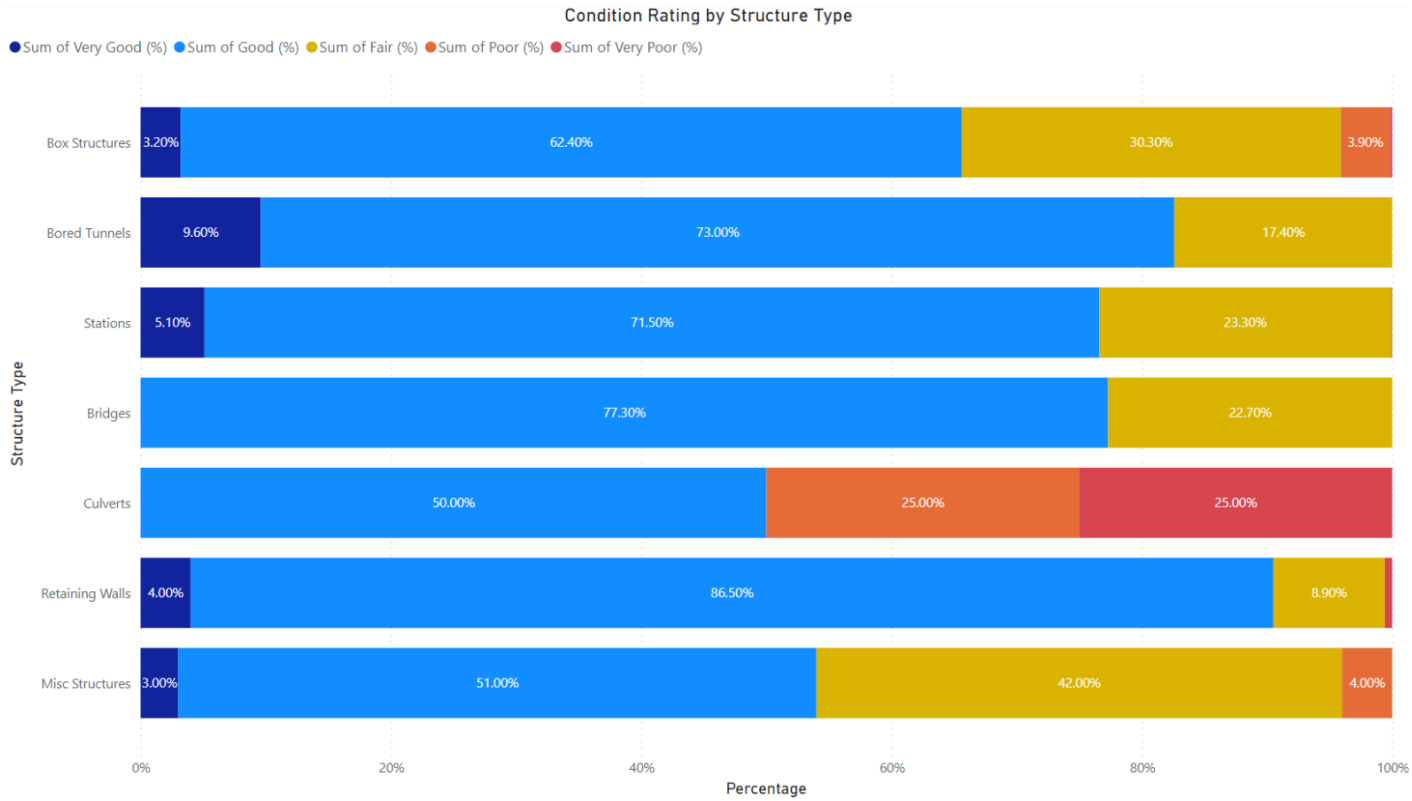


Figure 8-10: Distribution of structure types within each condition band.

8.2.10 Lifecycle Activities

The TTC's structures are required to be maintained in a state of good repair. The TTC structures are scheduled for inspection and maintenance activities as per applicable laws and regulations and corresponding to their age, criticality and condition. Inspection reports are used to create work orders for repairs and rehabilitation and the TTC deploys a phased rehabilitation approach to maintain the intended level of service. It is generally anticipated that a structure will require several rehabilitations before requiring replacement.

The original segments of the subway are now more than 70 years old. To date, only Line 3 has been decommissioned. The Line 3 structures remain in a state of good repair, and it is expected that some structures will be re-purposed as part of future plans to construct a Scarborough Rapid Transit Busway.

Table 8-14 provides examples of the typical lifecycle activities undertaken on the structures asset base. Special types of rehabilitation programs can also implemented to address emerging defect types within specific asset classes, and may last until the issues have been addressed. Therefore, the example list of activities is not intended to be finite or all-encompassing.

Table 8-14: Structures Lifecycle Activities.

Lifecycle Stage	Year of Life	Description	Example Activities	Frequency
Acquisition or construction	0	Building or buying an asset to deliver the required service.	Installation and commissioning of new infrastructure, such as bridges or tunnels.	One-off
Operation	0-100+	Operating the asset to deliver its intended service.	Assets used to enable the operation of the subway network.	Daily
Maintenance	0-20	Inspecting and performing minor interventions on assets using standard approaches to ensure they meet the required safety, legal, technical and operability standards.	Routine cleaning, maintenance, inspections, and minor repairs, including post-construction settling repairs and warranty issues.	Typically monthly to bi-annually
Maintenance & Overhaul	20-80	Intensive repair and replacement of key asset components at longer intervals.	Routine cleaning, maintenance, inspections plus major repairs, rehabilitation, abatement as necessary.	Maintenance: Typically monthly to bi-annually Overhauls: Discrete as required during lifetime.
Late Life	80-100+	More intensive inspections and monitoring as required, plus major repairs or upgrades as necessary.	Routine cleaning, maintenance, inspections, plus major repairs or upgrades as necessary.	Maintenance: Typically monthly to bi-annually Overhauls: Discrete as required during lifetime.
Decommissioning	100+ (or as required)	Taking the asset out of service by replacing it, reconstructing it entirely or removing it. This includes safe disposal of assets or recycling and re-use, where appropriate.	Other than Line 3, there has been no disposal of other subway structures. Therefore, the lifecycle does not include the plan for asset retirement or disposal, at the time being. Smaller structural components, such as the Prince Edward Viaduct track beams, and other similar ancillary structures, are replaced at the end of life, which can vary in length.	Discrete as required during lifetime.

8.2.11 Current Maintenance Projects

The following significant structural maintenance projects are being undertaken throughout 2024:

- Asbestos Abatement.
- Tunnel & Station Leak Remediation.
- Prince Edward Viaduct Beam Replacement.
- Structure Rehabilitation.

- EC&E Major Rehabilitation Programs.

These activities are reviewed continuously to ensure the highest priority defects are addressed as identified by the latest data from structural inspections and condition assessments. The program of work is also kept under review to ensure the impact of the work on subway operational requirements is minimized.

8.2.11.1 Asbestos Abatement

Thermal and acoustic asbestos bearing material has been used in varying quantities throughout the construction of the TTC's facilities. In the subway system, asbestos was used as an insulation material on tunnel walls, station ceilings and piping. The TTC implemented a program in the early 1980s to remove asbestos-containing insulation in the subway system.

The asbestos (and sometimes mold) is removed by the TTC's internal workforce qualified in designated material removal. Finch to Eglinton on Line 1 is the focus of this work; in addition, asbestos abatement works are carried out as required prior to the commencement of other projects at subway track level, if it is determined that asbestos may be disturbed during the works.

Further details of the program are provided in Table 8-15.

Table 8-15 Asbestos Abatement Program.

Activity	Frequency
Type 2 Removals	As needed – medium risk of asbestos exposure to workers.
Type 3 Removals	Approximately 15,000 sq. ft. annually – high risk of asbestos exposure to workers.
Mould Abatement	As needed.

8.2.11.2 Tunnel & Station Leak Remediation

Tunnel and station leak remediation works are required to ensure the environment remains benign and hence minimizes the risk of resulting deterioration of the tunnel and station condition. Remediation works are prioritized based on the areas identified as having the highest degree of reoccurring incidents that compromise the safe operation of the transit system.

In addition, the scope of the program addresses new water leaks, which may arise during the rehabilitation of the pre-cast concrete tunnel linear sections as well as during the rehabilitation of various other structures, including box structures, stations, and vent/fan shafts. New tunnel structures (e.g. the Toronto-York Spadina Subway Extension on Line 1, and Line 4 Sheppard) also developed leaks immediately after construction due to various issues and needed excessive leak repair.

Further details of the program are provided in Table 8-16.

Table 8-16 Tunnel & Station Leaks Program.

Activity	Frequency
Tunnels	Approximately 250 leak locations annually.
Stations	Approximately 100 leak locations annually.
Installation of waterproofing membranes	As needed.

8.2.11.3 Prince Edward Viaduct Beam Replacement

The purpose of this project is to replace deteriorated concrete track supporting beams and bearings that were installed in the early 1960s on the Prince Edward Viaduct (PEV). These concrete beams and bearings are deteriorating from freeze-thaw cycles and penetration of salt-laden water, originating from failures in the top deck expansion joints and drainage system.

Every two years, the bridge track beams and sidewalk panels are inspected and the plan for beam replacement is reviewed based on previous and current inspection findings. The majority of the original beams have now been replaced during a program that saw 12 beams on average replaced annually; the last original beam is scheduled for replacment in 2024. A second round of beam replacement commenced in 2001 and the current rate of replacement is six-to-12 beams per year.

The TTC has a special work car (RT27) that was designed and built specifically for the purpose of beam replacement. The use of this work car, combined with specially trained crew ensures efficient, safe and timely beam replacement. Beams are replaced during overnight maintenance periods between Saturday and Sunday when track access is maximized.

Further details of the program are provided in Table 8-17.

Table 8-17 Prince Edward Viaduct Beam Replacement Program.

Activity	Frequency
PEV Beam Replacement	Between 6-12 beams annually.
PEV Repairs	As needed.

Figure 8-11: Replacing Beams on the Prince Edward Viaduct.

8.2.11.4 Structure Rehabilitation

Structure Rehabilitation is a maintenance activity that can take many forms depending on the nature of deterioration present, the location and type of structure, and the required work needed to rehabilitate the structure.

The most common defect is loose and deteriorated concrete, which is detected during inspections and scheduled for removal. This ensures the safety of the public and employees. Loose concrete is first removed using hand tools only. If further removals are required, the location of any utilities are confirmed prior to removal of loose concrete with power tools (chipping). This is followed by concrete repairs (patching) when time permits on a non-emergency basis depending on location and structural function.

In addition, there can be many other activities undertaken, such as:

- Repair of deteriorated concrete at track level (invert and floor slabs, beams, columns, walls, catwalks, stairs);
- Renewal and maintenance of structural joints;
- Repairs of concrete and steel liners in bored tunnels, including repairs to the liner keys;
- Drainage cleaning and repair, vacuuming of maintenance pits and pump room pits, cleaning invert and tunnel walls; including unclogging and flushing buried storm water drainage pipes;
- Removal or construction of structure elements as part of projects done by others, such as rearrangement of walkways, walls, equipment bases, cutting and coring of concrete, cutting platform edges; and
- Removal of old and non-functional structures for other asset owners, such as obsolete light poles presenting a risk to the safe operation of the system.

Further details of the program are provided in Table 8-18.

Table 8-18 Structure Rehabilitation Program.

Activity	Frequency (access dependent)
Routine Inspections	Every 2-4 years (see Table 8-10).
Superficial and Emergency Inspections	As needed.
Monitoring/Supplementary Inspections	As needed.
Spall Repairs	Approximately 150m^2 annually.
Structure Steel Repairs	As needed.
Priority Concrete and Man-Made Material Fibre (MMMF) Removals	As needed.
Rehabilitation of Station Platform Edges	As needed.
Tunnel Liner Repairs	Continuous – approximately 10 annually.
Tunnel Liner Replacement	As needed.
Tunnel Flushing	Annually or as needed.
Manhole Vacuuming and Drain Cleaning	Bi-annually or as needed.

8.2.11.5 EC&E Major Rehabilitation Programs

The TTC's Engineering, Construction and Expansion (EC&E) Group also undertake major additional rehabilitation programs. If the structural work required exceeds the capabilities of the TTC's Structure Maintenance team's resources whether due to amount or complexity of work, or due to specific expertise or equipment being required, then Structure Maintenance follows a process to hand the work over to EC&E to undertake.

EC&E has a robust and well-developed process for larger and more complex projects, which are over and above typical maintenance activities. Typical projects that are outsourced to EC&E would be paving, roofing, drainage improvements, bridge bearing replacements (other than PEV), culvert renewals or complex repairs, various station renewals and improvements, and various structural rehabilitations. The Structure Maintenance team and EC&E work closely together to ensure the work is co-ordinated effectively to minimize disruption to the provision of service.

8.2.12 Costs

$525 million is estimated to be required to uphold the state of good repair of structures between 2024 and 2033. Approved funding for lifecycle costs of structures assets are included in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. The *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* provides detail of the unfunded activities related to structures assets.

Further details on funding requirements can be found in extracts from the *2024-2038 Capital Investment Plan*, with the funded and unfunded elements set out in the *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs* in Appendix E: Capital Investment Needs.

The total conventional and Wheel-Trans operating budget as well as the 2024-2033 Capital Budget and Plan is described in the *Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan*. An extract of these budgets is contained in Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan.

8.2.13 Risks

Lifecycle activities are undertaken to minimize the risks to the achievement of the TTC's levels of service. A summary of the key risks, and the mitigation actions in place, is contained in Table 8-9.

Table 8-19: Key Structures Risks.

Risk	Impact	Mitigation
Public exposed to asbestos.	Public exposed to increased risk of developing asbestos-related diseases.	Asbestos Abatement Program – Abatement of deteriorated asbestos containing material surfaces.
Employees exposed to asbestos.	TTC employees exposed to increased risk of developing asbestos-related diseases. Projects are delayed until asbestos abatement works have been completed.	Asbestos Abatement Program – Material testing undertaken prior to any construction work – Abatement works undertaken as needed before projects commence.
Employees exposed to mold.	TTC employees exposed to increased risk of developing mold related diseases. Projects are delayed until mold abatement works have been completed.	Asbestos Abatement Program – Mould abatement as direct by Occupational Health. Abatement works undertaken as needed before projects commence.
Tunnel and station water ingress cause deterioration of concrete and steel tunnel components and corrosion of the subway rails and other subway related assets.	Condition of concrete tunnels deteriorates due to corrosion of steel reinforcement causes the concrete to spall. Condition of rails deteriorates due to corrosion.	Tunnel & Station Leak Remediation Program to prevent water ingress into tunnels and stations as required.
A Prince Edward Viaduct track beam collapses.	Operation of subway lines is disrupted and risk of injury to public and TTC employees.	Prince Edward Viaduct track beams replaced, as required.

Loose concrete falls on public, TTC employees, subway cars or other assets.	Public and TTC employees placed at risk of injury due to falling concrete or operation of subway lines is disrupted due to falling concrete causing impact with subway cars or other assets.	Structure Rehabilitation Program – Areas of spalling concrete identified by inspection program followed by concrete removals as required.
Tunnel liner collapse.	Operation of subway lines is disrupted and risk of injury to public and TTC employees.	Structure Rehabilitation Program – Liner repairs as required.
Box structure, station, bridge or other structure collapse.	Operation of subway lines is disrupted and risk of injury to public and TTC employees.	Structure Rehabilitation Program – Structural elements repaired, as required.
Drainage systems become blocked.	The subways become flooded causing disruption and rail corrosion.	Structure Rehabilitation Program – Vacuuming the drainage pits to remove silt and debris and jet snaking horizontally to remove accumulation of detritus, as required. Flushing of the track invert (floor) as required to keep it clean of mud and debris.

9. Replacement Costs

The TTC has grown to become one of the most visible and vital public service organizations in North America. It has a large, complex, and diverse range of infrastructure assets with an estimated asset value of $25.18 billion, on which it relies to deliver essential public services.

The replacement values shown in this section are based on the TTC 2023 Property Insurance Report data, which covers the replacement cost of TTC assets including, but not limited to, Facilities, Tunnels, Structures and Associated Equipment and Fleet. This information was calculated as of December 31, 2022, and covers the insurance period from June 1, 2023, to June 1, 2024.

The asset replacement valuation has been based on the historical cost of the constructed asset, inflated to estimate its replacement value during the current insurance period. The following escalation factors have been used to calculate the cost for this period:

- Infrastructure Assets: 1.1446249
- Vehicle Assets: 1.0766

It is understood that the replacement costs only cover direct costs and no other associated costs, such as design costs, access costs, and disposal costs. It is projected that the costs that comprise these values will continue to trend upwards with the implementation of new construction standards, inflationary pressures, and increased function and use of these assets.

9.1 Asset Class Breakdown

The estimated total replacement value for the TTC's fleet is $7.104 billion, which consists of both operational (revenue) and non-operational (non-revenue) vehicles.

Facilities are currently valued at $5.036 billion, which is inclusive of facility "contents". The contents at each facility could include, but is not limited to, any number of the following items:

- Barrier Rails and Ornamental Metal
- Telephone System and Booths
- Collectors' Booths
- Collectors' Booth Equipment
- Furnishings, Concession Booths
- Switchboards
- Lighting & Dist. Panel boards
- Lighting Fixtures
- Conduit & Wireway Sections
- Transfer Switches
- Emergency Lights
- Misc. Electrical Wiring & Devices
- Batteries & Battery Chargers
- Clocks
- Exhaust Fans and Ductwork
- Drainage Pumps
- Ejector Pumps
- Heaters & Air Conditioners
- Fire Protection System
- T.V. System

The linear infrastructure is currently valued at $2.883 billion, although this figure is absent of below ground subway track because these assets are currently incorporated into the Bored Tunnels part of the Structures asset class.

Systems are currently valued at $1.056 billion, although this figure does not currently include any information relating to mechanical systems or other systems, such as finance and IT.

Finally, structures are currently valued at $9.099 billion, though it should be noted that this figure is currently inclusive of below ground subway track figures because they form part of the Bored Tunnels sections of the insurance report.

A summary of these figures can be seen in Table 9-1 below:

Table 9-1: Summary of Replacement Cost Values by Asset Class.

Asset Class	Total Replacement Cost ($ Billions)	Notes
Fleet	$7.104	This figure is currently inclusive of Line 3 subway cars and associated service vehicles (which are in the process of being decommissioned following the closure of Line 3 and are no longer in operation).
Facilities	$5.036	This figure includes contents.
Linear Infrastructure	$2.883	This figure does not currently include below ground subway track because it is included within the Bored Tunnels part of structures.
Systems	$1.056	This figure does not currently include mechanical systems and other systems (IT) because these figures are packaged into the Contents section of facilities.
Structures	$9.099	This figure includes below ground subway track.
Total Replacement Cost	**$25.178**	

It is anticipated that these figures may change as the Improvement Plan is implemented and more accurate financial information can be aligned to the sub-asset classes within each category.

10. Response to Growth

10.1 Development of Forward Plan

In 2023, the TTC published a Board report titled, *'Sustaining a Reliable Transit System: Outlook 2024 and Beyond'* to highlight the challenges faced in realizing the benefits of public transportation to the city of Toronto and its three million residents by enabling access to employment, education, services, and social connection through an integrated mass transit network.

When developing the TTC's forward plan for 2024 and beyond, the following factors were taken into consideration:

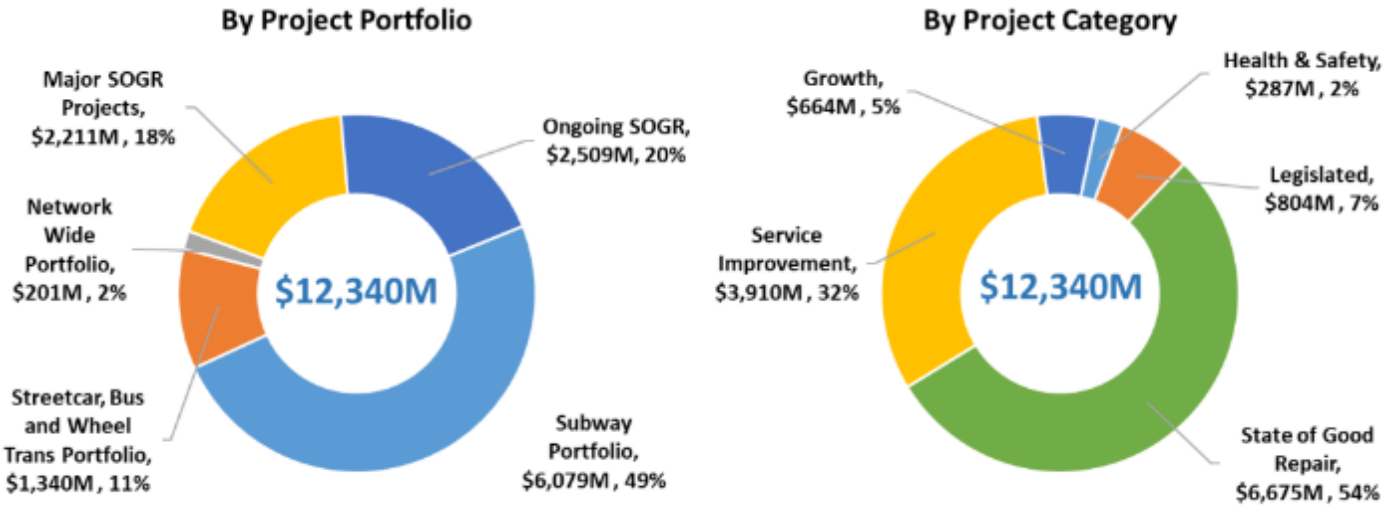
- Ridership is currently averaging at 74% of the pre-pandemic level, due in large part to the continuation of hybrid work averaging 2.3 days per week in the office (18% of the gap, with the other 12% of the gap due to mode shift).
- Recovery of ridership continues to be strongest on bus compared to other modes (boardings at 84% pre-pandemic levels) and serves many of Toronto's equity-seeking communities, compared to streetcar and subway use at 57% and 63% pre-pandemic levels, respectively.
- Recent data shows traffic congestion in Toronto is near pre-pandemic levels despite 50% of office worker trips not taking place. Major construction is also planned and underway over the next seven-to-eight years with further potential impacts on surface transit reliability.
- Customer experience and satisfaction are important to attracting and retaining riders. However, concerns regarding streetcar service and community safety, among other factors, have resulted in a decline in customer satisfaction scores.
- The heavy reliance on the farebox has demonstrated the vulnerability of the system and poses a risk to service (approximately 70% of operating costs pre-pandemic were funded by fares); the TTC continues to face significant ridership revenue impacts from COVID.
- New rapid transit services are being built that will transform the network, but also introduce new operating cost pressures to a challenging fiscal framework once entered into revenue service (e.g. Line 5, Line 6 and future subway expansion).
- Population growth in Toronto and the region is expected, with Toronto's population expected to grow to 3.56 million by 2051. With a current transit mode share of 23% (compared to 27% pre-pandemic), and the City's TransformTO goals to increase share of trips taking sustainable transportation modes – ensuring the competitiveness of public transit will be key in a climate-changed environment.

10.2 Service Improvement and Growth

The TTC has established a long-term planning horizon to 2041, based on an assumed annual growth rate of 1.5% to address forecasted population and ridership growth. This information is used to determine long-term service and fleet plan requirements, which are inputs to the capital asset plans. Along with an assessment of SOGR requirements based on asset management practices, the TTC utilizes this information to determine capital investment needs for the system. The City's TransformTO policy will also have an outsized impact on the TTC's capital and operating growth across all vehicles.

Figure 9-1 below shows the distribution of spend across project portfolios and by project category between 2023 and 2032, with 37% of the total allocated to service improvement and growth.

Figure 10-1: 2023-2032 Base Capital Plan (extracted from TTC 15-Year CIP).



10.3 Expansion Plans

The TTC is committed, with its partners, to growing the Toronto transit network through a series of expansion projects. Figure 10-2 below reflects the existing and future transit network around the city of Toronto and its neighbouring regions. However, YNSE, SSE, ECLRT, FWLRT and the Ontario Line will be Provinicial assets upon completion and will be owned and managed by the Province.

- Line 1 – Yonge North Subway Extension (YNSE)

  This Metrolinx-led subway development will extend Line 1 from Finch Station to Richmond Hill Centre Station. Spanning eight kilometres and serving five stations, the extension is proposed to connect to a number of bus and train services from the TTC, GO, Viva, and York Region Transit.

- Line 2 – Scarborough Subway Extension (SSE)

  Led by Metrolinx, this extension will replace the now-decommissioned Line 3 Scarborough RT by expanding Line 2 from Kennedy Station to Sheppard Avenue East and McCowan Road, through Scarborough Centre. The extension will add 7.8 kilometres to Line 2 and serve an additional three stations, connecting the downtown core to further transit links from the TTC, GO and Durham Region services.

- Line 5 – Eglinton Crosstown Light Rail Transit (ECLRT)

  A new light rail transit line being built by Metrolinx will run across Eglinton Avenue, from Mount Dennis to Kennedy Station, spanning 19 kilometres in total, including a 10-kilomtre underground section through the middle of the city. Featuring 25 stations and stops along Eglinton Avenue, the service will connect to TTC bus routes, subway stations and GO lines. The TTC and the City of Toronto are exploring the option of advancing the ECLRT further east, extending the line from Kennedy Station to pass through the University of Toronto Scarborough Campus and terminate at the future Line 2 terminus at Sheppard Avenue and McCowan Road.

- Eglinton Crosstown West Extension (ECWE)

  Led by Metrolinx, this extension will add 9.2 kilometres to the Eglinton West Crosstown LRT and will connect the future Mount Dennis LRT Station to Renforth Drive. Serving seven stations, the extended route will operate mainly underground and connect to local and regional transit options from the TTC, MiWay and GO. Additional plans are being explored to extend the line further west by 4.7 kilometres to Pearson International Airport.

- Line 6 – Finch West Light Rail Transit (FWLRT)

  A new light rail transit line being built by Metrolinx that will run along Finch Avenue West, between Keele Street and Humber College. Spanning 11 kilometres, the line will pass 18 stops and link to Line 1's Finch West Station.

- Ontario Line

  The Ontario Line will be a 15.6-kilometre subway line running from Exhibition Place, through downtown Toronto and out to the Ontario Science Centre (where it is presently located). Planned by Metrolinx, the line will introduce 15 new stations to the city and connect to transit options, including Line 1, Line 2, the Eglinton Crosstown LRT, many TTC streetcar and bus routes, and the GO network.

- Waterfront Transit Network Expansion

  With significant development along Toronto's waterfront, the TTC and the City of Toronto completed a Waterfront Transit "Reset" Study, which identified future transit needs and options within the area. Focusing on the waterfront from Long Branch in the west through to the TTC's Leslie Barns streetcar facility in the east, a series of individual projects were identified to strengthen transit links, and they are now in various stages of planning, design and approval processes.

Figure 10-2: Existing and Future Rapid Transit Network.

11. Improvement Plan

11.1 The TTC's Asset Management Journey

The publication of the O.Reg in 2017 reflected the Province's commitment to guide investments in municipal infrastructure and to facilitate asset management best practices throughout the municipal sector, providing a degree of consistency to Asset Management Plans, and leveraging Asset Management Planning to optimize infrastructure investment decisions.

Effective asset management ensures that an organization's assets are managed in a way that balances the achievement of the required level of performance while managing risk and reducing whole-life cost. It involves the development of strategies and plans aligned to an organization's corporate objectives that are based on lifecycle decision-making.

The Province has encouraged municipalities to consider compliance with the regulation as a starting point, and this is reflected in the TTC's aim to go beyond regulatory compliance and and improve its asset management maturity by fully aligning with transit asset management best practice.

The TTC is developing an Enterprise Asset Management (EAM) program to achieve an increased maturity across the entire organization. The program has identified a series of projects to be delivered, which will focus on improving capability in key asset management areas, such as governance, decision-making, lifecycle delivery, asset information, people, and risk management.

Improving asset management capabilities provides the TTC with an opportunity to address many asset-related challenges:

Table 11-1: TTC existing challenges.

Challenge	How asset management will help
Funding gap as a result of lower farebox recovery	Ability to show link between spending on assets and on performance, enabling prioritization decisions to be made. Demonstration to funders that the TTC is optimizing costs across the whole asset lifecycle.
Aging infrastructure base	Enables the TTC to review different options using a risk-based approach to optimize state of good repair (SOGR) maintenance and renewal activities.
Asset performance below desired levels	Development of operations and maintenance policies, which identify the correct balance between cost, risk, and performance.
Onboarding of new assets (e.g., the Scarborough and Yonge subway extensions)	Development of standardized approaches to operations and maintenance activities, which are aligned to the requirements of Metrolinx.
Growth in demand as a result of population increases in the City and GTA	Identification of demand changes ahead of time and feed into decision-making on investment.
Need to meet net-zero goals and adapt to climate change	Inclusion of net-zero deadlines in decision-making criteria. Whole-life costing and performance analysis to take into account greenhouse gas emissions and requirements to improve resilience to extreme weather events.

The EAM program assesses the current state and projects future needs of the existing capital assets to ensure informed and proactive decision-making. The outcome of this program is evidence-based investments and

capital financing strategies that maintain the assets and services in state of good repair and aligns with the TTC's objectives.

11.2 Asset Management Plan 2025

While this Asset Management Plan meets the requirements of the regulation for 2024, the final phase due on July 1, 2025, requires the TTC to have a financial plan in place that identifies future levels of service, and the lifecycle needs and costs of all assets to meet those levels of service. To achieve this, the TTC plans to:

1. Identify proposed levels of service as progression from those shown in this 2024 document;
2. Identify the lifecycle activities and costs associated with those levels of service;
3. Improve whole-life costing capabilities to facilitate investment options analysis; and
4. Improve risk identification and evaluation capabilities to allow more informed investment options analysis.

The EAM program will support this and include a series of projects aligned to the development of future Asset Management Plans.

Figure 11-1 shows a list of the proposed programs and their intended benefits:

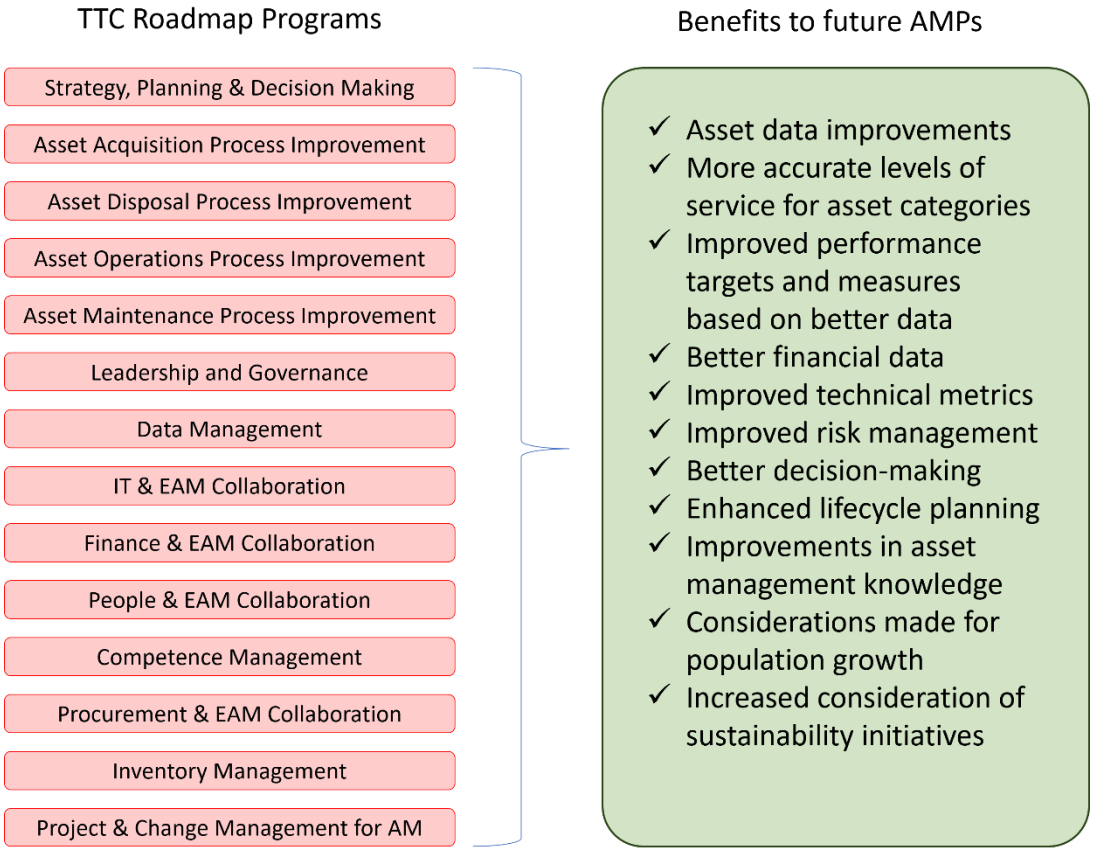


Figure 11-1: The TTC's EAM roadmap programs and the benefits to future AMPs.

12. Appendix A: Service Standards

12.1 Service Standards

The following is a summary of the key elements of the TTC Service Standards.

12.1.1 Coverage and Access Standard

The TTC provides, at minimum, coverage and access to transit service as presented in Table 12-1.

Table 12-1: Coverage and access to service.

Operating Day	% of Population and Employment	Within Walk Distance	Within Walk Time
Base Network - "All-Day, Every-Day" Weekdays* - (6:00 am to 1:00 am) Saturdays** - (6:00 am to 1:00 am) Sundays** - (8:00 am to 1:00 am)	90%	400 metres	5 minutes
Overnight Network - "Blue Night" Every Day (1:30 am to 6:00 am)	95%	1,250 metres	15 minutes

* Proximity standard measured against service during AM peak operating period.

** Proximity standard measured against service during afternoon operating periods.

12.1.2 Surface Stop Spacing

The TTC place bus stops in accordance with the standard presented in Table 12-2.

Table 12-2: Bus Stop Spacing Standards.

Service Classification	Stop Spacing Range
Streetcar	300 - 400 metres
Bus – Local	300 - 400 metres
Bus – Express (Tier 1)	650 – 1,000 metres
Bus – Express (Tier 2, Limited Stop)	650 – 1,000 metres
Bus – Express (Tier 2, Local/Express)	>650m for express portion; 300 – 400m for local potion
Bus – Community	flag stop

12.1.3 Span of Service and Service Levels

The TTC provides transit service 24 hours a day, seven days a week. The span of service (operating hours) and service levels (frequency of service) determine the availability and convenience of transit service for customers. The span of service and service levels vary for each transit service classification: rapid transit (subway and LRT), streetcar, bus.

Table 12-3 presents the minimum span of service and service levels for each transit service classification. In many cases, however, routes need to operate more frequently than the minimum frequencies to accommodate higher ridership levels. In these cases, vehicle crowding standards match service to the number of riders using a particular transit service at a given time.

Table 12-3: Service levels.

Operating Period	Minimum Service Levels (minutes)					
	Rapid Transit*	Streetcar	Bus - Local	Bus - Express (Tier 1)	Bus - Express (Tier 2)	Bus - Community
Weekdays						
Morning Peak 6:00 am - 9:00 am	6	30	30	10	15	
Midday 9:00 am - 3:00 pm	6	30	30	15		60
Afternoon Peak 3:00 pm - 7:00 pm	6	30	30	10	15	60
Early Evening 7:00 pm - 10:00 pm	6	30	30	15		
Late Evening 10:00 am - 1:00 am	6	30	30			
Overnight 1:30 am - 5:30 am		30	30			
Saturdays						
Early Morning 6:00 am – 8:00 am	6	30	30			
Morning 8:00 am – 12:00 pm	6	30	30	15		
Afternoon 12:00 pm – 7:00 pm	6	30	30	15		
Early Evening 7:00 pm – 10:00 pm	6	30	30			
Late Evening 10:00 pm – 1:00 am	6	30	30			
Overnight 1:30 am - 5:30 am		30	30			
Sundays/holidays						
Early Morning 6:00 am – 8:00 am		30	30			
Morning 8:00 am – 12:00 pm	6	30	30	15		
Afternoon 12:00 pm – 7:00 pm	6	30	30	15		
Early Evening 7:00 pm – 10:00 pm	6	30	30			
Late Evening 10:00 pm – 1:00 am	6	30	30			
Overnight 1:30 am - 5:30 am		30	30			

Note: Service is subject to ridership meeting minimum performance standards. For local bus routes, the standard applies to all branches of the route.

*New rapid transit lines may have a frequency of up to 10 minutes in the first few years of operation until ridership matures.

12.1.4 Vehicle Crowding

Average vehicle crowding sets a standard of comfort for passengers while on board transit vehicles. The standard determines the appropriate level of service based on the maximum load point, or the greatest number of customers riding at one time, in the busiest direction, along a route during the busiest 60 minutes of each period of service. The number of customers at other locations along the route, and in the reverse direction, is lower (often much lower) than the maximum load point.

Vehicle crowding standards are applied as an average. For example, the off-peak crowding standard for vehicles calls for a seated load, with no standees. This standard does not guarantee that no customers will stand; it does ensure that, on average, vehicles will carry a seated load of customers during the busiest 60 minutes during off-peak periods of service.

Table 12-4 provides a summary of the TTC's vehicle crowding standards.

Table 12-4: Vehicle crowding standards.

Transit Service Classification / Vehicle Type	Peak periods	Off-peak periods**
Bus (local, express)		
Orion VII 12-metre low-floor bus (38 seats)	53	38
Orion VII 12-metre low-floor bus (36 seats)	51	36
New Flyer D40LF 12-metre low-floor bus	50	35
Nova LFS 12-metre low-floor bus*	51	35
Nova LFS artic 18-metre low-floor bus*	77	46
Bus (community)		
To be determined	seated load	seated load
Streetcar		
Standard 15-metre streetcar (CLRV)	74	42
Articulated 23-metre streetcar (ALRV)	108	61
Articulated 30-metre low-floor streetcar*	130	70
Rapid transit		
Train (6 cars, TR-series)	1100	540
Train (6 cars, T-series)	1000	500
Train (4 cars, S-series)	220	130
Train (4 cars, TR-series)	740	370

Note: *Standards for new vehicles are subject to confirmation after in-service experience.
**The off-peak crowding standard for bus is a seated load up to a minimum of 35

12.1.5 Service Reliability – Surface Transit

Convenience, comfort, predictability and dependability are the main features customers expect of a transit system. A person using any transportation mode has an expectation that the service will be reliable. Services that cannot meet their published schedules or provide a consistent headway lose the loyalty of their customers. A consistent and reliable service reduces the variability of wait times for customers and improves comfort as customers are evenly distributed between vehicles.

12.1.5.1 On-Time Performance

The on-time performance of a route is affected by many variables including: traffic congestion, traffic incidents, construction-related delays, weather, etc. On-time performance standards vary by frequency of service and provide the tools for evaluating the on-time performance of individual TTC routes. Passengers using high-frequency services are generally more interested in regular, even headways than in strict adherence to published timetables, whereas passengers on less frequent services expect arrivals/departures to occur as published.

Table 12-5 provides a summary of the TTC's on-time performance standards.

Table 12-5: On-time performance standards.

On-Time Departure	To be considered on-time, a vehicle must leave its origin timepoint between one minute early and five minutes late. The TTC's goal is to have 90% of all trips depart on-time.
On-Time Arrival	To be considered on-time, a vehicle must arrive at its terminal timepoint between one minute early and five minutes late. The TTC's goal is to have 60% of all trips arrive on-time.

12.1.5.2 Headway Performance

Table 12-6 provides a summary of the TTC's headway performance standards.

Table 12-6: Headway performance standards.

Service frequency greater than 10 minutes	Service is considered to be on time if it is no more than one minute early and no more than five minutes late. The TTC's goal is to have 60% of all trips meet the on-time performance standard.
Service frequency greater than and equal to five minutes and less than and equal to 10 minutes	For services that operate between five and 10 minutes, passengers do not rely on printed schedules, but expect vehicles to arrive at prescribed headways. Therefore, on-time performance for frequent service is measured by how well actual headways correlate to 15 scheduled headway intervals. Trips are monitored at a location based on arrival time, without regard to whether the trip that arrived was scheduled for that time slot. The vehicle is considered on-time when the headway deviation is less than 50% of the scheduled headway. For example, a service that operates every six minutes is deemed on-time if the headway deviation falls between three minutes and nine minutes. The TTC's goal is to have 60% of all trips operated within +/-50% of the scheduled headway over the entire service day.
Service frequency less than five minutes	For services that operate better than five minutes, the vehicle is considered on-time when the headway deviation is less than 75% of the scheduled headway. For example, a service that operates every three minutes is deemed on-time if the headway deviation falls between 0.75 minutes and 5.25 minutes. The TTC's goal is to have 60% of all trips operated within +/- 75% of the scheduled headway over the entire service day.

12.1.5.3 Missed Trips

Any vehicle leaving more than 20 minutes late from an end is considered a 'missed trip'. The TTC's goal is to minimize the number of missed trips on each route.

12.1.5.4 Short Turns

A short turn is when a vehicle is turned back and taken out of service before reaching the terminus of a route. While some short turns are necessary, the TTC's goal is to minimize short turns due to schedule and Operator issues.

This score card is one of many initiatives underway to increase accountability and transparency at the TTC about how well we are serving our customers. This daily report shows at a glance how we did on the previous business day to meet our commitment to provide punctual subway/RT, bus and streetcar service as well as reliable up-time availability of elevator and escalator service in subway stations. Report for December 3, 2023.

Mode:	Our objective:	Our target:	Actual:	How we did:
1 Yonge-University	Deliver a punctual subway service[1]	90%	92%	✓
2 Bloor-Danforth	Deliver a punctual subway service[1]	90%	94%	✓
3 Scarborough	Deliver a punctual SRT service[1]	90%	N/A	N/A
4 Sheppard	Deliver a punctual subway service[1]	98%	93%	✗
Bus	On time departures from end terminals[3]	90%	83%	✗
Streetcar	On time departures from end terminals[3]	90%	70%	✗
Wheel-Trans	On time service	90%	82%	✗
Elevator	Provide easy access to our customers[2]	98%	100%	✓
Escalator	Provide easy access to our customers[2]	97%	97%	✓

Legend

1. % of Service (up to Headway + 3 minutes)
2. % of devices available
3. % of service (end terminal departures between +1 minute early and -5 minutes late) from two business days ago.

12.1.6 Service Reliability – Rapid Transit

12.1.6.1 On-Time Performance

As with frequent bus service, passengers on rapid transit do not rely on printed schedules, but expect trains to arrive at prescribed headways. Two different measures are used to evaluate on-time performance: headway performance and average trip time on each line.

Table 12-7 provides a summary of the TTC's On-time performance standards.

Table 12-7: On-time performance standards.

Service frequency less than and equal to six minutes	For services that operate better than six minutes, the vehicle is considered on-time when the headway deviation is less than 100% of the scheduled headway. For example, a service that operates every three minutes is deemed on-time if the headway deviation falls between zero minutes and six minutes. The TTC's goal is to have 95% of all trips operated within +/-100% of the scheduled headway over the entire service day.
Average Trip Time	The TTC's goal is to have 85% of trips operated within five minutes of scheduled total trip time by time period or +10% of scheduled trip time. The average trip time is measured as the train departs the terminal to when the train arrives at the terminal.

12.1.6.2 Capacity Delivered

Capacity delivered is measured as the number of trains that pass the peak point during the peak hour divided by the scheduled number of trains during the peak hour. The TTC's capacity delivered target is to deliver 90% of the scheduled trains per hour.

12.1.7 Service Productivity

Service productivity is a measurement of the effectiveness of the application of the the TTC's resources. The performance measurement must take into account that each service classification has different performance expectations and ridership potential, and, even within the same service classification, performance will vary.

Table 12-8 presents the service productivity performance targets for surface transit services – expressed as average boardings per revenue service hour.

Rapid transit productivity numbers are large and vary by line. It is impractical to apply a common standard to all rapid transit lines; therefore, the productivity of each line is assessed on an individual basis.

Table 12-8: Service productivity performance standards.

Operating Period	Streetcar		Bus – Local		Bus – Express (Tier 1)		Bus – Express (Tier 2)**		Bus – Community	
	Class Avg.	Route Min.	Class Avg.	Route Min.	Class Avg.	Route Min.	Class Avg.	Route Min.	Class Avg.	Route Min.
Peak Periods*	95	50	75	20	65	40	50	40	8	6
Off-Peak Periods	85	35	55	10	55	30	N/A	N/A	8	6

* Monday to Friday: 6:00 am - 9:00 am, 3:00 pm - 7:00 pm

**Excludes Downtown Premium Express Routes

12.1.8 Economic Performance

The TTC requires a municipal subsidy to deliver public transit service within the city of Toronto. Therefore, a primary objective of planning transit services is to ensure that all transit services operated by the TTC are as efficient and cost-effective as possible and, for that reason, affordable to both TTC customers and citizens.

In planning transit services it is important to have a measure that can compare the economic productivity of any given route in relation to other routes within a service classification or to the service classification average. Economic performance is therefore assessed based on the net cost per passenger using the formula shown below.

$$\text{Net cost per passenger} = \frac{\text{Route Operating Cost}}{\text{Route Boardings}} - \text{Average Fare per Boarding}$$

The net cost per passenger measure is reviewed annually – during the Annual Performance Review and during the Route Enhancement Plan process. Routes that perform within the bottom 10% of the service classification would be subject to compulsory review to recommend a change to either improve or remove the service. Individual route performance will be assessed annually.

12.1.9 Annual Performance Review

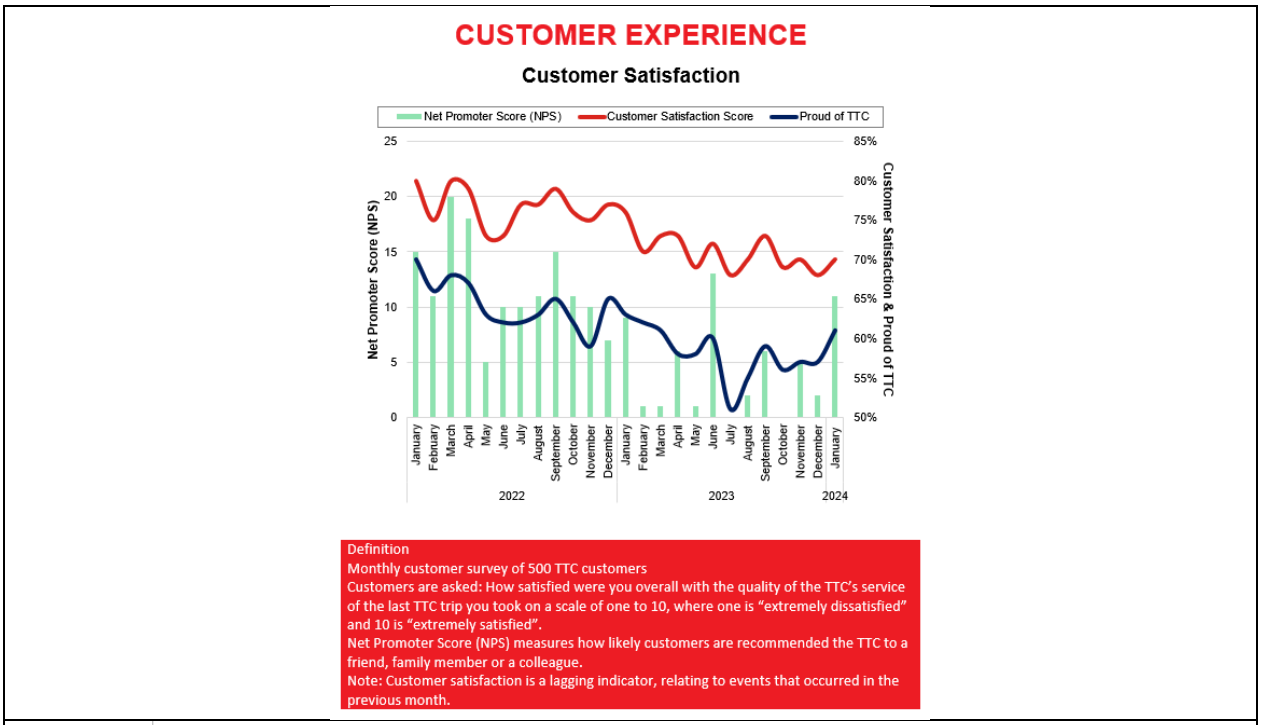
The Annual Route Performance Review provides a process to measure and evaluate route performance on a year-to-year basis. Under this program, existing services are evaluated against the standards and targets listed above. The Annual Route Performance Review is published in the Annual Service Plan.

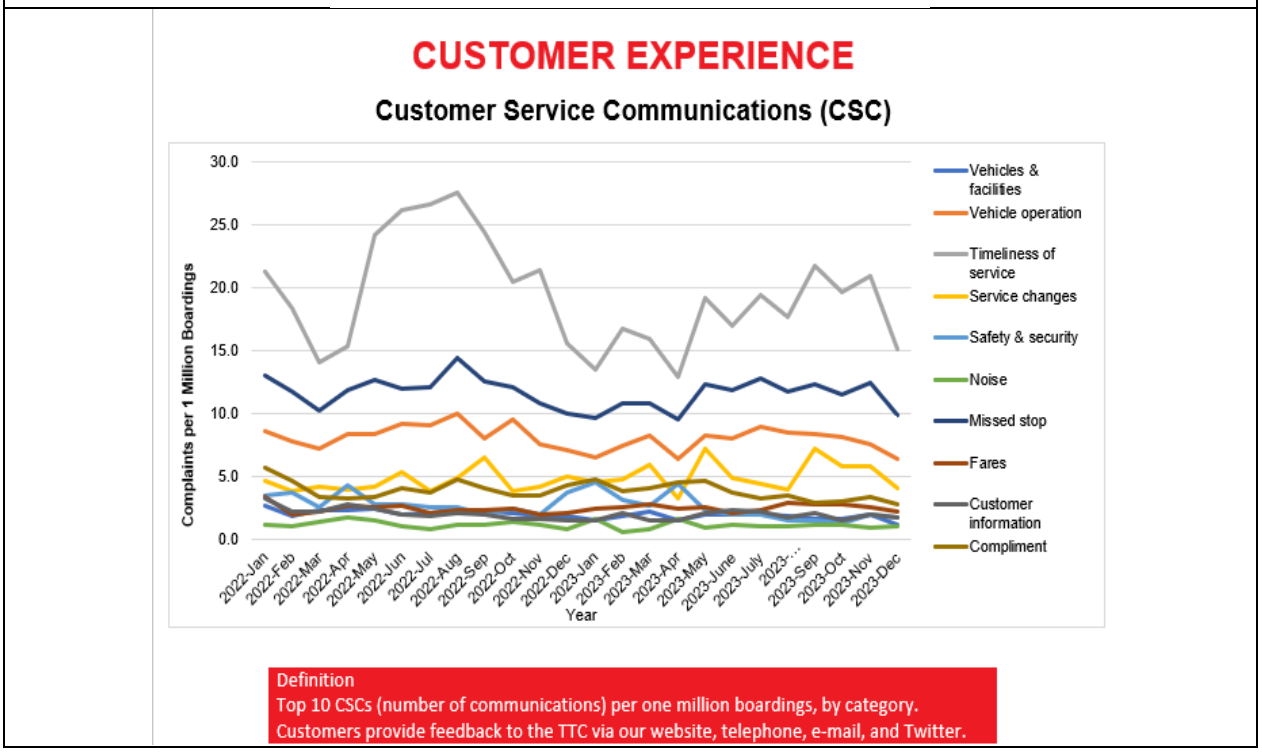
13. Appendix B: KPIs

13.1 Customer Experience

13.1.1 Customer Satisfaction & Customer Service Communications

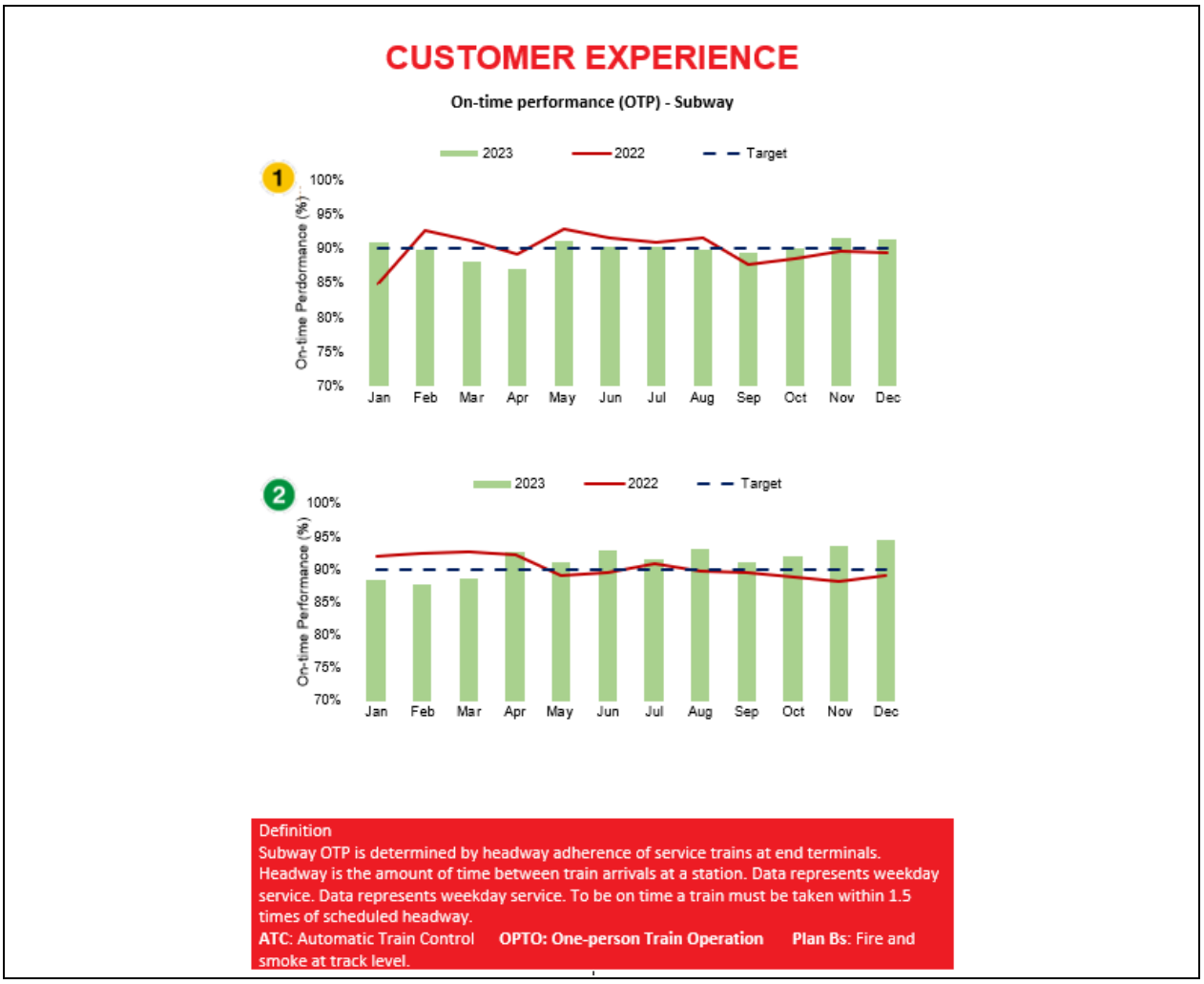
Figure 13-1: Customer Satisfaction and Customer Service Communications KPIs.

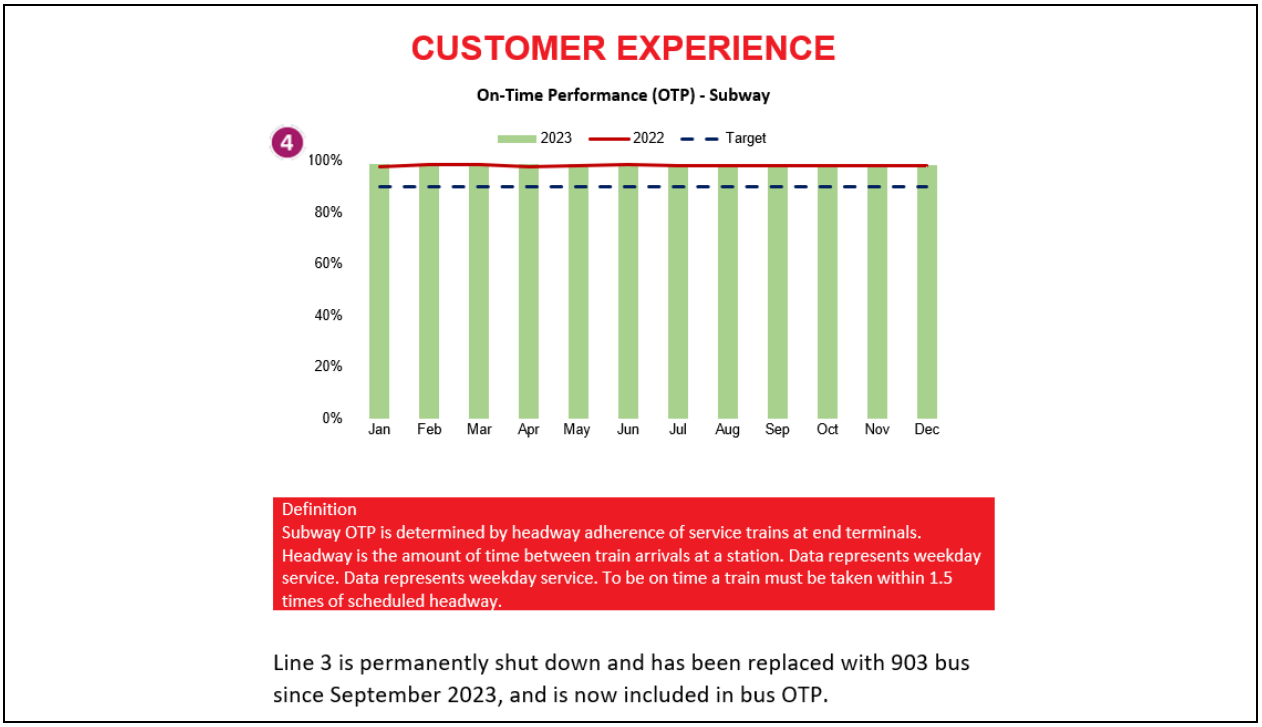




13.1.2 On-time Performance – Subway

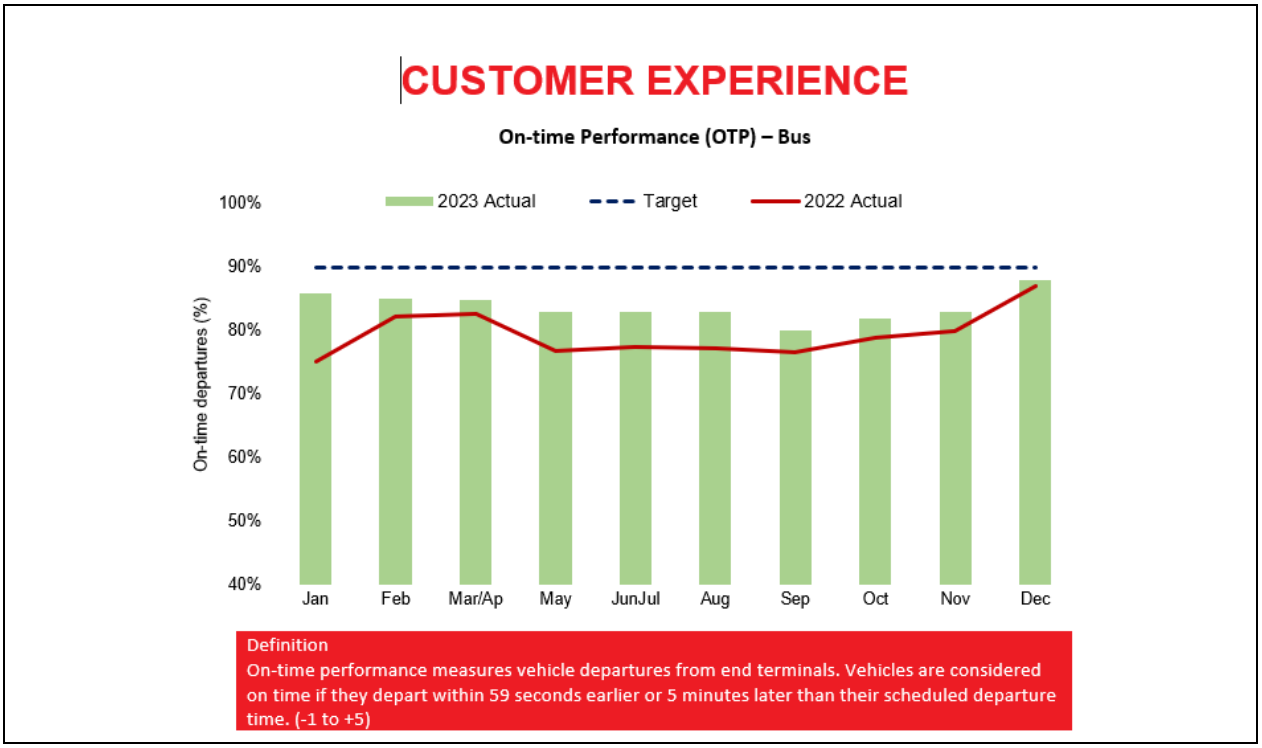
Figure 13-2: On-time Performance - Subway.





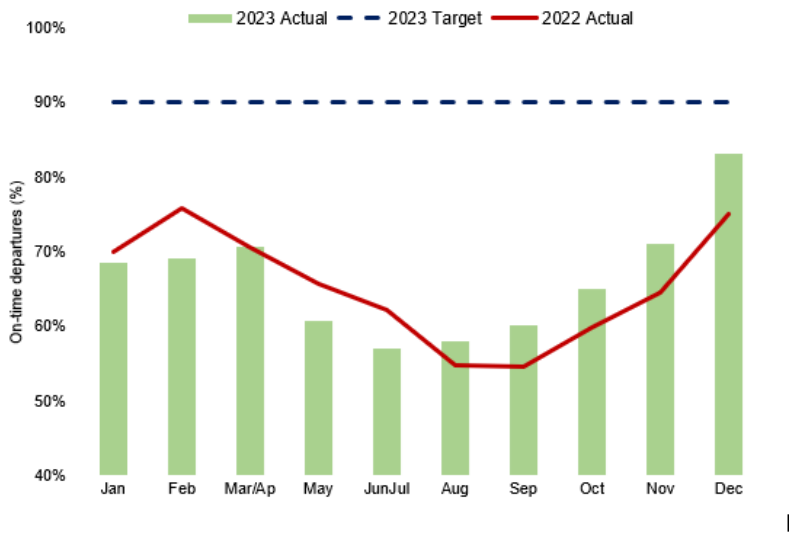
13.1.3 On-time performance – Buses, Streetcars & Wheel-Trans

Figure 13-3: On-time Performance – Buses, Streetcars and Wheel-Trans.



CUSTOMER EXPERIENCE

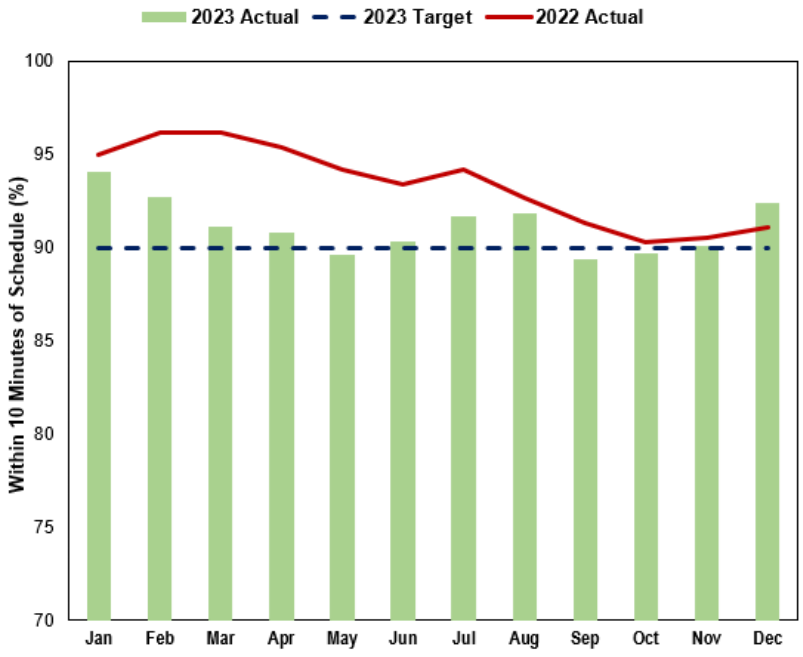
On-time Performance (OTP) - Streetcar



Definition
On-time performance measures vehicle departures from end terminals. Vehicles are considered on time if they depart within 59 seconds earlier or 5 minutes later than their scheduled departure time. (-1 to +5)

CUSTOMER EXPERIENCE

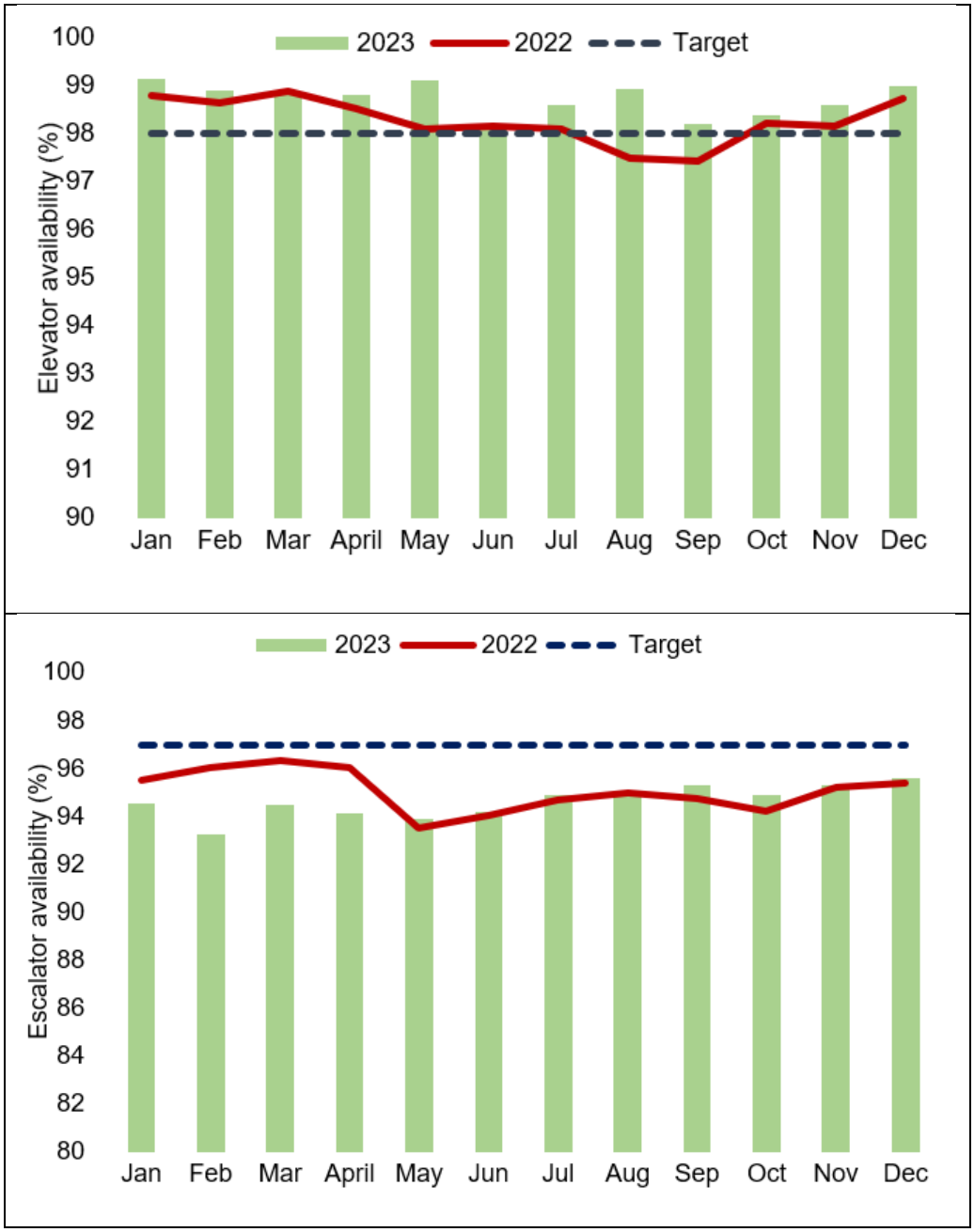
On-time Performance (OTP) – Wheel-Trans



Definition
On-time performance measures vehicle departures from end terminals. Vehicles are considered on time if they depart within 59 seconds earlier or 5 minutes later than their scheduled departure time. (-1 to +5)

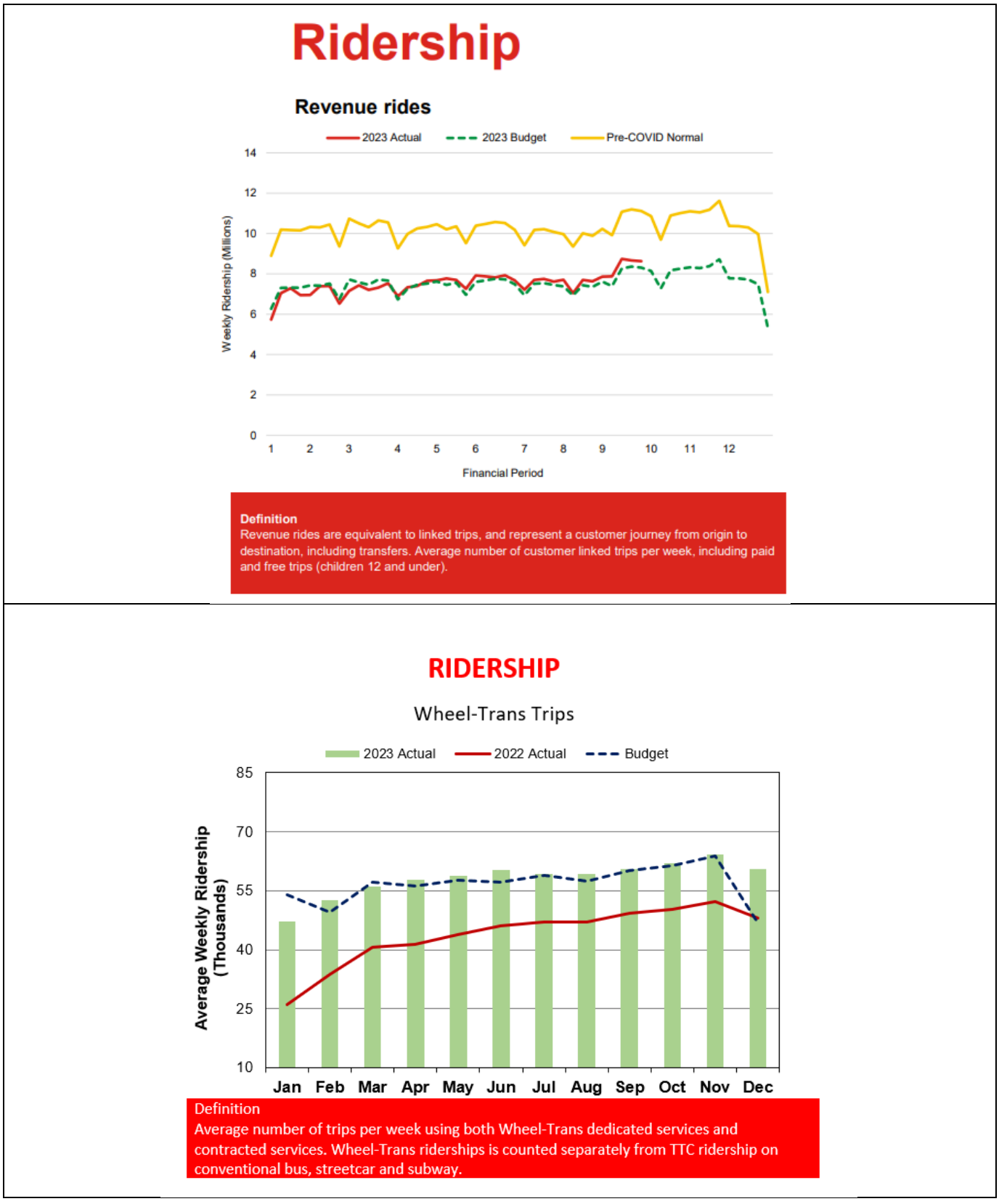
13.1.4 Accessibility – Elevator and Escalator Availability

Figure 13-4: Accessibility – Elevator and Escalator Availability.

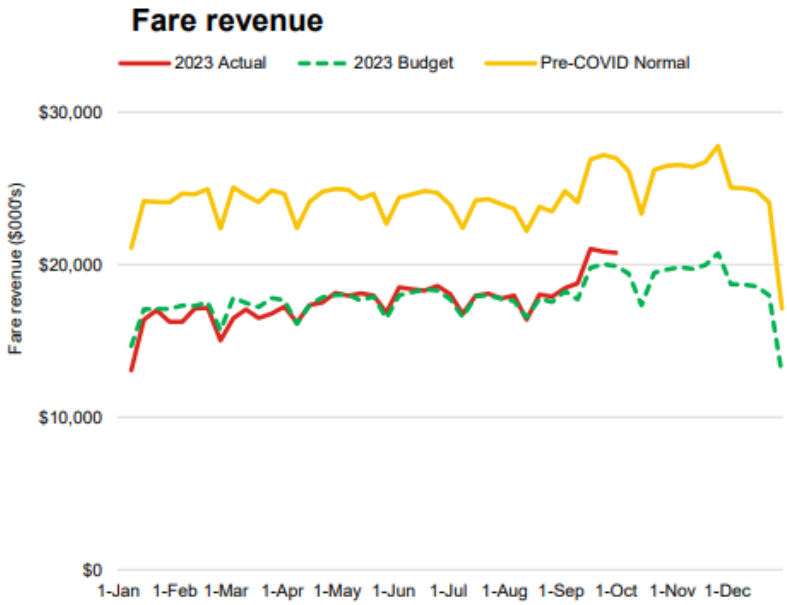


13.2 Ridership & Financial

Figure 13-5: Ridership and financial metrics.

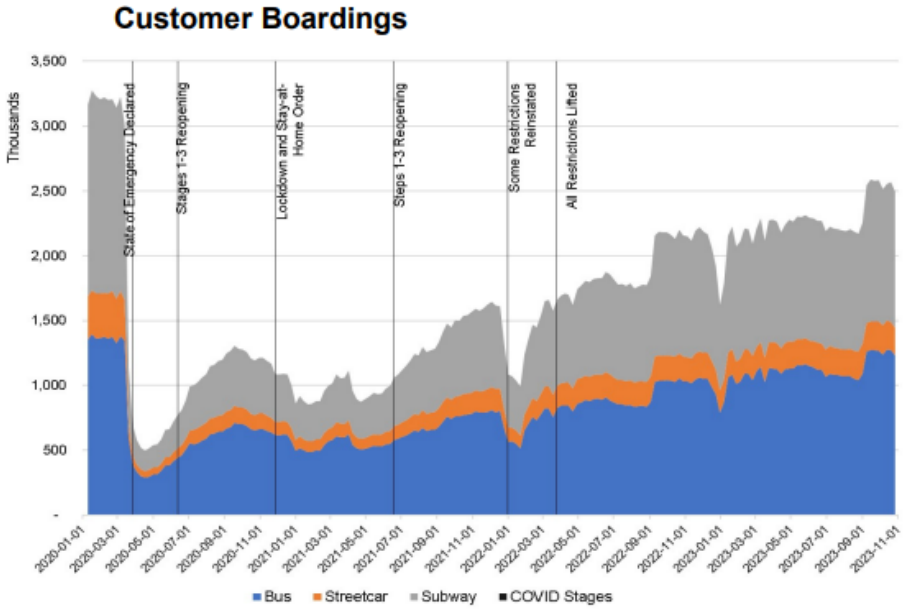


Financial



Definition
Revenue generated through fares.

Ridership



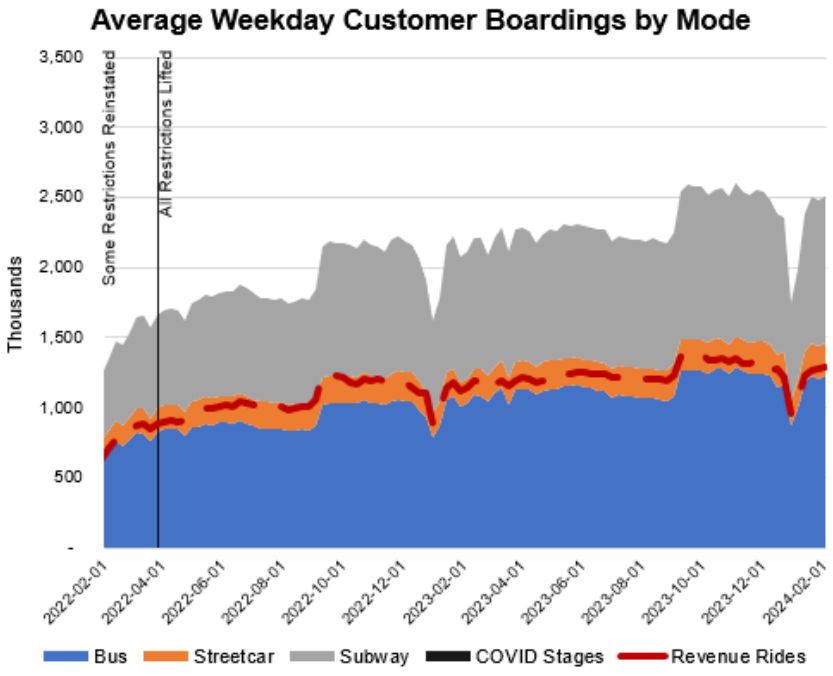
Definition
Boardings measure customer use of the system, by mode and by location. Customers are counted each time they board a TTC vehicle.

*Compared to the last week of full demand and full service March 2020. Not adjusted for summer seasonality.

Customer Boardings

Boardings measure customer use of the system, by mode and by location. Customers are counted each time they board a TTC vehicle.

CUSTOMER BOARDINGS

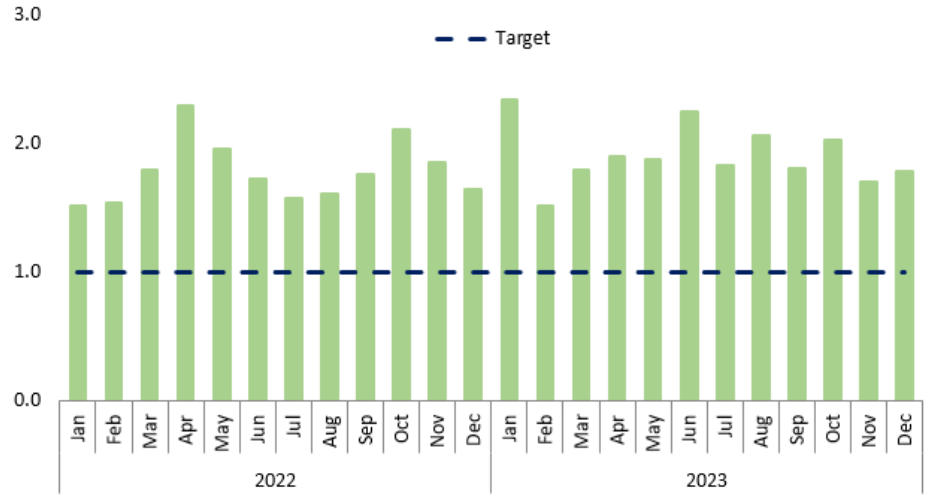


13.3 Safety & Security

Figure 13-6: Safety and security metrics.

SAFETY & SECURITY

Offences against Customers



Note: *Prior period date may be restated as offences are further reviewed.*

Definition
Number of offences against customers per one million boardings.

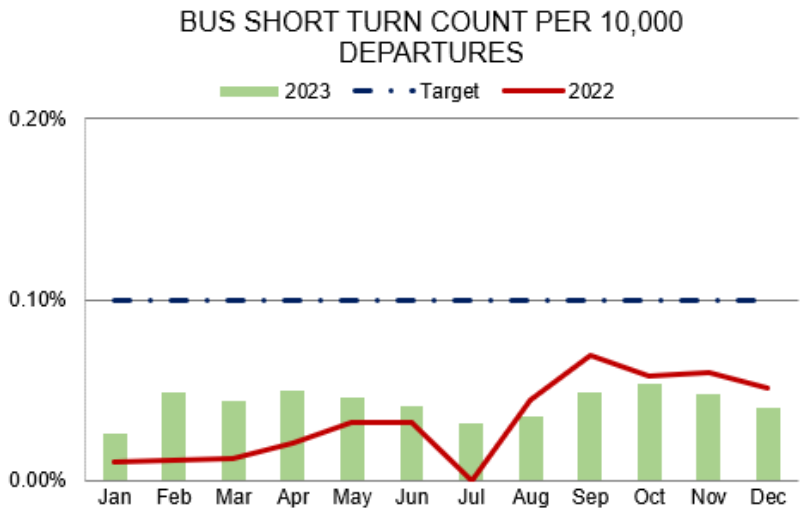
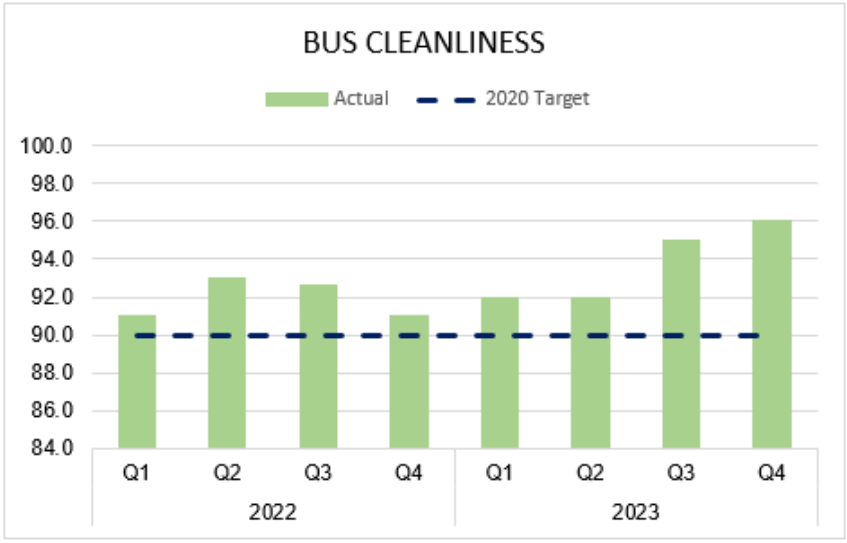
SAFETY & SECURITY

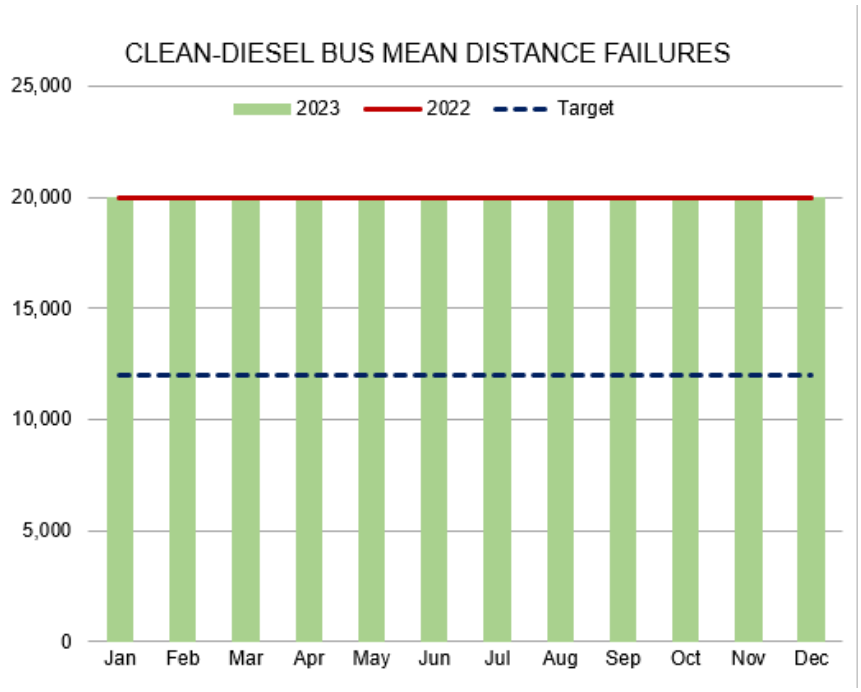
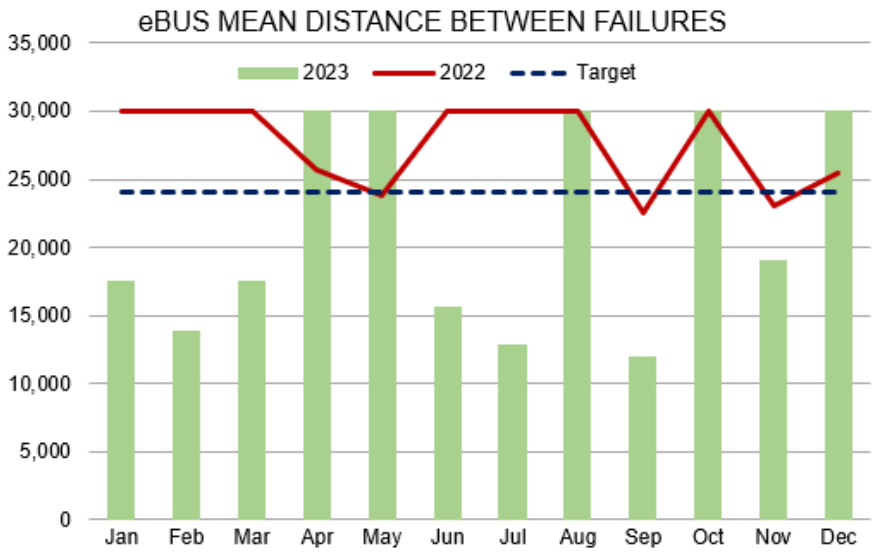
Offences against Employees

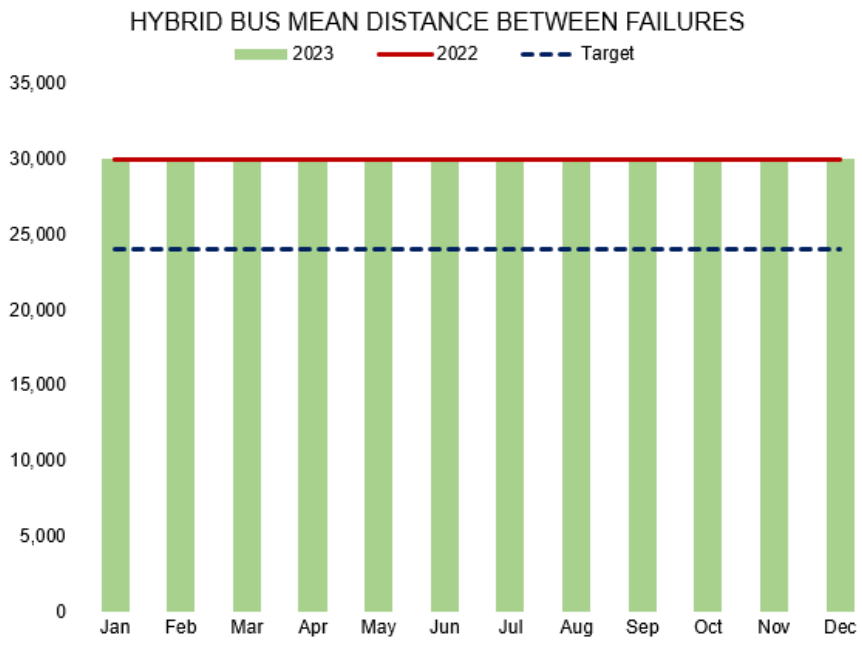
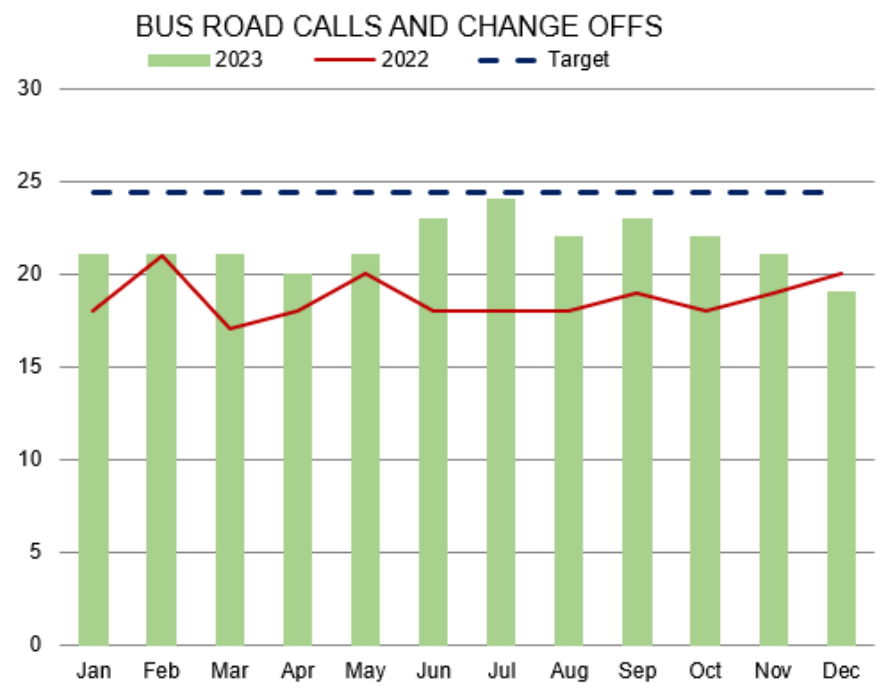
Definition
Number of offences against employees per one million boardings.

13.4 Bus Service

Figure 13-7: Bus metrics.

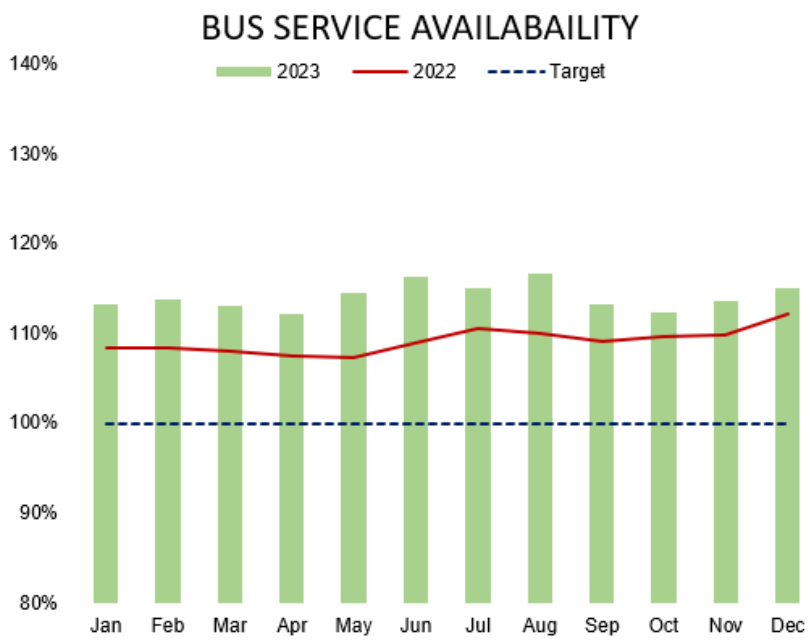
Bus Short Turns A short turn occurs when a vehicle is turned back and taken out of service before it can reach the end of its route (per 100 departures).	
Bus Cleanliness Results of a third-party audit. Average of pre-service, in-service and post service cleanliness results.	

Clean-diesel bus mean distance between failures Total distance (km) accumulated per number of mechanical road calls.	
eBus Mean distance between failures Total distance (km) accumulated per number of mechanical road calls.	

Hybrid bus Mean distance between failures Total distance accumulated per number of mechanical phone calls.	
Bus road calls and change offs Average daily number of vehicle equipment failures requiring a road call for service repair or a change off to repair facility for a replacement vehicle (weekday data). Lower number of is favourable. Target is 1.5% of peak revenue service.	

Bus service availability

Daily weekday average number of buses put into service per the number of buses scheduled for the a.m., peak period.

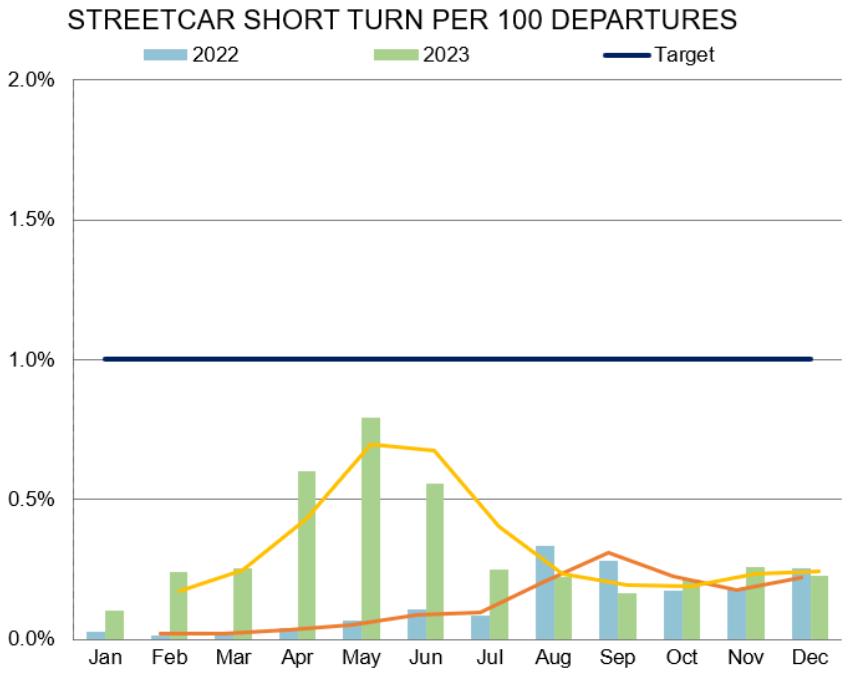


13.5 Streetcar Service

Figure 13-8: Streetcar metrics.

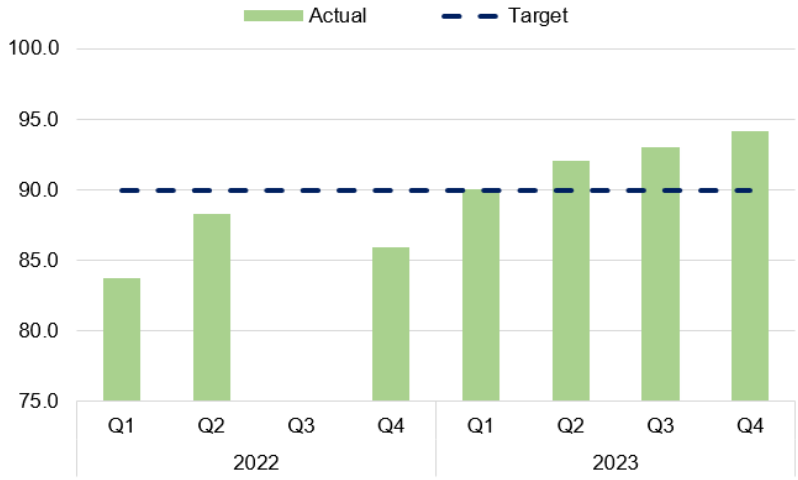
Streetcar short turns

A short turn occurs when a vehicle is turned back and taken out of service before it can reach the end of its route (percent of departures).



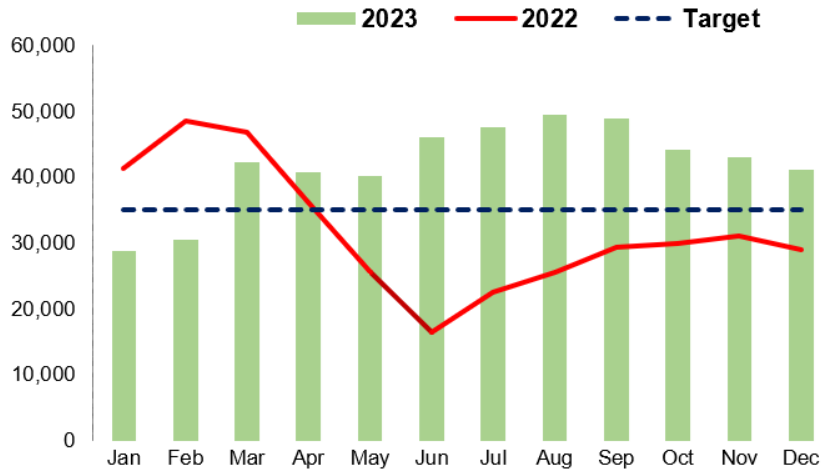
Streetcar cleanliness

Results of a third-party audit. Average of pre-service, in-service and post service cleanliness results.



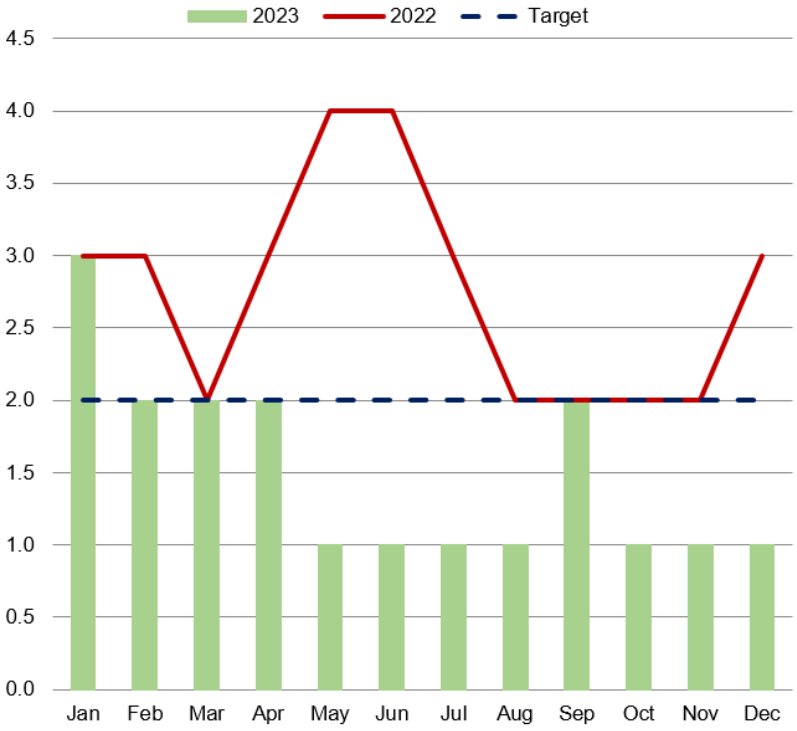
Streetcar Mean distance between failures:

Total distance (km) accumulated per number of mechanical road calls.



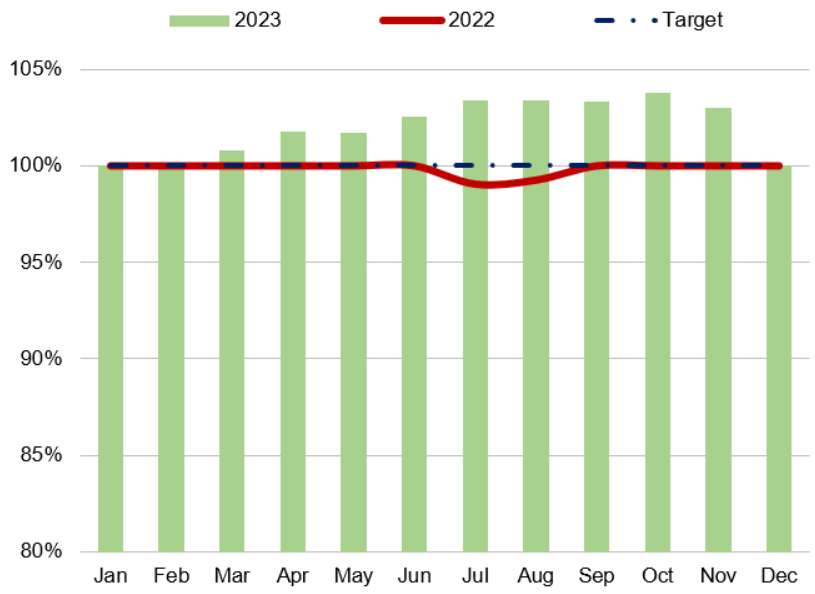
Streetcar road calls and change offs

Average daily number of vehicle equipment failures requiring a road call for service repair or a change—off to repair facility for a replacement vehicle (weekday data). Lower number is favourable.



Streetcar service availability

Daily weekday average number of streetcars put into service per the number of streetcars scheduled for the a.m. peak period.

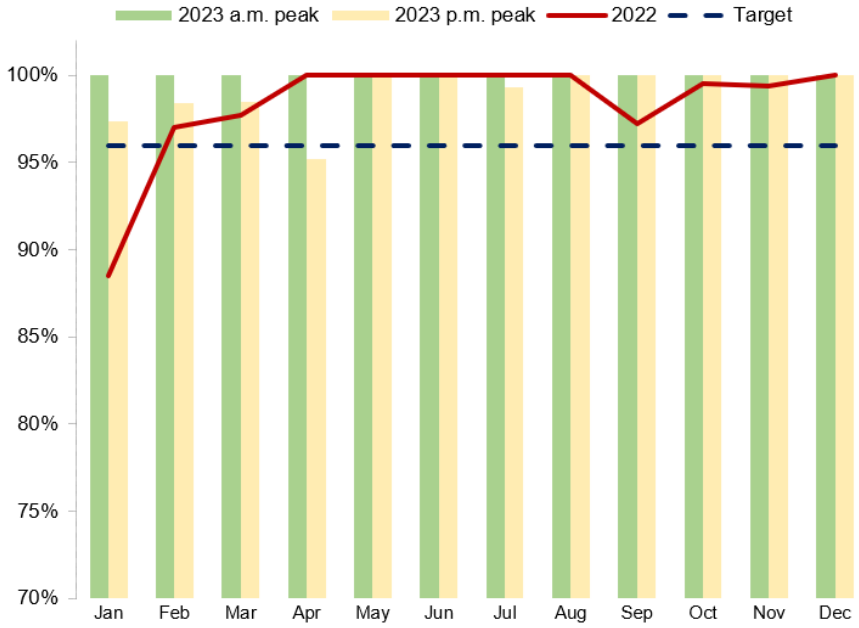


13.6 Subway Service

Figure 13-9: Subway train metrics.

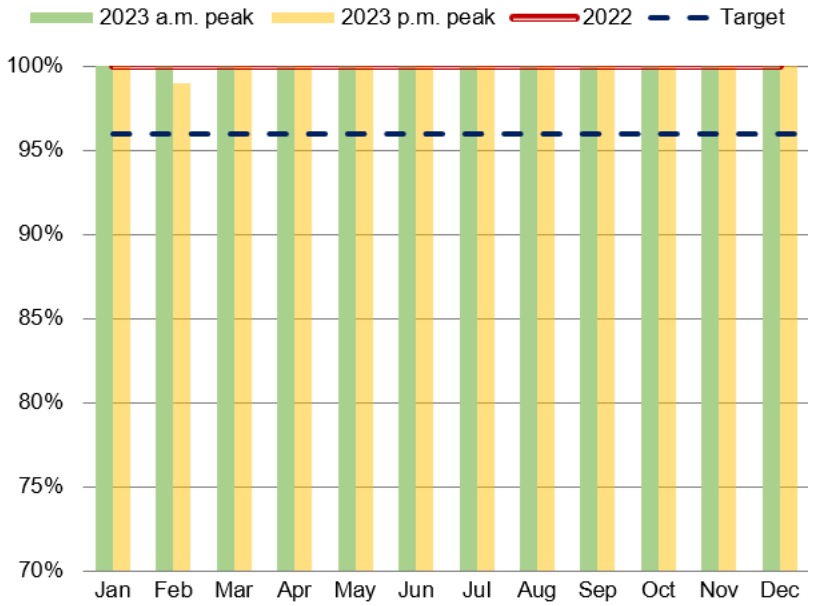
Line 1 capacity:

Total number of trains that travelled through 12 key sampling points through a.m. and p.m. peaks as a percentage of trains scheduled. Data is based on weekday service. Peak episodes: 6 a.m. to 9 a.m. and 3 p.m. to 7 p.m.



Line 2 capacity:

Total number of trains that travelled through 10 key sampling points during a.m. and p.m. peaks as a percentage of trains scheduled. Data is based on weekday service. Peak periods: 6 a.m. to 9 a.m. and 3 p.m. to 7 p.m.



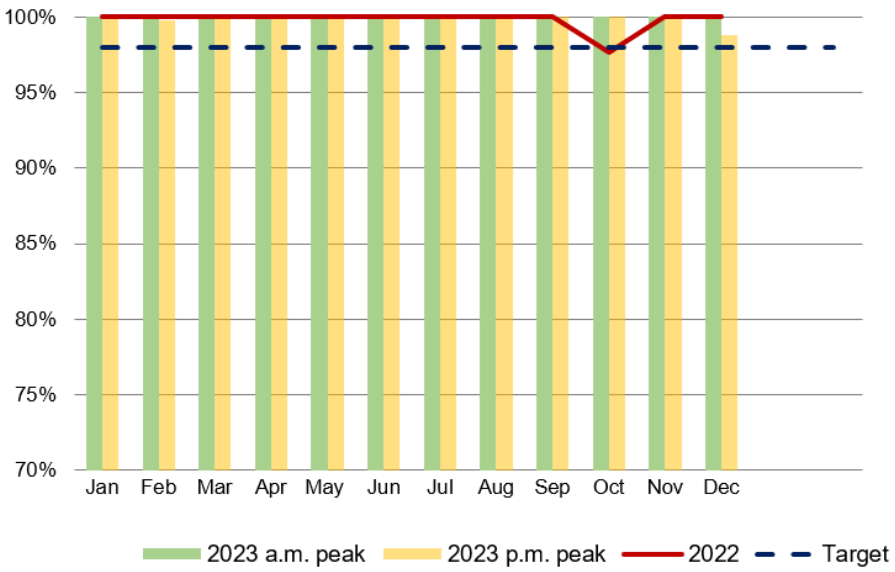
Line 3 capacity

Total number of trains that travelled through two key sampling points during a.m. and p.m. peaks as a percentage of trains scheduled. Data is based on weekday service. Peak periods: 6 a.m. to 9 a.m. and 3 p.m. to 7 p.m.

Line was shutdown on July 24th and is now closed permanently. Service was initially provided by Shuttle buses. Since September 3, 2023 the 903 Kennedy-Scarborough Centre Express has replaced Line 3 Scarborough bus shuttle.

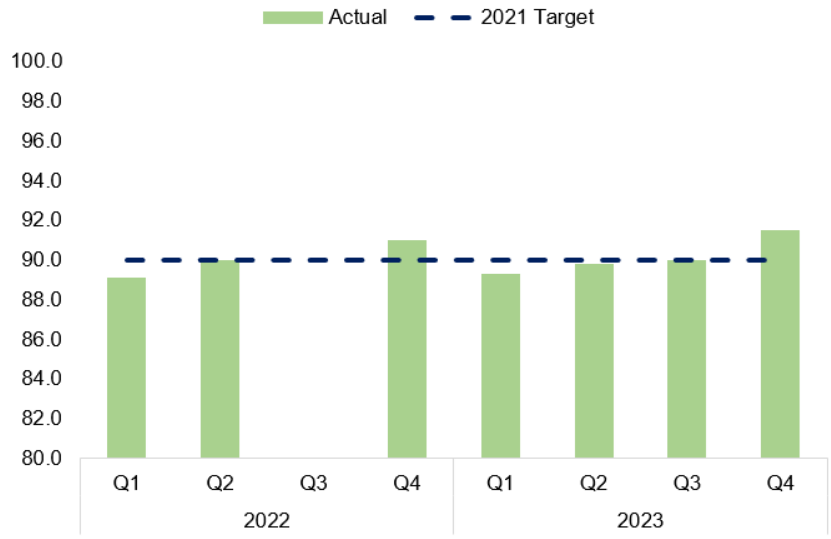
Line 4 capacity

Total number of trains that travelled through two key sampling points during a.m. and p.m. peaks as a percentage of trains scheduled. Data is based on weekday service. Peak periods: 6 a.m. to 9 a.m. and 3 p.m. to 7 p.m.



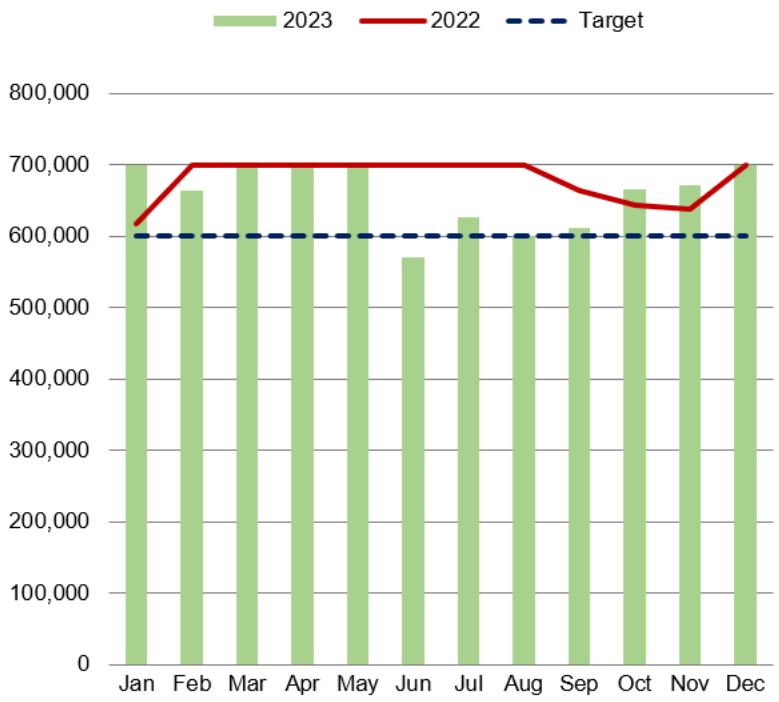
Subway Cleanliness Score

Results of a third-party audit. Average of pre-service, in-service, and post-service cleanliness results.



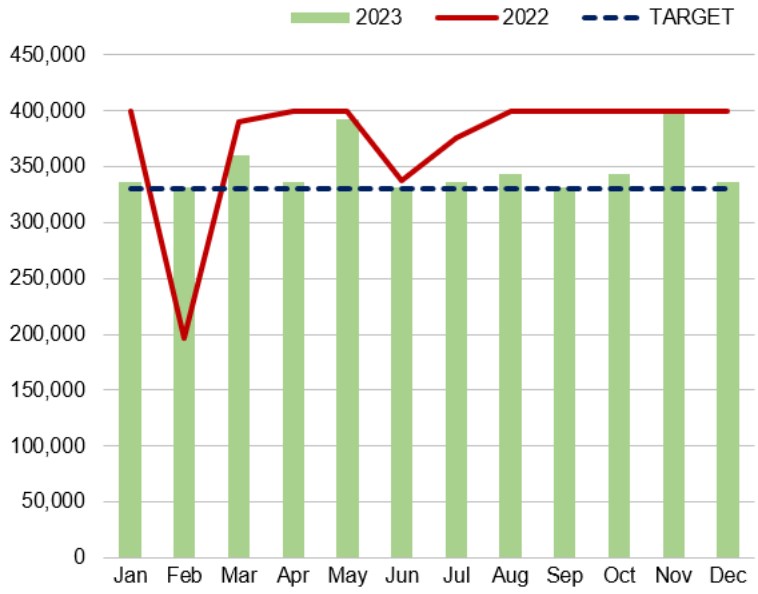
TR train Mean distance between failures:

Total distance (km) travelled per number of equipment incidents resulting in delays of five minutes or more. TR trains operate on Line 1 and Line 4.



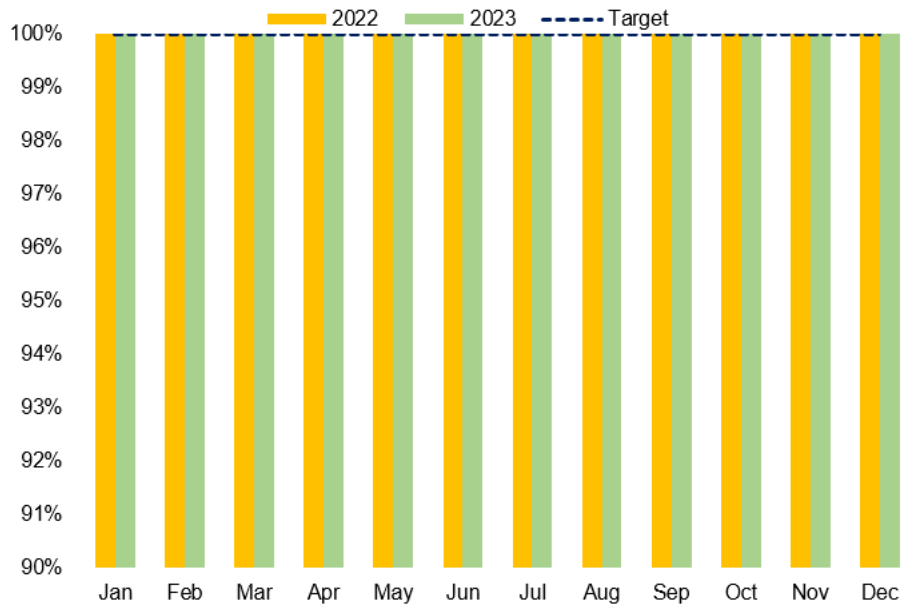
T1 train Mean distance between failures:

Total distance (km) travelled per number of equipment incidents resulting in delays of five minutes or more. T1 trains operates on Line 2



Subway Service availability

Daily weekday average number of trains put into service per the number of trains scheduled for the a.m. peak period.

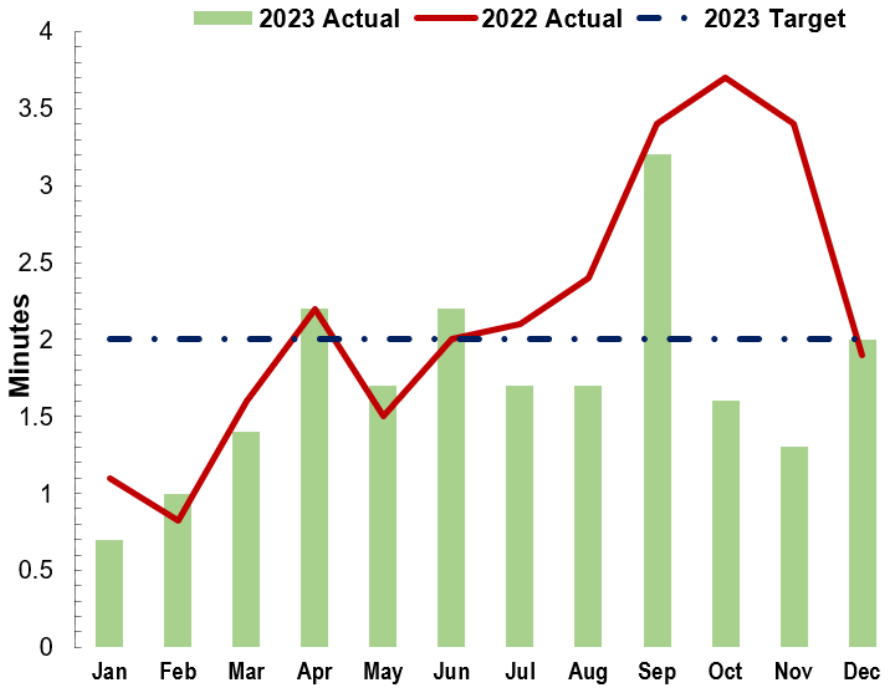


13.7 Wheel-Trans Service

Figure 13-10: Wheel-Trans metrics.

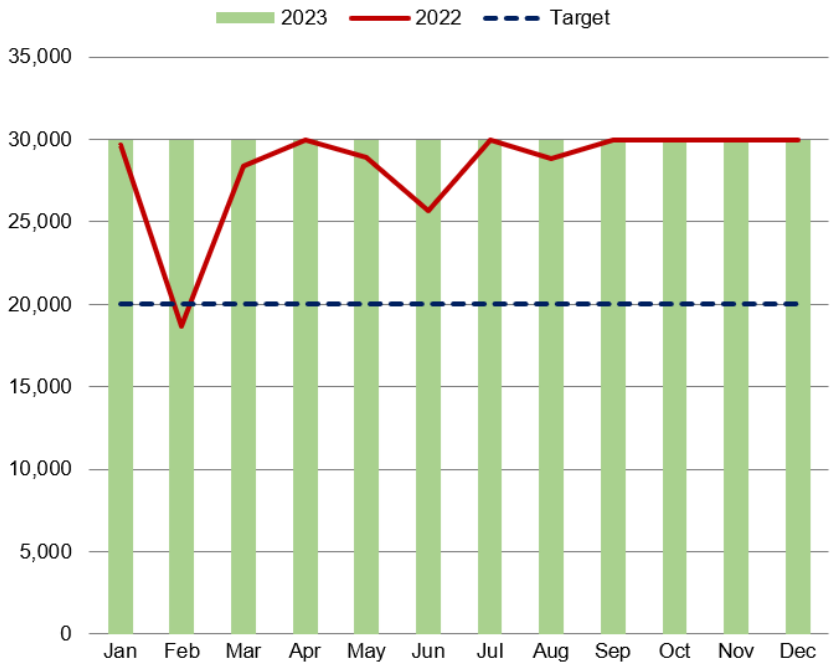
Wheel-Trans contact centre wait time

The average amount of time a customer waits in the queue before their call is answered.



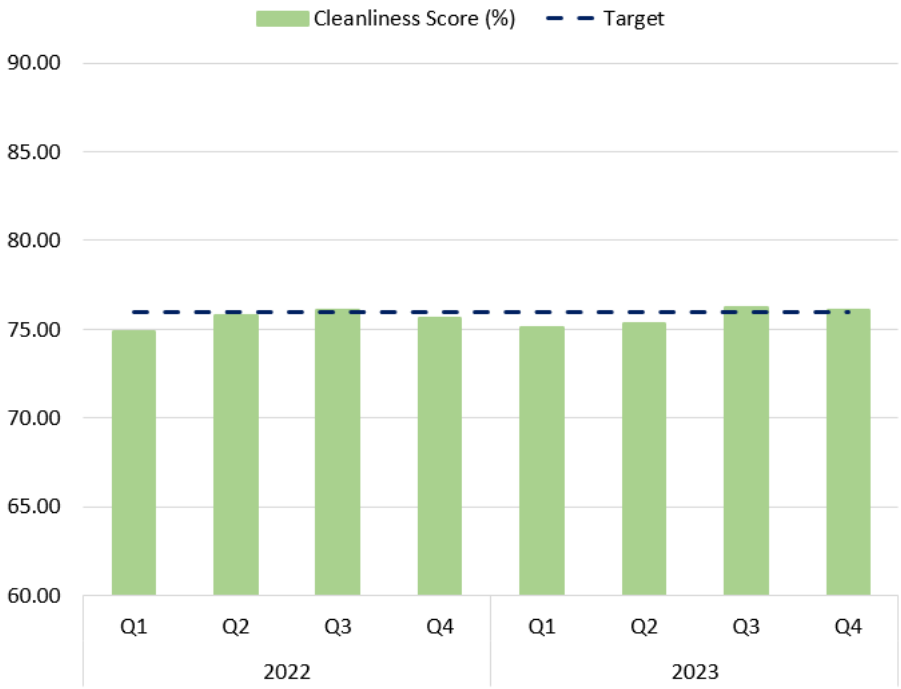
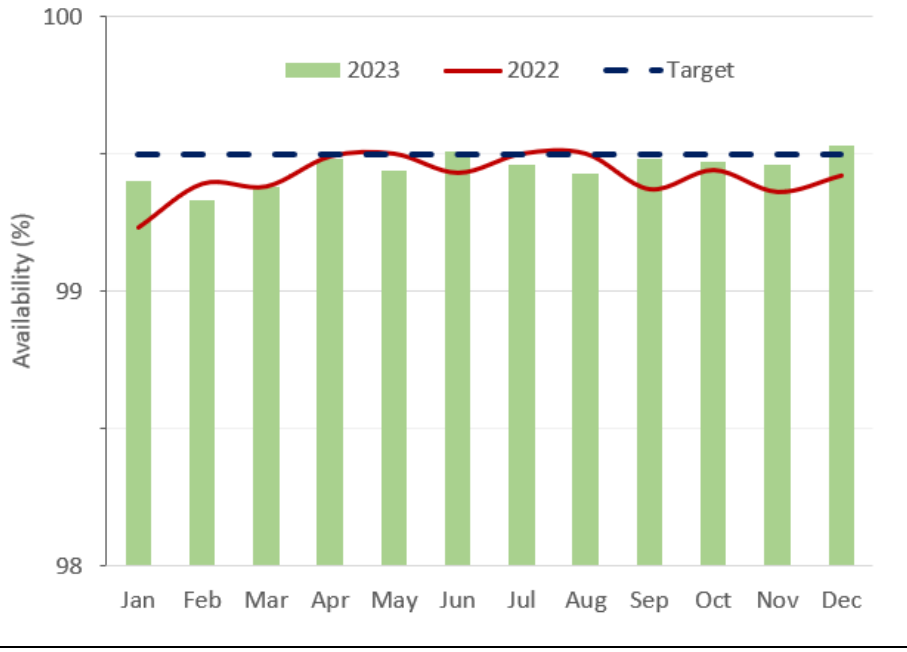
W-T Mean distance between failures

Total distance accumulated by the Wheel-Trans fleet per number of mechanical road calls.



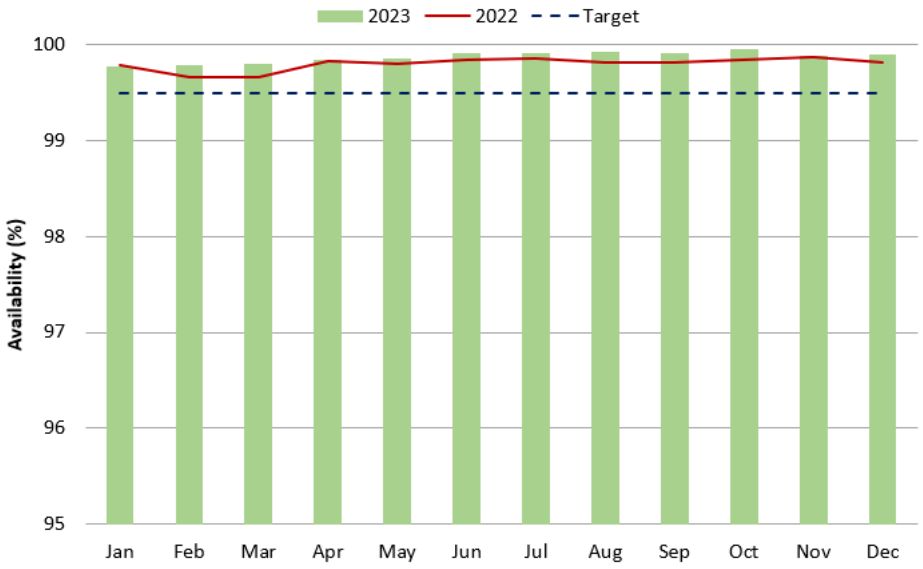
13.8 Station Performance

Figure 13-11: Stations metrics.

Station Cleanliness Results of a third-party audit. Average of all stations.	
Fare Gate Availability Percentage of fare gates that are available for use.	

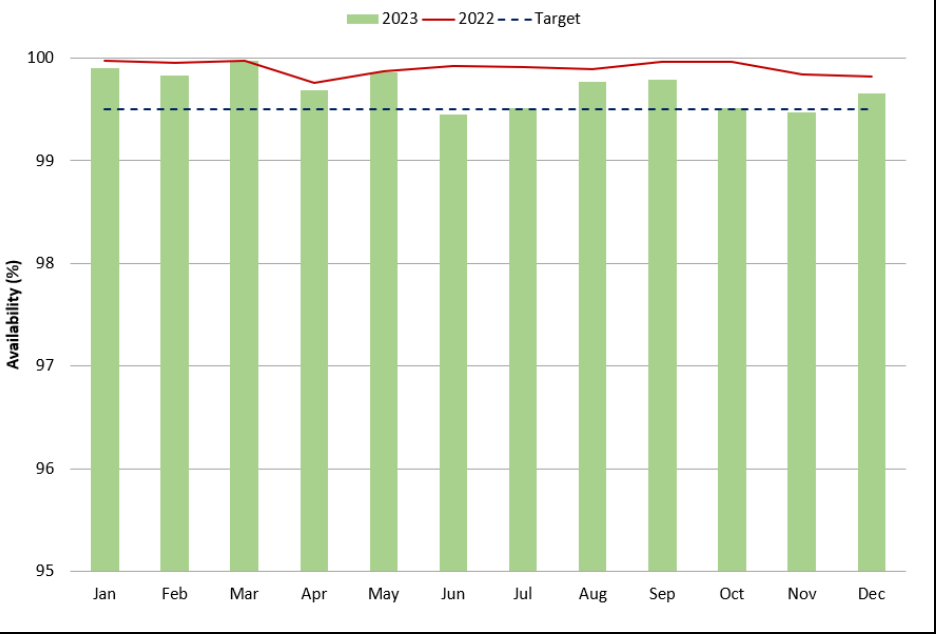
PRESTO Reader

Percentage of PRESTO readers in working order. PRESTO readers allow customers to pay their fare and are installed onboard TTC buses and streetcars.



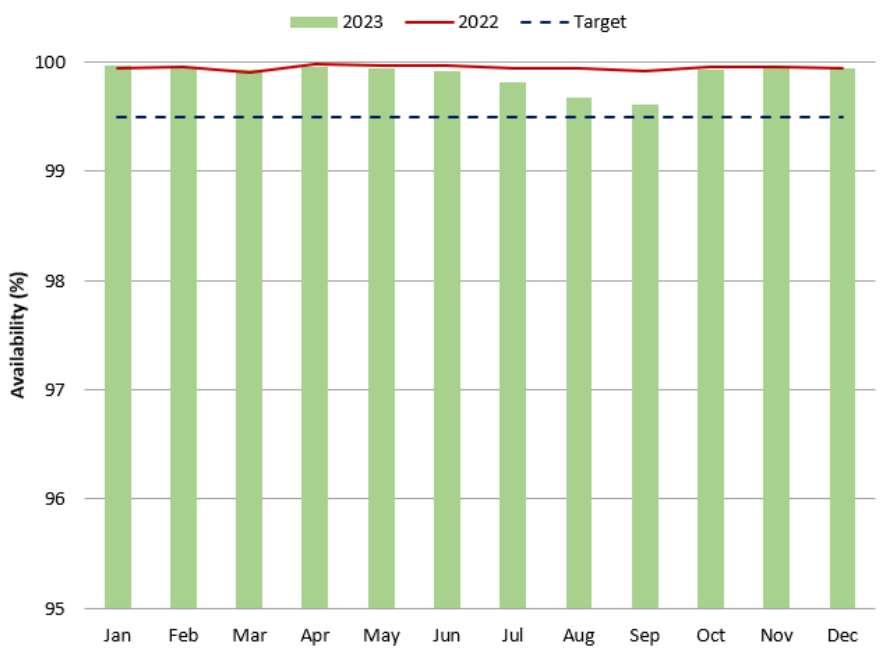
PRESTO Fares and Transfers Machine (FTM)

Availability of FTMs based on duration of fault to time of resolution. FTMs allow customers to purchase Proof of Payment tickets on streetcars and at selected streetcar stops.



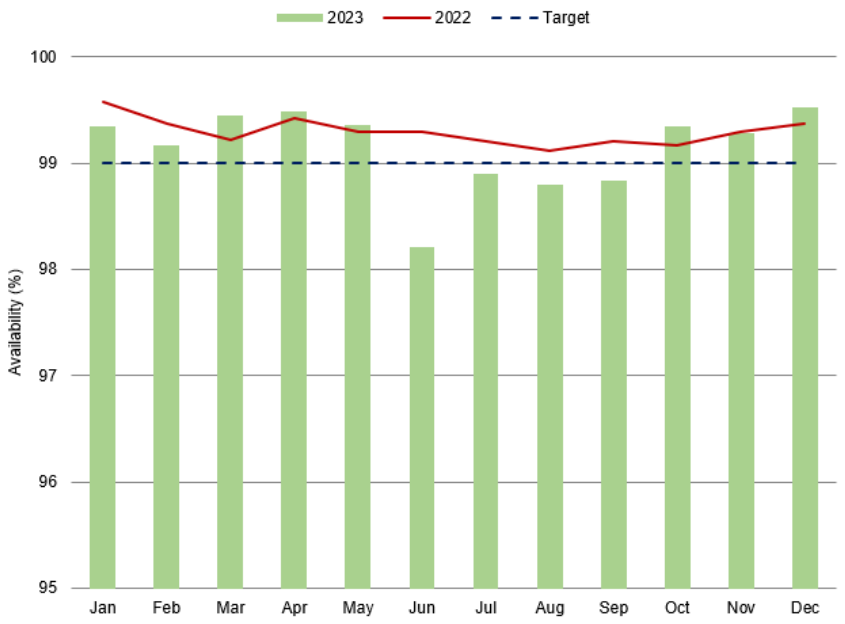
PRESTO Self-Serve Relod Machine (SSRM)

Availability of SSRMs based on duration of fault to time of resolution. SSRMs allow customers to load funds onto PRESTO cards, view their balance and card history, and activate products purchased online. SSRMs are installed at station entrances.



PRESTO Fare Vending Machines (FVM)

Availability of FVMs based on duration of fault to time of resolution. FVMs allow customers to load funds onto PRESTO cards, purchase cards, view balance and card history, and activate products purchased online. FVMs are installed at station entrances.



14. Appendix C: Structures Network Map

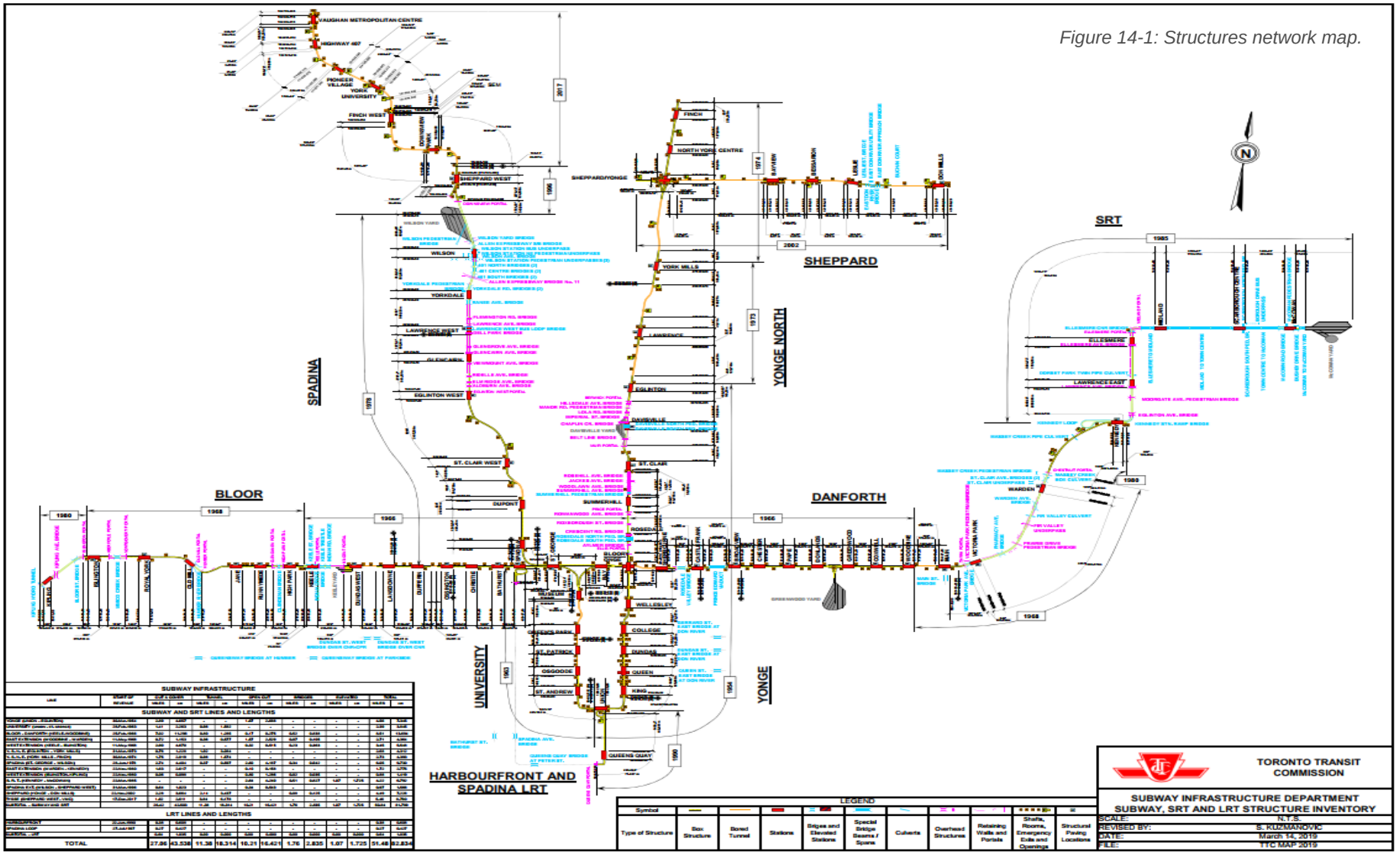


Figure 14-1: Structures network map.

15. Appendix D: Ontario Regulation 588/17

ONTARIO REGULATION 588/17

made under the

INFRASTRUCTURE FOR JOBS AND PROSPERITY ACT, 2015

Made: December 13, 2017
Filed: December 27, 2017
Published on e-Laws: December 27, 2017
Printed in *The Ontario Gazette*: January 13, 2018

ASSET MANAGEMENT PLANNING FOR MUNICIPAL INFRASTRUCTURE

CONTENTS

INTERPRETATION AND APPLICATION

Definitions

1. (1) In this Regulation,

"asset category" means a category of municipal infrastructure assets that is,

(a) an aggregate of assets described in each of clauses (a) to (e) of the definition of core municipal infrastructure asset, or

(b) composed of any other aggregate of municipal infrastructure assets that provide the same type of service; ("catégorie de biens")

"core municipal infrastructure asset" means any municipal infrastructure asset that is a,

(a) water asset that relates to the collection, production, treatment, storage, supply or distribution of water,

(b) wastewater asset that relates to the collection, transmission, treatment or disposal of wastewater, including any wastewater asset that from time to time manages stormwater,

(c) stormwater management asset that relates to the collection, transmission, treatment, retention, infiltration, control or disposal of stormwater,

(d) road, or

(e) bridge or culvert; (“bien d’infrastructure municipale essentiel”)

“ecological functions” has the same meaning as in Ontario Regulation 140/02 (Oak Ridges Moraine Conservation Plan) made under the *Oak Ridges Moraine Conservation Act, 2001*; (“fonctions écologiques”)

“green infrastructure asset” means an infrastructure asset consisting of natural or human-made elements that provide ecological and hydrological functions and processes and includes natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces and green roofs; (“bien d’infrastructure verte”)

“hydrological functions” has the same meaning as in Ontario Regulation 140/02; (“fonctions hydrologiques”)

“joint municipal water board” means a joint board established in accordance with a transfer order made under the *Municipal Water and Sewage Transfer Act, 1997*; (“conseil mixte de gestion municipale des eaux”)

“lifecycle activities” means activities undertaken with respect to a municipal infrastructure asset over its service life, including constructing, maintaining, renewing, operating and decommissioning, and all engineering and design work associated with those activities; (“activités relatives au cycle de vie”)

“municipal infrastructure asset” means an infrastructure asset, including a green infrastructure asset, directly owned by a municipality or included on the consolidated financial statements of a municipality, but does not include an infrastructure asset that is managed by a joint municipal water board; (“bien d’infrastructure municipale”)

“municipality” has the same meaning as in the *Municipal Act, 2001*; (“municipalité”)

“operating costs” means the aggregate of costs, including energy costs, of operating a municipal infrastructure asset over its service life; (“frais d’exploitation”)

“service life” means the total period during which a municipal infrastructure asset is in use or is available to be used; (“durée de vie”)

“significant operating costs” means, where the operating costs with respect to all municipal infrastructure assets within an asset category are in excess of a threshold amount set by the municipality, the total amount of those operating costs. (“frais d’exploitation importants”)

(2) In Tables 1 and 2,

“connection-days” means the number of properties connected to a municipal system that are affected by a service issue, multiplied by the number of days on which those properties are affected by the service issue. (“jours-branchements”)

(3) In Table 4,

“arterial roads” means Class 1 and Class 2 highways as determined under the Table to section 1 of Ontario Regulation 239/02 (Minimum Maintenance Standards for Municipal Highways) made under the *Municipal Act, 2001*; (“artères”)

“collector roads” means Class 3 and Class 4 highways as determined under the Table to section 1 of Ontario Regulation 239/02; (“routes collectrices”)

“lane-kilometre” means a kilometre-long segment of roadway that is a single lane in width; (“kilomètre de voie”)

“local roads” means Class 5 and Class 6 highways as determined under the Table to section 1 of Ontario Regulation 239/02. (“routes locales”)

(4) In Table 5,

“Ontario Structure Inspection Manual” means the Ontario Structure Inspection Manual (OSIM), published by the Ministry of Transportation and dated October 2000 (revised November 2003 and April 2008) and available on a Government of Ontario website; (“manuel d’inspection des structures de l’Ontario”)

“structural culvert” has the meaning set out for “culvert (structural)” in the Ontario Structure Inspection Manual. (“ponceau structurel”)

Application

2. For the purposes of section 6 of the Act, every municipality is prescribed as a broader public sector entity to which that section applies.

STRATEGIC ASSET MANAGEMENT POLICIES

Strategic asset management policy

3. (1) Every municipality shall prepare a strategic asset management policy that includes the following:

7. 1. Any of the municipality's goals, policies or plans that are supported by its Asset Management Plan.

8. 2. The process by which the Asset Management Plan is to be considered in the development of the municipality's budget or of any long-term financial plans of the municipality that take into account municipal infrastructure assets.

9. 3. The municipality's approach to continuous improvement and adoption of appropriate practices regarding Asset Management Planning.

10. 4. The principles to be followed by the municipality in its Asset Management Planning, which must include the principles set out in section 3 of the Act.

11. 5. The municipality's commitment to consider, as part of its Asset Management Planning,

    i. the actions that may be required to address the vulnerabilities that may be caused by climate change to the municipality's infrastructure assets, in respect of such matters as,

        A. operations, such as increased maintenance schedules,

        B. levels of service, and

        C. lifecycle management,

    ii. the anticipated costs that could arise from the vulnerabilities described in subparagraph i,

    iii. adaptation opportunities that may be undertaken to manage the vulnerabilities described in subparagraph i,

    iv. mitigation approaches to climate change, such as greenhouse gas emission reduction goals and targets, and

    v. disaster planning and contingency funding.

12. 6. A process to ensure that the municipality's Asset Management Planning is aligned with any of the following financial plans:

    i. Financial plans related to the municipality's water assets including any financial plans prepared under the *Safe Drinking Water Act, 2002*.

    ii. Financial plans related to the municipality's wastewater assets.

13. 7. A process to ensure that the municipality's Asset Management Planning is aligned with Ontario's land-use planning framework, including any relevant policy statements issued under subsection 3 (1) of the *Planning Act*, any provincial plans as defined in the *Planning Act* and the municipality's official plan.

14. 8. An explanation of the capitalization thresholds used to determine which assets are to be included in the municipality's Asset Management Plan and how the thresholds compare to those in the municipality's tangible capital asset policy, if it has one.

15. 9. The municipality's commitment to coordinate planning for asset management, where municipal infrastructure assets connect or are interrelated with those of its upper-tier municipality, neighbouring municipalities or jointly-owned municipal bodies.

16. 10. The persons responsible for the municipality's Asset Management Planning, including the executive lead.

17. 11. An explanation of the municipal council's involvement in the municipality's Asset Management Planning.

18. 12. The municipality's commitment to provide opportunities for municipal residents and other interested parties to provide input into the municipality's Asset Management Planning.

(2) For the purposes of this section,

"capitalization threshold" is the value of a municipal infrastructure asset at or above which a municipality will capitalize the value of it and below which it will expense the value of it. ("seuil de capitalisation")

Update of asset management policy

4. Every municipality shall prepare its first strategic asset management policy by July 1, 2019 and shall review and, if necessary, update it at least every five years.

Asset Management Plans, current levels of service

5. (1) Every municipality shall prepare an Asset Management Plan in respect of its core municipal infrastructure assets by July 1, 2022, and in respect of all of its other municipal infrastructure assets by July 1, 2024.

(2) A municipality's Asset Management Plan must include the following:

19. 1. For each asset category, the current levels of service being provided, determined in accordance with the following qualitative descriptions and technical metrics and based on data from at most the two calendar years prior to the year in which all information required under this section is included in the Asset Management Plan:

    i. With respect to core municipal infrastructure assets, the qualitative descriptions set out in Column 2 and the technical metrics set out in Column 3 of Table 1, 2, 3, 4 or 5, as the case may be.

    ii. With respect to all other municipal infrastructure assets, the qualitative descriptions and technical metrics established by the municipality.

20. 2. The current performance of each asset category, determined in accordance with the performance measures established by the municipality, such as those that would measure energy usage and operating efficiency, and based on data from at most two calendar years prior to the year in which all information required under this section is included in the Asset Management Plan.

21. 3. For each asset category,

    i. a summary of the assets in the category,

    ii. the replacement cost of the assets in the category,

iii. the average age of the assets in the category, determined by assessing the average age of the components of the assets,

iv. the information available on the condition of the assets in the category, and

v. a description of the municipality's approach to assessing the condition of the assets in the category, based on recognized and generally accepted good engineering practices where appropriate.

22. 4. For each asset category, the lifecycle activities that would need to be undertaken to maintain the current levels of service as described in paragraph 1 for each of the 10 years following the year for which the current levels of service under paragraph 1 are determined and the costs of providing those activities based on an assessment of the following:

i. The full lifecycle of the assets.

ii. The options for which lifecycle activities could potentially be undertaken to maintain the current levels of service.

iii. The risks associated with the options referred to in subparagraph ii.

iv. The lifecycle activities referred to in subparagraph ii that can be undertaken for the lowest cost to maintain the current levels of service.

23. 5. For municipalities with a population of less than 25,000, as reported by Statistics Canada in the most recent official census, the following:

    i. A description of assumptions regarding future changes in population or economic activity.

    ii. How the assumptions referred to in subparagraph i relate to the information required by paragraph 4.

24. 6. For municipalities with a population of 25,000 or more, as reported by Statistics Canada in the most recent official census, the following:

    i. With respect to municipalities in the Greater Golden Horseshoe growth plan area, if the population and employment forecasts for the municipality are set out in Schedule 3 or 7 to the 2017 Growth Plan, those forecasts.

    ii. With respect to lower-tier municipalities in the Greater Golden Horseshoe growth plan area, if the population and employment forecasts for the municipality are not set out in Schedule 7 to the 2017 Growth Plan, the portion of the forecasts allocated to the lower-tier municipality in the official plan of the upper-tier municipality of which it is a part.

    iii. With respect to upper-tier municipalities or single-tier municipalities outside of the Greater Golden Horseshoe growth plan area, the population and employment forecasts for the municipality that are set out in its official plan.

iv. With respect to lower-tier municipalities outside of the Greater Golden Horseshoe growth plan area, the population and employment forecasts for the lower-tier municipality that are set out in the official plan of the upper-tier municipality of which it is a part.

v. If, with respect to any municipality referred to in subparagraph iii or iv, the population and employment forecasts for the municipality cannot be determined as set out in those subparagraphs, a description of assumptions regarding future changes in population or economic activity.

vi. For each of the 10 years following the year for which the current levels of service under paragraph 1 are determined, the estimated capital expenditures and significant operating costs related to the lifecycle activities required to maintain the current levels of service in order to accommodate projected increases in demand caused by growth, including estimated capital expenditures and significant operating costs related to new construction or to upgrading of existing municipal infrastructure assets.

(3) Every Asset Management Plan must indicate how all background information and reports upon which the information required by paragraph 3 of subsection (2) is based will be made available to the public.

(4) In this section,

"2017 Growth Plan" means the Growth Plan for the Greater Golden Horseshoe, 2017 that was approved under subsection 7 (6) of the *Places to Grow Act, 2005* on May 16, 2017 and came into effect on July 1, 2017; ("Plan de croissance de 2017")

"Greater Golden Horseshoe growth plan area" means the area designated by section 2 of Ontario Regulation 416/05 (Growth Plan Areas) made under the *Places to Grow Act, 2005*. ("zone de croissance planifiée de la région élargie du Golden Horseshoe")

Asset Management Plans, proposed levels of service

6. (1) Subject to subsection (2), by July 1, 2025, every Asset Management Plan prepared under section 5 must include the following additional information:

25. 1. For each asset category, the levels of service that the municipality proposes to provide for each of the 10 years following the year in which all information required under section 5 and this section is included in the Asset Management Plan, determined in accordance with the following qualitative descriptions and technical metrics:

i. With respect to core municipal infrastructure assets, the qualitative descriptions set out in Column 2 and the technical metrics set out in Column 3 of Table 1, 2, 3, 4 or 5, as the case may be.

ii. With respect to all other municipal infrastructure assets, the qualitative descriptions and technical metrics established by the municipality.

26. 2. An explanation of why the proposed levels of service under paragraph 1 are appropriate for the municipality, based on an assessment of the following:

i. The options for the proposed levels of service and the risks associated with those options to the long term sustainability of the municipality.

ii. How the proposed levels of service differ from the current levels of service set out under paragraph 1 of subsection 5 (2).

iii. Whether the proposed levels of service are achievable.

iv. The municipality's ability to afford the proposed levels of service.

27. 3. The proposed performance of each asset category for each year of the 10-year period referred to in paragraph 1, determined in accordance with the performance measures established by the municipality, such as those that would measure energy usage and operating efficiency.

28. 4. A lifecycle management and financial strategy that sets out the following information with respect to the assets in each asset category for the 10-year period referred to in paragraph 1:

i. An identification of the lifecycle activities that would need to be undertaken to provide the proposed levels of service described in paragraph 1, based on an assessment of the following:

A. The full lifecycle of the assets.

B. The options for which lifecycle activities could potentially be undertaken to achieve the proposed levels of service.

C. The risks associated with the options referred to in sub-subparagraph B.

D. The lifecycle activities referred to in sub-subparagraph B that can be undertaken for the lowest cost to achieve the proposed levels of service.

ii. An estimate of the annual costs for each of the 10 years of undertaking the lifecycle activities identified in subparagraph i, separated into capital expenditures and significant operating costs.

iii. An identification of the annual funding projected to be available to undertake lifecycle activities and an explanation of the options examined by the municipality to maximize the funding projected to be available.

iv. If, based on the funding projected to be available, the municipality identifies a funding shortfall for the lifecycle activities identified in subparagraph i,

A. an identification of the lifecycle activities, whether set out in subparagraph i or otherwise, that the municipality will undertake, and

B. if applicable, an explanation of how the municipality will manage the risks associated with not undertaking any of the lifecycle activities identified in subparagraph i.

29. 5. For municipalities with a population of less than 25,000, as reported by Statistics Canada in the most recent official census, a discussion of how the assumptions regarding future changes in population and economic activity, set out in subparagraph 5 i of subsection 5 (2), informed the preparation of the lifecycle management and financial strategy referred to in paragraph 4 of this subsection.

30. 6. For municipalities with a population of 25,000 or more, as reported by Statistics Canada in the most recent official census,

i. the estimated capital expenditures and significant operating costs to achieve the proposed levels of service as described in paragraph 1 in order to accommodate projected increases in demand caused by population and employment growth, as set out in the forecasts or assumptions referred to in paragraph 6 of subsection 5 (2), including estimated capital expenditures and significant operating costs related to new construction or to upgrading of existing municipal infrastructure assets,

ii. the funding projected to be available, by source, as a result of increased population and economic activity, and

iii. an overview of the risks associated with implementation of the Asset Management Plan and any actions that would be proposed in response to those risks.

31. 7. An explanation of any other key assumptions underlying the plan that have not previously been explained.

(2) With respect to an Asset Management Plan prepared under section 5 on or before July 1, 2022, if the additional information required under this section is not included before July 1, 2024, the municipality shall, before including the additional information, update the current levels of service set out under paragraph 1 of subsection 5 (2) and the current performance measures set out under paragraph 2 of subsection 5 (2) based on data from the two most recent calendar years.

Update of Asset Management Plans

7. (1) Every municipality shall review and update its Asset Management Plan at least five years after the year in which the plan is completed under section 6 and at least every five years thereafter.

(2) The updated Asset Management Plan must comply with the requirements set out under paragraphs 1, 2 and 3 and subparagraphs 5 i and 6 i, ii, iii, iv and v of subsection 5 (2), subsection 5 (3) and paragraphs 1 to 7 of subsection 6 (1).

Endorsement and approval required

8. Every Asset Management Plan prepared under section 5 or 6, or updated under section 7, must be,

(a) endorsed by the executive lead of the municipality; and

(b) approved by a resolution passed by the municipal council.

Annual review of Asset Management Planning progress

9. (1) Every municipal council shall conduct an annual review of its asset management progress on or before July 1 in each year, starting the year after the municipality's Asset Management Plan is completed under section 6.

(2) The annual review must address,

(a) the municipality's progress in implementing its Asset Management Plan;

(b) any factors impeding the municipality's ability to implement its Asset Management Plan; and

(c) a strategy to address the factors described in clause (b).

Public availability

10. Every municipality shall post its current strategic asset management policy and Asset Management Plan on a website that is available to the public, and shall provide a copy of the policy and plan to any person who requests it.

TABLE 1

WATER ASSETS

Column 1 Service attribute	Column 2 Community levels of service (qualitative descriptions)	Column 3 Technical levels of service (technical metrics)
Scope	1. Description, which may include maps, of the user groups or areas of the municipality that are connected to the municipal water system. 2. Description, which may include maps, of the user groups or areas of the municipality that have fire flow.	1. Percentage of properties connected to the municipal water system. 2. Percentage of properties where fire flow is available.
Reliability	Description of boil water advisories and service interruptions.	1. The number of connection-days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system. 2. The number of connection-days per year due to water main breaks compared to the total number of properties connected to the municipal water system.

TABLE 2

WASTEWATER ASSETS

Column 1 Service attribute	Column 2 Community levels of service (qualitative descriptions)	Column 3 Technical levels of service (technical metrics)
Scope	Description, which may include maps, of the user groups or areas of the municipality that are connected to the municipal wastewater system.	Percentage of properties connected to the municipal wastewater system.
Reliability	1. Description of how combined sewers in the municipal wastewater system are designed with overflow structures in place which allow overflow during storm events to prevent backups into homes. 2. Description of the frequency and volume of overflows in combined sewers in the municipal wastewater system that occur in habitable areas or beaches. 3. Description of how stormwater can get into sanitary sewers in the municipal wastewater system, causing sewage to overflow into streets or backup into homes. 4. Description of how sanitary sewers in the municipal wastewater system are designed to be resilient to avoid events described in paragraph 3. 5. Description of the effluent that is discharged from sewage treatment plants in the municipal wastewater system.	1. The number of events per year where combined sewer flow in the municipal wastewater system exceeds system capacity compared to the total number of properties connected to the municipal wastewater system. 2. The number of connection-days per year due to wastewater backups compared to the total number of properties connected to the municipal wastewater system. 3. The number of effluent violations per year due to wastewater discharge compared to the total number of properties connected to the municipal wastewater system.

TABLE 3

STORMWATER MANAGEMENT ASSETS

Column 1 Service attribute	Column 2 Community levels of service (qualitative descriptions)	Column 3 Technical levels of service (technical metrics)

Scope	Description, which may include maps, of the user groups or areas of the municipality that are protected from flooding, including the extent of the protection provided by the municipal stormwater management system.	1. Percentage of properties in municipality resilient to a 100-year storm. 2. Percentage of the municipal stormwater management system resilient to a 5-year storm.

TABLE 4

ROADS

Column 1 Service attribute	Column 2 Community levels of service (qualitative descriptions)	Column 3 Technical levels of service (technical metrics)
Scope	Description, which may include maps, of the road network in the municipality and its level of connectivity.	Number of lane-kilometres of each of arterial roads, collector roads and local roads as a proportion of square kilometres of land area of the municipality.
Quality	Description or images that illustrate the different levels of road class pavement condition.	1. For paved roads in the municipality, the average pavement condition index value. 2. For unpaved roads in the municipality, the average surface condition (e.g. excellent, good, fair or poor).

TABLE 5

BRIDGES AND CULVERTS

Column 1 Service attribute	Column 2 Community levels of service (qualitative descriptions)	Column 3 Technical levels of service (technical metrics)
Scope	Description of the traffic that is supported by municipal bridges (e.g., heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, cyclists).	Percentage of bridges in the municipality with loading or dimensional restrictions.
Quality	1. Description or images of the condition of bridges and how this would affect use of the bridges. 2. Description or images of the condition of culverts and how this would affect use of the culverts.	1. For bridges in the municipality, the average bridge condition index value. 2. For structural culverts in the municipality, the average bridge condition index value.

COMMENCEMENT

Commencement

11. This Regulation comes into force on the later of January 1, 2018 and the day it is filed.

16. Appendix E: Capital Investment Needs

The following tables are extracts from *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs.*

Table 16-1: Modernizing the subway and expanding capacity funding requirements.

PORTFOLIO ($ Millions)	2024-2038 CAPITAL INVESTMENT PLAN					
	FUNDED	CIP UNFUNDED			TOTAL CIP	FUNDING REQUIRED BY
		2024-2033	POST	TOTAL		
Modernizing the Subway & Expanding Capacity:						
Purchase of Subway Cars	918.8	1,833.1	471.8	2,305.0	3,223.8	Q1 2024
Line 2 Automatic Train Control	593.3	-	273.5	273.5	866.9	Post 2033
Line 2 Capacity Enhancements	872.9	150.6	1,647.7	1,798.3	2,671.2	2028
Line 1 Capacity Enhancements (Includes TMSF)	1,028.8	3,000.5	2,164.8	5,165.3	6,194.1	2026
Line 2 Maintenance & Storage Facility	2.5	1,758.5	1,856.9	3,615.4	3,617.9	2030
Platform Edge Doors	-	252.0	3,848.0	4,100.0	4,100.0	TBD
Bloor-Yonge Capacity Improvements	1,182.9	-	252.2	252.2	1,435.1	Post 2033
Various Subway Projects	37.1	136.4	-	136.4	173.6	
TOTAL	**4,636.3**	**7,131.2**	**10,515.0**	**17,646.2**	**22,282.5**	
Upholding the State-of-Good-Repair:						
Subway Car Overhaul	460.2	115.7	137.1	252.8	713.0	2026
Signals / Electrical / Communications	513.2	394.6	325.0	719.5	1,232.7	2024
Equipment	226.0	194.8	153.7	348.5	574.5	2025
Bridges & Tunnels	496.3	29.0	257.7	286.7	783.0	2027
Subway Track	338.0	-	197.9	197.9	535.9	Post 2033
Various SOGR Projects	1,272.7	93.1	125.6	218.7	1,491.4	
TOTAL	**3,306.4**	**827.2**	**1,196.8**	**2,024.1**	**5,330.5**	
TOTAL SUBWAY PROJECTS	**7,942.7**	**7,958.5**	**11,711.8**	**19,670.3**	**27,613.0**	

Table 16-2: Transforming and electrifying bus service funding requirements.

PORTFOLIO ($ Millions)	2024-2038 CAPITAL INVESTMENT PLAN					
	FUNDED	CIP UNFUNDED			TOTAL CIP	FUNDING REQUIRED BY
		2024-2033	POST	TOTAL		
Transforming & Electrifying Bus Service:						
Purchase of Hybrid / Electric Buses	681.7	2,669.6	1,349.6	4,019.2	4,700.9	2024
Purchase of Wheel-Trans Buses	27.5	168.2	183.2	351.5	378.9	2025
Install Charging Infrastructure	66.8	763.2	220.7	983.9	1,050.8	2024
Implement Transit Priority Measure	88.7	255.4	7.8	263.1	351.8	2025
10th Bus Garage	5.3	-	463.0	463.0	468.3	Post 2033
TOTAL	**869.9**	**3,856.3**	**2,224.4**	**6,080.7**	**6,950.6**	
Upholding the State-of-Good-Repair:						
Bus Overhaul	548.4	252.5	402.7	655.2	1,203.6	2025
SRT Bus Replacement Infrastructure	77.2	55.7	-	55.7	132.9	2024
Equipment	75.2	131.6	10.4	142.0	217.2	2025
Service Planning	15.2	71.3	5.8	77.1	92.3	2026
Various SOGR Projects	100.9	5.1	2.5	7.6	108.5	
TOTAL	**816.9**	**516.3**	**421.4**	**937.6**	**1,754.6**	
TOTAL BUS & WT PROJECTS	**1,686.9**	**4,372.6**	**2,645.7**	**7,018.3**	**8,705.2**	

Table 16-4: Supporting a larger streetcar fleet funding requirements.

PORTFOLIO ($ Millions)	2024-2038 CAPITAL INVESTMENT PLAN					
	FUNDED	CIP UNFUNDED			TOTAL CIP	FUNDING REQUIRED BY
		2024-2033	POST	TOTAL		
Supporting a Larger Streetcar Fleet:						
Purchase of Streetcars	325.0	-	-	-	325.0	N/A
Upgrade Overhead Power	94.9	16.2	68.2	84.4	179.3	2031
Hillcrest Maintenance & Storage Facility	140.7	-	-	-	140.7	N/A
Renew Russell Carhouse	158.1	-	-	-	158.1	N/A
Various Streetcar Projects	2.1	2.7	-	2.7	4.8	
TOTAL	**720.9**	**18.9**	**68.2**	**87.1**	**807.9**	
Upholding the State-of-Good-Repair:						
Streetcar Overhaul	80.7	374.9	118.1	493.0	573.7	2025
Surface Track	402.7	37.4	238.9	276.3	679.0	2029
Traction Power	60.4	4.5	40.3	44.8	105.2	2024
Transit Shelters & Loops	5.7	36.0	3.3	39.3	45.0	2025
Various SOGR Projects	72.8	7.9	15.9	23.8	96.6	
TOTAL	**622.2**	**460.8**	**416.5**	**877.3**	**1,499.5**	
TOTAL STREETCAR PROJECTS	**1,343.1**	**479.7**	**484.7**	**964.3**	**2,307.4**	

Table 16-3: Facility maintenance funding requirements.

PORTFOLIO ($ Millions)	2024-2038 CAPITAL INVESTMENT PLAN					
	FUNDED	CIP UNFUNDED			TOTAL CIP	FUNDING REQUIRED BY
		2024-2033	POST	TOTAL		
Major Control Centre	17.8	458.8	-	458.8	476.6	2026
Facility Renewal Programs	536.9	697.9	194.5	892.3	1,429.2	2025
Sustainability	21.0	69.0	37.7	106.7	127.7	2025
Roofing Rehabilitation	99.1	229.0	53.7	282.6	381.7	2025
TOTAL FACILITY PROJECTS	**674.7**	**1,454.6**	**285.9**	**1,740.5**	**2,415.2**	

Table 16-5: Network-wide assets funding requirements.

PORTFOLIO ($ Millions)	2024-2038 CAPITAL INVESTMENT PLAN					
	FUNDED	CIP UNFUNDED			TOTAL CIP	FUNDING REQUIRED BY
		2024-2033	POST	TOTAL		
Equipment	68.3	212.2	76.0	288.3	356.6	2024
IT Systems / Equipment	431.7	128.6	-	128.6	560.3	2025
Automotive Non-Revenue Vehicle Purchase	79.5	120.6	101.4	222.0	301.5	2026
Various Network Wide Projects	170.9	78.0	7.6	85.6	256.5	
TOTAL NETWROK WIDE PROJECTS	**750.3**	**539.4**	**185.0**	**724.5**	**1,474.8**	

The following tables show the 2024-2038 Capital Investment Plan Cashflow Summary, taken from Appendix C of *TTC's 2024-2038 Capital Investment Plan: A Review of Unfunded Capital Needs.*

Table 16-6: 2024-2038 capital investment plan cash flow summary (1/4).

Program Description ($ Millions)	CIP	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total 10 Year	Post 2033	Total 15 Year
Subway Track	Funded	33.1	34.1	34.6	34.1	33.3	33.5	34.7	33.0	33.5	34.0	338.0	-	338.0
Subway Track	Unfunded	-	-	-	-	-	-	-	-	-	-	-	197.9	197.9
Subway Track	**Total CIP**	**33.1**	**34.1**	**34.6**	**34.1**	**33.3**	**33.5**	**34.7**	**33.0**	**33.5**	**34.0**	**338.0**	**197.9**	**535.9**
Surface Track	Funded	40.7	71.2	88.8	85.4	77.2	34.6	36.0	36.0	36.0	45.0	550.9	-	550.9
Surface Track	Unfunded	-	-	-	-	-	10.4	9.0	9.0	9.0	-	37.4	238.9	276.3
Surface Track	**Total CIP**	**40.7**	**71.2**	**88.8**	**85.4**	**77.2**	**45.0**	**45.0**	**45.0**	**45.0**	**45.0**	**588.3**	**238.9**	**827.2**
Traction Power	Funded	29.2	29.2	27.1	26.6	28.1	28.8	29.9	23.8	21.7	31.9	276.3	-	276.3
Traction Power	Unfunded	5.4	2.4	2.4	2.6	1.7	8.7	8.7	15.7	17.8	8.5	73.7	227.9	301.6
Traction Power	**Total CIP**	**34.6**	**31.5**	**29.6**	**29.2**	**29.8**	**37.5**	**38.5**	**39.5**	**39.4**	**40.4**	**350.0**	**227.9**	**577.9**
Power Distribution / Electric Systems	Funded	7.4	7.7	10.6	17.8	31.3	34.6	13.8	9.8	10.4	8.3	151.6	-	151.6
Power Distribution / Electric Systems	Unfunded	0.8	3.8	5.3	5.3	5.4	5.8	14.7	15.7	5.2	5.3	67.3	78.9	146.2
Power Distribution / Electric Systems	**Total CIP**	**8.2**	**11.5**	**15.9**	**23.2**	**36.6**	**40.4**	**28.5**	**25.5**	**15.6**	**13.5**	**218.9**	**78.9**	**297.8**
Communications	Funded	15.2	13.8	19.7	17.2	17.2	15.9	13.5	11.7	10.9	11.2	146.3	-	146.3
Communications	Unfunded	5.3	8.5	8.3	10.9	8.5	6.6	6.2	12.0	12.1	11.8	90.2	89.9	180.1
Communications	**Total CIP**	**20.5**	**22.3**	**27.9**	**28.2**	**25.7**	**22.5**	**19.6**	**23.7**	**23.0**	**23.0**	**236.5**	**89.9**	**326.4**
Signal Systems	Funded	21.6	22.3	26.6	17.3	7.9	7.4	7.3	12.9	13.2	10.3	146.8	-	146.8
Signal Systems	Unfunded	5.2	7.4	6.3	14.2	31.7	31.7	35.9	36.7	20.6	6.4	196.1	58.5	254.6
Signal Systems	**Total CIP**	**26.8**	**29.6**	**32.9**	**31.5**	**39.6**	**39.1**	**43.2**	**49.5**	**33.8**	**16.8**	**342.9**	**58.5**	**401.4**
Finishes	Funded	22.2	34.4	24.9	19.6	13.5	10.6	9.1	11.3	13.9	12.9	172.4	-	172.4
Finishes	Unfunded	-	4.6	42.5	58.8	38.6	50.1	46.5	15.1	11.9	11.0	279.2	61.8	341.0
Finishes	**Total CIP**	**22.2**	**39.1**	**67.4**	**78.4**	**52.1**	**60.7**	**55.6**	**26.5**	**25.8**	**23.9**	**451.6**	**61.8**	**513.5**
Equipment	Funded	68.9	70.9	67.1	60.2	44.7	28.3	24.3	22.7	24.4	25.1	436.5	-	436.5
Equipment	Unfunded	100.5	178.6	161.2	242.9	122.1	109.8	139.3	84.8	79.6	83.0	1,301.9	460.9	1,762.7
Equipment	**Total CIP**	**169.4**	**249.5**	**228.3**	**303.2**	**166.8**	**138.1**	**163.6**	**107.4**	**104.0**	**108.1**	**1,738.4**	**460.9**	**2,199.2**
Yards & Roads	Funded	0.5	0.1	1.2	-	-	-	-	-	-	-	1.8	-	1.8
Yards & Roads	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Yards & Roads	**Total CIP**	**0.5**	**0.1**	**1.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**-**	**1.8**
Ongrade Paving	Funded	10.8	12.9	14.0	6.4	14.9	21.4	14.8	0.8	14.7	15.0	125.7	-	125.7
Ongrade Paving	Unfunded	-	-	-	-	-	-	-	14.5	-	-	14.5	80.2	94.7
Ongrade Paving	**Total CIP**	**10.8**	**12.9**	**14.0**	**6.4**	**14.9**	**21.4**	**14.8**	**15.3**	**14.7**	**15.0**	**140.2**	**80.2**	**220.4**
Bridges & Tunnels	Funded	44.2	55.7	61.2	61.1	52.0	37.5	39.7	46.9	48.2	49.8	496.3	-	496.3
Bridges & Tunnels	Unfunded	-	-	-	5.0	8.0	8.0	8.0	-	-	-	29.0	257.7	286.7
Bridges & Tunnels	**Total CIP**	**44.2**	**55.7**	**61.2**	**66.1**	**60.0**	**45.5**	**47.7**	**46.9**	**48.2**	**49.8**	**525.3**	**257.7**	**783.0**
Fire Ventilation & Second Exits	Funded	23.7	29.3	30.8	27.6	41.9	46.1	52.0	48.3	40.6	25.9	366.2	-	366.2
Fire Ventilation & Second Exits	Unfunded	-	-	0.4	1.4	1.2	3.9	1.5	4.2	9.3	5.8	27.9	50.0	77.9
Fire Ventilation & Second Exits	**Total CIP**	**23.7**	**29.3**	**31.2**	**29.1**	**43.1**	**50.0**	**53.5**	**52.5**	**50.0**	**31.8**	**394.1**	**50.0**	**444.1**

Table 16-7: 2024-2038 capital investment plan cash flow summary (2/4).

Program Description ($ Millions)	CIP	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total 10 Year	Post 2033	Total 15 Year
Easier Access Phase III	Funded	114.9	152.4	121.8	101.4	34.5	-	-	-	-	-	525.1	-	525.1
Easier Access Phase III	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Easier Access Phase III	**Total CIP**	**114.9**	**152.4**	**121.8**	**101.4**	**34.5**	**-**	**-**	**-**	**-**	**-**	**525.1**	**-**	**525.1**
Sheppard Subway	Funded	0.2	0.2	3.0	-	-	-	-	-	-	-	3.4	-	3.4
Sheppard Subway	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Sheppard Subway	**Total CIP**	**0.2**	**0.2**	**3.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3.4**	**-**	**3.4**
Wheel-Trans Bus Purchase	Funded	15.8	9.6	2.1	-	-	-	-	-	-	-	27.5	-	27.5
Wheel-Trans Bus Purchase	Unfunded	-	-	2.3	2.8	47.0	56.4	9.3	11.3	7.9	31.1	168.2	183.2	351.5
Wheel-Trans Bus Purchase	**Total CIP**	**15.8**	**9.6**	**4.4**	**2.8**	**47.0**	**56.4**	**9.3**	**11.3**	**7.9**	**31.1**	**195.7**	**183.2**	**378.9**
Purchase Of Subway Cars	Funded	2.2	80.2	52.5	38.8	15.6	170.1	133.8	162.8	153.2	109.6	918.8	-	918.8
Purchase Of Subway Cars	Unfunded	-	160.3	105.0	77.6	31.2	340.3	267.5	325.7	306.4	219.2	1,833.1	471.8	2,305.0
Purchase Of Subway Cars	**Total CIP**	**2.2**	**240.5**	**157.4**	**116.4**	**46.8**	**510.4**	**401.3**	**488.5**	**459.6**	**328.8**	**2,751.9**	**471.8**	**3,223.8**
Streetcar Overhaul	Funded	37.4	18.9	10.0	1.3	5.5	7.5	-	-	-	-	80.7	-	80.7
Streetcar Overhaul	Unfunded	1.0	18.5	64.1	25.3	40.3	13.5	22.1	63.3	63.4	63.4	374.9	118.1	493.0
Streetcar Overhaul	**Total CIP**	**38.4**	**37.4**	**74.1**	**26.6**	**45.8**	**21.0**	**22.1**	**63.3**	**63.4**	**63.4**	**455.6**	**118.1**	**573.7**
Subway Car Overhaul	Funded	38.3	46.6	33.0	31.9	37.8	68.0	65.1	63.4	46.6	29.5	460.2	-	460.2
Subway Car Overhaul	Unfunded	-	-	30.7	31.7	33.9	4.6	5.6	5.2	4.1	-	115.7	137.1	252.8
Subway Car Overhaul	**Total CIP**	**38.3**	**46.6**	**63.7**	**63.6**	**71.8**	**72.6**	**70.7**	**68.6**	**50.7**	**29.5**	**575.9**	**137.1**	**713.0**
Purchase Automotive Non-Revenue Vehicles	Funded	16.5	24.0	10.5	8.1	10.3	2.7	2.7	2.7	1.9	-	79.5	-	79.5
Purchase Automotive Non-Revenue Vehicles	Unfunded	-	-	8.9	13.7	12.7	16.4	13.8	9.8	19.9	25.4	120.6	101.4	222.0
Purchase Automotive Non-Revenue Vehicles	**Total CIP**	**16.5**	**24.0**	**19.4**	**21.7**	**23.0**	**19.1**	**16.6**	**12.5**	**21.9**	**25.4**	**200.0**	**101.4**	**301.5**
Rail Non-Revenue Vehicle Overhaul	Funded	2.2	3.4	4.4	5.7	5.3	4.2	3.6	1.9	1.6	1.6	33.8	-	33.8
Rail Non-Revenue Vehicle Overhaul	Unfunded	-	-	-	-	-	-	-	-	-	-	-	8.2	8.2
Rail Non-Revenue Vehicle Overhaul	**Total CIP**	**2.2**	**3.4**	**4.4**	**5.7**	**5.3**	**4.2**	**3.6**	**1.9**	**1.6**	**1.6**	**33.8**	**8.2**	**42.1**
Rail Non-Revenue Vehicle Purchase	Funded	0.7	4.4	6.3	6.9	5.6	9.9	12.9	8.4	5.5	2.6	63.2	-	63.2
Rail Non-Revenue Vehicle Purchase	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Rail Non-Revenue Vehicle Purchase	**Total CIP**	**0.7**	**4.4**	**6.3**	**6.9**	**5.6**	**9.9**	**12.9**	**8.4**	**5.5**	**2.6**	**63.2**	**-**	**63.2**
Shop Equipment	Funded	10.1	11.5	3.0	2.3	2.4	1.4	1.6	1.5	1.6	2.1	37.3	-	37.3
Shop Equipment	Unfunded	1.2	7.0	11.2	9.9	7.2	6.5	9.1	6.2	9.2	6.8	74.3	41.4	115.7
Shop Equipment	**Total CIP**	**11.2**	**18.5**	**14.1**	**12.1**	**9.6**	**8.0**	**10.7**	**7.8**	**10.8**	**8.9**	**111.6**	**41.4**	**153.0**
Fare Handling Equipment	Funded	1.3	1.2	1.2	1.2	1.2	1.2	1.7	1.7	1.7	1.7	14.1	-	14.1
Fare Handling Equipment	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Fare Handling Equipment	**Total CIP**	**1.3**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.7**	**1.7**	**1.7**	**1.7**	**14.1**	**-**	**14.1**
Environmental Programs	Funded	9.2	14.5	18.3	18.2	12.6	8.6	9.3	7.9	6.2	6.0	110.8	-	110.8
Environmental Programs	Unfunded	-	1.2	1.0	2.1	1.8	-	-	-	-	-	6.1	30.0	36.1
Environmental Programs	**Total CIP**	**9.2**	**15.7**	**19.3**	**20.3**	**14.3**	**8.6**	**9.3**	**7.9**	**6.2**	**6.0**	**116.9**	**30.0**	**146.9**
IT Systems / Software	Funded	87.0	87.1	78.8	78.9	18.0	16.8	16.2	14.2	18.1	16.5	431.7	-	431.7
IT Systems / Software	Unfunded	5.8	14.3	30.1	38.7	28.7	7.5	0.6	0.4	0.4	2.1	128.6	-	128.6
IT Systems / Software	**Total CIP**	**92.9**	**101.4**	**108.9**	**117.6**	**46.7**	**24.3**	**16.8**	**14.6**	**18.5**	**18.7**	**560.3**	**-**	**560.3**

Table 16-8: 2024-2038 capital investment plan cash flow summary (3/4).

Program Description ($ Millions)	CIP	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total 10 Year	Post 2033	Total 15 Year
Furniture & Office Equipment	Funded	0.1	0.3	0.2	0.1	0.2	0.1	0.1	0.3	0.1	0.1	1.3	-	1.3
Furniture & Office Equipment	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Furniture & Office Equipment	**Total CIP**	**0.1**	**0.3**	**0.2**	**0.1**	**0.2**	**0.1**	**0.1**	**0.3**	**0.1**	**0.1**	**1.3**	**-**	**1.3**
Service Planning	Funded	17.8	21.2	24.8	27.5	10.0	3.8	3.6	3.1	3.3	3.3	118.4	-	118.4
Service Planning	Unfunded	-	8.5	25.5	33.3	51.1	59.4	50.3	41.9	41.9	14.9	326.7	13.6	340.2
Service Planning	**Total CIP**	**17.8**	**29.8**	**50.3**	**60.7**	**61.1**	**63.2**	**53.9**	**45.0**	**45.2**	**18.2**	**445.1**	**13.6**	**458.7**
Transit Shelters & Loops	Funded	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.6	5.7	-	5.7
Transit Shelters & Loops	Unfunded	-	0.6	7.0	14.8	12.8	0.8	-	-	-	-	36.0	3.3	39.3
Transit Shelters & Loops	**Total CIP**	**0.4**	**1.1**	**7.5**	**15.3**	**13.4**	**1.4**	**0.6**	**0.6**	**0.7**	**0.6**	**41.7**	**3.3**	**45.0**
Other Buildings & Structures	Funded	75.3	119.8	180.3	121.6	75.5	58.5	1.4	0.7	5.5	5.7	644.2	-	644.2
Other Buildings & Structures	Unfunded	1.5	20.9	101.2	234.5	352.6	350.4	437.2	673.6	592.8	537.5	3,302.1	6,311.1	9,613.3
Other Buildings & Structures	**Total CIP**	**76.8**	**140.7**	**281.4**	**356.0**	**428.1**	**408.9**	**438.6**	**674.2**	**598.3**	**543.2**	**3,946.3**	**6,311.1**	**10,257.4**
Purchase Of Buses	Funded	200.2	456.4	25.1	-	-	-	-	-	-	-	681.7	-	681.7
Purchase Of Buses	Unfunded	17.7	135.5	265.7	263.0	374.5	325.0	372.1	335.1	301.9	279.1	2,669.6	1,349.6	4,019.2
Purchase Of Buses	**Total CIP**	**217.9**	**591.9**	**290.8**	**263.0**	**374.5**	**325.0**	**372.1**	**335.1**	**301.9**	**279.1**	**3,351.2**	**1,349.6**	**4,700.9**
Bus Overhaul	Funded	70.6	31.8	6.3	2.8	47.6	81.4	81.3	73.0	77.6	76.0	548.4	-	548.4
Bus Overhaul	Unfunded	1.0	29.6	68.9	66.5	27.3	23.3	4.5	12.2	14.0	5.2	252.5	402.7	655.2
Bus Overhaul	**Total CIP**	**71.6**	**61.4**	**75.2**	**69.3**	**74.9**	**104.7**	**85.8**	**85.2**	**91.6**	**81.2**	**801.0**	**402.7**	**1,203.6**
Other Maintenance Equipment	Funded	3.6	2.0	1.4	1.1	1.0	1.1	1.1	1.1	1.2	1.0	14.6	-	14.6
Other Maintenance Equipment	Unfunded	0.7	-	-	-	0.7	0.1	-	-	-	-	1.5	0.7	2.2
Other Maintenance Equipment	**Total CIP**	**4.3**	**2.0**	**1.4**	**1.1**	**1.7**	**1.1**	**1.1**	**1.1**	**1.2**	**1.0**	**16.1**	**0.7**	**16.8**
Queensway Garage Renovations	Funded	-	-	-	-	-	-	-	-	-	-	-	-	-
Queensway Garage Renovations	Unfunded	-	0.7	2.7	7.9	-	-	-	-	-	-	11.2	-	11.2
Queensway Garage Renovations	**Total CIP**	**-**	**0.7**	**2.7**	**7.9**	**-**	**-**	**-**	**-**	**-**	**-**	**11.2**	**-**	**11.2**
Purchase Of Streetcars	Funded	217.8	90.9	16.3	-	-	-	-	-	-	-	325.0	-	325.0
Purchase Of Streetcars	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Purchase Of Streetcars	**Total CIP**	**217.8**	**90.9**	**16.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**325.0**	**-**	**325.0**
Toronto-York Spadina Subway Extension	Funded	42.3	6.8	-	-	-	-	-	-	-	-	49.1	-	49.1
Toronto-York Spadina Subway Extension	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Toronto-York Spadina Subway Extension	**Total CIP**	**42.3**	**6.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**49.1**	**-**	**49.1**
Fare System	Funded	3.8	2.4	2.5	-	-	-	-	-	-	-	8.7	-	8.7
Fare System	Unfunded	-	2.0	27.0	20.0	-	-	-	-	-	-	49.0	-	49.0
Fare System	**Total CIP**	**3.8**	**4.4**	**29.5**	**20.0**	**-**	**-**	**-**	**-**	**-**	**-**	**57.7**	**-**	**57.7**
ATC Resignalling	Funded	18.3	31.9	57.2	69.3	69.7	60.6	78.2	81.7	80.5	83.3	630.5	-	630.5
ATC Resignalling	Unfunded	-	-	-	-	-	-	-	-	-	-	-	273.5	273.5
ATC Resignalling	**Total CIP**	**18.3**	**31.9**	**57.2**	**69.3**	**69.7**	**60.6**	**78.2**	**81.7**	**80.5**	**83.3**	**630.5**	**273.5**	**904.0**
Streetcar Maintenance & Storage Facility	Funded	0.2	1.3	2.8	2.4	-	-	-	-	-	-	6.7	-	6.7
Streetcar Maintenance & Storage Facility	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Streetcar Maintenance & Storage Facility	**Total CIP**	**0.2**	**1.3**	**2.8**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**6.7**	**-**	**6.7**

Table 16-9: 2024-2038 capital investment plan cash flow summary (4/4).

Program Description ($ Millions)	CIP	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total 10 Year	Post 2033	Total 15 Year
TR / T1 Rail Yard Accommodation	Funded	7.0	48.2	23.0	13.4	23.0	-	-	-	-	-	114.6	-	114.6
TR / T1 Rail Yard Accommodation	Unfunded	-	0.9	-	3.2	3.2	3.3	-	-	-	-	10.6	-	10.6
TR / T1 Rail Yard Accommodation	**Total CIP**	**7.0**	**49.1**	**23.0**	**16.6**	**26.2**	**3.3**	**-**	**-**	**-**	**-**	**125.2**	**-**	**125.2**
SRT Transition	Funded	7.0	22.2	-	-	-	-	-	-	-	-	29.2	-	29.2
SRT Transition	Unfunded	3.7	20.0	20.0	12.0	-	-	-	-	-	-	55.7	-	55.7
SRT Transition	**Total CIP**	**10.7**	**42.2**	**20.0**	**12.0**	**-**	**-**	**-**	**-**	**-**	**-**	**84.9**	**-**	**84.9**
McNiccoll Bus Garage	Funded	0.3	1.6	1.8	0.6	-	-	-	-	-	-	4.4	-	4.4
McNiccoll Bus Garage	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
McNiccoll Bus Garage	**Total CIP**	**0.3**	**1.6**	**1.8**	**0.6**	**-**	**-**	**-**	**-**	**-**	**-**	**4.4**	**-**	**4.4**
Waterfront Transit	Funded	0.7	0.6	2.9	1.0	12.0	9.1	4.3	-	-	-	30.6	-	30.6
Waterfront Transit	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Waterfront Transit	**Total CIP**	**0.7**	**0.6**	**2.9**	**1.0**	**12.0**	**9.1**	**4.3**	**-**	**-**	**-**	**30.6**	**-**	**30.6**
Safety & Reliability	Funded	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	-	10.0
Safety & Reliability	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Safety & Reliability	**Total CIP**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**10.0**	**-**	**10.0**
Warehouse Consolidation	Funded	0.2	0.2	-	-	-	-	-	-	-	-	0.5	-	0.5
Warehouse Consolidation	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Warehouse Consolidation	**Total CIP**	**0.2**	**0.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.5**	**-**	**0.5**
Corporate Initiatives	Funded	6.8	7.8	8.3	9.0	10.0	10.3	10.3	10.5	11.0	11.0	94.8	-	94.8
Corporate Initiatives	Unfunded	-	-	-	-	-	-	-	-	-	-	-	-	-
Corporate Initiatives	**Total CIP**	**6.8**	**7.8**	**8.3**	**9.0**	**10.0**	**10.3**	**10.3**	**10.5**	**11.0**	**11.0**	**94.8**	**-**	**94.8**
Bloor-Yonge Capacity Improvements	Funded	13.7	19.6	39.9	82.4	102.6	140.4	194.8	247.8	189.4	152.2	1,182.9	-	1,182.9
Bloor-Yonge Capacity Improvements	Unfunded	-	-	-	-	-	-	-	-	-	-	-	252.2	252.2
Bloor-Yonge Capacity Improvements	**Total CIP**	**13.7**	**19.6**	**39.9**	**82.4**	**102.6**	**140.4**	**194.8**	**247.8**	**189.4**	**152.2**	**1,182.9**	**252.2**	**1,435.1**
Line 1 Capacity Enhancements	Funded	17.6	50.0	123.7	217.2	205.1	111.4	84.6	62.7	48.1	108.3	1,028.8	-	1,028.8
Line 1 Capacity Enhancements	Unfunded	-	-	53.2	159.6	304.5	236.8	460.8	860.7	678.7	246.2	3,000.5	2,164.8	5,165.3
Line 1 Capacity Enhancements	**Total CIP**	**17.6**	**50.0**	**176.9**	**376.8**	**509.7**	**348.2**	**545.4**	**923.4**	**726.8**	**354.5**	**4,029.3**	**2,164.8**	**6,194.1**
Line 2 Capacity Enhancements	Funded	10.7	27.1	72.2	66.0	144.3	148.8	143.3	130.9	79.8	49.7	872.9	-	872.9
Line 2 Capacity Enhancements	Unfunded	-	-	-	-	2.3	25.6	20.1	18.6	30.0	54.0	150.6	1,647.7	1,798.3
Line 2 Capacity Enhancements	**Total CIP**	**10.7**	**27.1**	**72.2**	**66.0**	**146.6**	**174.4**	**163.4**	**149.6**	**109.8**	**103.7**	**1,023.5**	**1,647.7**	**2,671.2**
TransformTO	Funded	-	-	-	-	-	-	-	-	-	-	-	-	-
TransformTO	Unfunded	106.4	124.4	367.4	412.1	320.5	378.7	372.1	369.7	359.9	299.7	3,110.9	2,228.8	5,339.8
TransformTO	**Total CIP**	**106.4**	**124.4**	**367.4**	**412.1**	**320.5**	**378.7**	**372.1**	**369.7**	**359.9**	**299.7**	**3,110.9**	**2,228.8**	**5,339.8**
Grand Total	**Funded**	1,368.7	1,779.2	1,341.8	1,284.1	1,213.4	1,216.1	1,126.3	1,135.2	1,001.9	931.1	12,397.7	-	12,397.7
	Unfunded	256.3	749.8	1,418.3	1,769.6	1,869.5	2,083.7	2,315.0	2,941.2	2,596.1	1,916.2	17,915.7	17,542.0	35,457.7
	Total CIP	**1,625.0**	**2,529.0**	**2,760.1**	**3,053.7**	**3,082.9**	**3,299.8**	**3,441.3**	**4,076.4**	**3,598.0**	**2,847.3**	**30,313.4**	**17,542.0**	**47,855.4**

17. Appendix F: Approved 2024 Operating Budget and 2024-2033 Capital Budget and Plan

The table below shows the TTC conventional transit operating budget for 2024. It is taken from Appendix B1 of the Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan.

Table 17-1: Conventional Transit Operating Budget.

TORONTO TRANSIT COMMISSION
2024 OPERATING BUDGET

($000s)	2023 BUDGET	2024 BUDGET	2023 vs. 2024 BUDGET CHANGE
REVENUES			
Passenger Revenues	931,437	998,206	66,769
Outside City Services & Charters	8,882	9,025	143
Advertising	24,820	26,030	1,210
Rent Revenue	12,998	11,935	(1,062)
Commuter Parking	6,017	7,498	1,481
Other Income	28,533	34,301	5,767
Reserve Draws	52,585	66,476	13,890
Provincial Funding - New Deal		175,300	175,300
TOTAL REVENUES	1,065,272	1,328,770	263,498
EXPENSES			
Departmental Expenses			
CEO's Office	33,068	33,073	4
Corporate Affairs	2,236	2,425	189
Corporate Services	98,137	103,313	5,176
Diversity & Culture	12,357	13,577	1,220
Innovation & Sustainability	3,142	5,264	2,122
People Group	43,964	48,279	4,314
Strategy & Customer Experience	82,197	87,798	5,601
Engineering, Construction & Expansion	6,747	7,451	703
Operations & Infrastructure	298,797	314,562	15,765
Transportation & Vehicles	924,938	985,497	60,560
Corporate Budgets			
Employee Benefits	420,024	462,284	42,260
Vehicle Fuel	102,931	101,087	(1,845)
Traction Power	48,759	51,228	2,469
Utilities	30,874	32,965	2,090
Depreciation	24,145	23,850	(295)
Taxes, Licences and Insurance	17,293	20,461	3,168
Accident Claim Payments	20,000	20,000	0
Contribution to Reserve: Accident Claims	17,000	17,000	0
Contribution to Reserve: Proceeds on Sale of Buses	0	2,706	2,706
Contribution to SFDA: Fair Pass Program Expansion	2,000	0	(2,000)
Non-Departmental Expenses	26,284	27,169	886
PRESTO Commissions	39,651	44,382	4,731
TOTAL EXPENSES	2,254,544	2,404,370	149,825
Operating Funding Required	1,189,272	1,075,600	(113,672)

Notes:

1. All figures by group are subject to refinement.
2. At May 17-19, 2005 City Council meeting, Council approved the establishment of a long-term receivable from the City for budgeted non-cash expenses related to post-retirement benefits. In addition, as part of City Council's approval of the 2010 TTC and Wheel-Trans operating budgets a long-term receivable for non-cash accident claim expenses was also established. Consistent with these approvals and practice since then, the budget for these non-cash expenses are not included in the current year net funding requirement from the City and the actual non-cash costs incurred will be added to the respective long-term receivable balances.
3. Refer to Appendix B2 for details of the Wheel-Trans shortfall & Appendix E for details on the contribution to reserve.

The table below shows the TTC Wheel-Trans operating budget for 2024. It is taken from Appendix B2 of the Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan.

Table 17-2: 2024 Wheel-Trans Operating Budget 2024.

WHEEL-TRANS SERVICE 2024 OPERATING BUDGET			
($000s)	2023 BUDGET	2024 BUDGET	2023 vs. 2024 BUDGET CHANGE
REVENUES			
Passenger Revenues	6,497	7,328	832
Accident Claim Payments/Contribution from Reserve	590	590	0
TOTAL REVENUES	7,087	7,918	832
EXPENSES			
Contracted Taxi Service	50,127	64,550	14,424
Operators	32,373	33,995	1,622
Divisional Staff	724	678	(45)
Mobile Supervision	803	819	15
Dispatch	5,983	6,390	407
Equipment Maintenance	13,618	13,628	10
Senior Manager's Office	1,511	1,713	202
Reservations	3,919	5,166	1,247
Taxi Administration	303	317	15
Customer Service	1,685	2,297	612
Lakeshore Garage Costs	1,006	1,014	7
Employee Benefits	18,706	20,340	1,634
Vehicle Fuel	4,311	4,445	134
Utilities	793	755	(38)
Accident Claim Payments/Contribution to Reserve	590	590	0
Non-Departmental Expenses	6,960	6,873	(87)
TOTAL EXPENSES	143,410	163,569	20,159
Operating Funding Required	136,323	155,651	19,328

Notes:

1. All figures by group are subject to refinement.
2. At the May 17-19, 2005 City Council meeting, Council approved the establishment of a long-term receivable from the City for budgeted non-cash expenses related to post-retirement benefits. In addition, as part of City Council's approval of the 2010 TTC and Wheel-Trans operating budgets a long-term receivable for non-cash accident claim expenses was also established. Consistent with these approvals and practice since then, the budget for these non-cash expenses are not included in the current year net funding requirement from the City and the actual non-cash costs incurred will be added to the respective long-term receivable balances.
3. Refer to Appendix E for details on the contribution to reserve.

The table below shows the cash-flow funding by year for each of the major projects portfolios. It is taken from Table 19 of the Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan.

Table 17-3: 2024-2033 Capital Plan by major project cateogry.

($ Millions)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	10-Year Total	% of Total
Major Projects Portfolio:												
Subway Portfolio	205.3	395.7	498.1	602.8	613.8	677.6	686.5	734.3	591.5	529.0	**5,534.6**	**45%**
Major SOGR Projects	246.3	266.6	200.3	177.3	243.7	275.3	260.1	236.4	244.2	236.0	**2,386.2**	**19%**
Streetcar, Bus and Wheel Trans Portfolio	499.3	640.2	137.8	81.4	57.4	12.7	-	-	-	-	**1,428.8**	**12%**
Network Wide Portfolio	40.3	44.2	40.2	53.9	-	-	-	-	-	-	**178.6**	**1%**
Subtotal Major Projects	**991.2**	**1,346.7**	**876.4**	**915.4**	**914.9**	**965.6**	**946.6**	**970.7**	**835.7**	**765.0**	**9,528.2**	**77%**
Major Projects as % of Total Budget	**72%**	**76%**	**65%**	**71%**	**75%**	**79%**	**84%**	**86%**	**83%**	**82%**	**77%**	
Ongoing SOGR	377.5	432.5	465.4	368.7	298.5	250.5	179.7	164.5	166.2	166.1	**2,869.6**	**23%**
Grand Total	**1,368.7**	**1,779.2**	**1,341.8**	**1,284.1**	**1,213.4**	**1,216.1**	**1,126.3**	**1,135.2**	**1,001.9**	**931.1**	**12,397.8**	**100%**

Tables below show the capital budget and plan summary for the years 2024-2033. They are taken from Appendix E of the Staff Recommended 2024 TTC Conventional and Wheel-Trans Operating Budgets and 2024-2033 Capital Budget and Plan.

Table 17-4: 2024-2033 Capital Budget and Plan summary (1/3).

Programs ($ millions)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2024-2033
Infrastructure Related Programs:											
Tracks:											
1.1 Subway Track	33.089	34.064	34.624	34.112	33.346	33.481	34.719	33.000	33.549	34.000	337.984
1.2 Surface Track	40.741	71.171	88.800	85.376	77.239	34.554	36.001	36.001	36.000	45.000	550.883
Signals, Electrical, Communications:											
2.1 Traction Power	29.207	29.171	27.125	26.628	28.115	28.822	29.875	23.790	21.676	31.889	276.298
2.2 Power Distribution	7.423	7.693	10.603	17.832	31.284	34.643	13.753	9.751	10.400	8.257	151.639
2.3 Communications	15.207	13.791	19.651	17.228	17.248	15.928	13.456	11.687	10.887	11.246	146.329
2.4 Signal Systems	21.613	22.257	26.629	17.303	7.940	7.367	7.269	12.854	13.216	10.332	146.780
2.4 YUS/BD Resignalling	18.288	31.865	57.154	69.262	69.700	60.630	78.157	81.690	80.469	83.270	630.485
Buildings and Structures:											
3.1 Finishes	22.179	34.410	24.930	19.598	13.505	10.616	9.103	11.305	13.900	12.868	172.414
3.2 Equipment	68.871	70.935	67.104	60.228	44.657	28.290	24.265	22.660	24.368	25.135	436.513
3.3 Yards & Roads	11.679	13.498	15.740	6.976	15.455	21.977	15.401	1.424	15.358	15.622	133.130
3.4 Bridges & Tunnels	44.204	55.693	61.220	61.077	52.006	37.458	39.693	46.938	48.219	49.783	496.291
3.9 Fire Ventilation Upgrade	23.669	29.271	30.804	27.637	41.891	46.104	51.990	48.318	40.607	25.947	366.238
3.9 Easier Access Phase III	114.927	152.436	121.807	101.448	34.454						525.072
3.9 Sheppard Subway	0.200	0.200	3.005								3.405
3.9 Leslie Barns	0.173	1.287	2.831	2.409							6.700
3.9 Toronto Rocket (Subway Car) Yard & Storage Track Accommodation	6.983	48.230	22.996	13.434	22.999						114.642
3.9 McNicoll Bus Garage	0.332	1.610	1.825	0.625							4.392
3.9 Line 1 Capacity Enhancement	17.592	50.039	123.726	217.185	205.149	111.408	84.550	62.740	48.074	108.317	1,028.780
3.9 Line 2 Capacity Enhancement	10.734	27.128	72.209	66.036	144.333	148.835	143.253	130.944	79.754	49.685	872.911
3.9 Corporate Initatives	6.750	7.750	8.250	9.000	10.000	10.250	10.250	10.500	11.000	11.000	94.750
3.9 Yonge-Bloor Capacity Improvement	13.723	19.603	39.922	82.428	102.618	140.448	194.778	247.797	189.383	152.176	1,182.876
3.9 Other Buildings & Structures	75.569	119.987	180.268	121.554	75.509	58.482	1.400	0.657	5.481	5.723	644.630

Table 17-5: 2024-2033 Capital Budget and Plan summary (2/3).

Programs ($ millions)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2024-2033
Tooling, Machinery and Equipment											
5.1 Shop Equipment	10.052	11.479	2.976	2.252	2.388	1.437	1.573	1.535	1.583	2.051	37.326
5.2 Revenue & Fare Handling Equipment	1.250	1.200	1.200	1.200	1.200	1.200	1.700	1.700	1.700	1.700	14.050
5.3 Other Maintenance Equipment	3.627	2.023	1.445	1.055	0.983	1.067	1.146	1.148	1.161	0.957	14.612
5.4 Fare System	3.830	2.414	2.500								8.744
Environmental Issues											
6.1 Environmental Program	9.177	14.486	18.315	18.236	12.552	8.583	9.307	7.900	6.200	6.000	110.756
6.1 Safety Program	0.977	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	9.977
Computer Equipment & Software											
7.1 IT Systems/Infrastructure	87.025	87.120	78.817	78.890	18.001	16.774	16.249	14.182	18.117	16.522	431.697
Other:											
9.1 Furniture & Office Equipment	0.050	0.260	0.150	0.100	0.227	0.050	0.075	0.270	0.050	0.050	1.282
9.2 Service Planning	17.849	22.235	26.836	29.455	9.960	3.810	3.602	3.100	3.300	3.300	123.447
Subtotal - Infrastructure Related Programs	**716.991**	**984.307**	**1,174.462**	**1,189.562**	**1,073.762**	**863.214**	**822.566**	**822.892**	**715.449**	**711.829**	**9,075.034**
Vehicle Related Programs:											
4.11 Purchase of Buses	200.175	456.427	25.053								681.655
4.11 Purchase of Wheel Trans Buses	15.787	9.609	2.056								27.452
4.12 Purchase of Subway Cars	2.239	80.155	52.478	38.811	15.611	170.132	133.763	162.825	153.199	109.591	918.804
4.13 Bus Overhaul	70.604	31.845	6.305	2.762	47.579	81.379	81.336	73.042	77.591	75.988	548.431
4.15 Streetcar Overhaul	37.445	18.878	10.022	1.320	5.500	7.529					80.694
4.16 Subway Car Overhaul	38.295	46.602	32.986	31.923	37.837	67.963	65.103	63.382	46.604	29.492	460.187
4.18 Purchase of Streetcars	217.762	90.920	16.345								325.027
4.21 Purchase Non-Revenue Vehicles	16.481	24.044	10.528	8.080	10.278	2.701	2.705	2.706	1.939		79.462
4.22 Rail Non-Revenue Vehicle Overhauls	2.152	3.369	4.394	5.657	5.274	4.198	3.626	1.925	1.607	1.641	33.843
4.23 Purchase Rail Non-Revenue Vehicle	0.717	3.448	4.291	4.940	5.558	9.898	12.871	8.403	5.512	2.585	58.223
Subtotal - Vehicle Related Programs	**601.657**	**765.297**	**164.458**	**93.493**	**127.637**	**343.800**	**299.404**	**312.283**	**286.452**	**219.297**	**3,213.778**
TOTAL - BASE PROGRAM	**1,318.648**	**1,749.604**	**1,338.920**	**1,283.055**	**1,201.399**	**1,207.014**	**1,121.970**	**1,135.175**	**1,001.901**	**931.126**	**12,288.812**

Table 17-6: 2024-2033 Capital Budget and Plan summary (3/3).

Programs ($ millions)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2024-2033
Transit Expansion Programs:											
SRT Bus Replacement Infrastructure	7.016	22.189									29.205
Waterfront Transit	0.657	0.603	2.922	1.000	12.000	9.077	4.300				30.559
Toronto-York Spadina Subway Extension (TYSSE)	42.348	6.797									49.145
TOTAL - TRANSIT EXPANSION PROGRAM	**50.021**	**29.589**	**2.922**	**1.000**	**12.000**	**9.077**	**4.300**				**108.909**
TOTAL - BASE & EXPANSION	**1,368.669**	**1,779.193**	**1,341.842**	**1,284.055**	**1,213.399**	**1,216.091**	**1,126.270**	**1,135.175**	**1,001.901**	**931.126**	**12,397.721**

18. Appendix G: Condition Scoring Frameworks

Table 18-1: Asset condition scoring framework.

Numerical Rating	Descriptive Rating	Description	Serviceable Life Remaining	Mileage Remaining*
1	Excellent	Element is likely new. No defects or repairs required.	Greater than 75%	Greater than 75%
2	Good	Localized minor deficiencies with limited to no repairs required.	51-75%	51-75%
3	Adequate	Some deficiencies, minor repairs required, but element is functioning as designed.	25-50%	25-50%
4	Marginal	Repairs required within one-to-five years. Can function as designed in the short-term, with some maintenance and monitoring.	Less than 25%	Less than 25%
5	Critical/Poor	Major repairs or specialist review required immediately. Element is not functioning as originally designed. Severe defects are present or identified as a safety hazard.	Beyond serviceable life	Exceeded maximum recommended mileage
	Unknown	Not enough data exists to provide a rating.	Age data unknown	Mileage data unknown

**Mileage is used as a criteria for the replacement of road non-revenue vehicles.*

Table 18-2: TTC BCI Ranges.

BCI	Condition State	General timelines to address needs
90 to 100	Very Good	Usually not required in next five years.
75 to 90	Good	Usually not required in next five years.
60 to 75	Fair	May be required within five years.
40 to 60	Poor	The structure is scheduled for a detailed condition survey. The scope and timeline for rehabilitation works is then determined by engineering judgment and the results of the detailed condition survey.
0 to 40	Very Poor	As above for ‘Poor’.