For Action

Extreme Precipitation Planning

Date: April 16, 2025
To: TTC Board
From: Executive Director – Innovation and Sustainability

Summary

Further to the TTC Board's requests on July 17, 2024, and February 21, 2025, this report details lessons learned from recent heavy rain and snow events. Recognizing there is a need to improve on current mitigations and that extreme precipitation will become more frequent and severe, lessons learned include actions under consideration by TTC and our colleagues at the City of Toronto to better safeguard operations, infrastructure, and, most importantly, our customers from the effects of climate change. In addition to lessons learned, the report looks at future climate projections and summarizes existing and planned risk mitigation strategies, including extreme weather preparedness measures, response protocols, inter-agency collaboration, investments in adaptation, and future resiliency planning.

Recommendations

It is recommended that the TTC Board:

1. Request that the TTC collaborate with City staff on the planned report to Council on the review of winter maintenance operations to ensure that the resilience of TTC operations is considered as one of the key priorities.

2. Request that the TTC continue its work on the Board-approved Innovation and Sustainability Strategy to plan for adaptation based on the City's latest climate projections of precipitation, heat, wind, freeze-thaw cycles, etc. and continue to collaborate with relevant City Divisions and Agencies to review opportunities to minimize major disruptions to TTC service during extreme weather events.

3. Forward the report to the City Manager for information.

Financial Summary

There are no capital or operating funding requests associated with the Board's receipt of this report.

The 2025-2034 Capital Budget and Plan includes $1.5 million to conduct climate risk studies and pilot adaptation measures to increase resilience. As climate risk studies are completed, capital and operating budget impacts will be identified and submitted for

Board approval through the budget process. Section 4 of this report highlights known unfunded or partially funded State of Good Repair (SOGR) programs that support flood resilience. According to the Canadian Climate Institute, every $1 invested in adapting to climate change saves $13 to $15 in the long term.[1]

The Executive Director of Finance has reviewed this report and agrees with the financial impact information summary.

Equity/Accessibility Matters

Extreme weather events have a disproportionate impact on vulnerable communities that rely heavily on transit, especially surface (bus and streetcar) transit modes. Residents in these communities often have less flexibility for remote work or alternative arrangements for access to essentials such as grocery stores, schools, medical appointments, and daycare during extreme precipitation events and depend on transit services. Additionally, there is a financial strain on TTC riders in vulnerable communities who have already purchased monthly passes and may suffer additional financial burden by seeking alternative transportation options.

Furthermore, individuals with reduced mobility and people with disabilities can be severely affected during precipitation events, particularly when snow and ice are not cleared from sidewalks or when pooling water obstructs pathways, making navigation hazardous or impossible.

A key principle of the TTC's 2024-2028 Corporate Plan is equity, diversity, inclusion, and accessibility (EDIA). To meet this commitment, the TTC will apply an EDIA lens to its resilience efforts, work to minimize service interruptions and provide timely communications about extreme weather events to minimize the impact such events have on TTC's customers.

Innovation and Sustainability Matters

TTC's Corporate Plan outlines the organization's four key priorities, one of which is environmental sustainability. The TTC's Innovation and Sustainability Strategy, approved by the Board in September 2024, commits to enhancing resilience to extreme climate events (Workstream 2.4). As a fundamental pillar of this strategy, resilience efforts are aimed at reducing the frequency, duration, and severity of service interruptions and their associated socio-economic impacts.

Decision History

In July 2024, the Board requested the CEO to report to the Board by Q1 2025 on impacts from extreme weather, lessons learned, and longer-term plans.
Decision: Prioritizing TTC Asset State of Good Repair to Keep the System Moving Reliably – 2025 Capital Budget Outlook

In September 2024, the Board approved TTC's Innovation and Sustainability Strategy, which emphasized the need to identify vulnerable assets and adopt mitigation measures to increase climate resilience.

[1] Damage Control, Reducing the Costs of Climate Impacts in Canada, September 2022, Canadian Climate Institute

Report: Innovation and Sustainability Strategy
Decision: Innovation and Sustainability Strategy

In February 2025, the Board requested staff to report to the Board in Q2 2025 on proactive extreme weather plans to improve the system during extreme weather incidents.
Decision: Improving the TTC's Response to Major Snow Incidents

In March 2025, City Council directed the City Manager to evaluate all options to improve winter maintenance work.
Decision: EX21.1 - Review of Toronto's Winter Maintenance Program

Issue Background

In 2024, Toronto experienced its highest annual precipitation levels, surpassing the previous record set in 2008 by 9% and exceeding the 30-year average by over 30%.

The record-breaking rainfall was primarily caused by summer storms, especially in July 2024. The most extreme rainfall began on July 15, when the city received 30 mm of rainfall in five hours. This was followed by more intense rainfall on the morning of July 16, delivering over 80 mm of rain in four hours. These consecutive heavy rainfall events resulted in more than 115 mm of precipitation within 24 hours, exceeding a 100-year design storm.[2]

This trend of heavy precipitation continued into February 2025, when the city experienced record-breaking snowfall. On February 8 and 9, 15 cm of snowfall accumulated. Heavy snowfall began on February 12 and continued into February 13, resulting in an additional 26 cm of snow. After a brief pause, snowfall resumed on February 15 and lasted until February 17, adding another 25 cm. Throughout this period, temperatures remained below freezing, with no snowmelt occurring between snowfall events. As a result, the city received over 50cm of snowfall in four days, and over 60 cm within nine days, leading to its second-highest snowpack, the highest since January 1999.

Climate change will lead to more frequent and severe precipitation events. To prepare, the TTC must address its state of good repair (SOGR) backlog to ensure physical assets are in good condition, increase adaptive capacity and resilience, and collaborate with City divisions and agencies responsible for interdependent infrastructure.

Comments

Increasing heavy precipitation events threaten TTC's infrastructure and service reliability. This section addresses the Board's requests to provide details regarding the July 2024 heavy rainfall and February 2025 snowfall events, Toronto's future climate projections, existing risk mitigation strategies, and upcoming resilience initiatives.

[2] A 100-year design storm is an extreme weather event with a 1% chance of occurring in any given year.

1. Lessons Learned from Recent Extreme Precipitation Events

Following all major weather events, TTC departments complete a reflective lesson learned assessment and amend operational plans accordingly.

To date, TTC has not systemically tracked financial impacts from extreme precipitation events, making it difficult to determine their true cost. TTC staff are working to improve data collection and financial tracking to enable reporting and inform resilience planning.

1.1 July 2024 Heavy Rainfall Event

Due to the July 2024 heavy rainfall event, the TTC observed a reduction[3] of ~280,000 boardings[4] resulting in an estimated loss of $350,000 in revenue from decreased ridership. Below are details on infrastructure and operational impacts, historically flood-prone areas, and improvement opportunities.

1.1.1 Subway Network

Impacts from the July 2024 heavy rainfall events were observed at 23 stations resulting in a total of approximately six hours of service delays, 19.5 hours of station bypasses, deployment of 75 shuttle buses, flooding at 15 (21% of all) stations, and power outage-related closures ranging from 1.5 to 4.5 hours per impacted station.

Common causes of flooding observed across several stations were drain blockages, insufficient drainage capacity, water infiltration through at-grade vent shafts, concrete imperfections (e.g., cracks and expansion joints), and water infiltration from adjacent properties.

Isolated and location-specific issues observed included:

- *Lawrence Station:* a failed backwater flow valve and water infiltration from the station entrance.
- *Union Station:* insufficient drainage in the electrical room and overflow from adjacent properties and catch basins.

Opportunities to enhance resilience include:

- Assessment of drainage capacity for flood-prone stations to ensure sufficient capacity based on climate change projections.
- Increase in vent shaft and drain cleaning activities.
- Pilot solutions to decrease water infiltration through vent shafts and station entrances.
- Pilot the use of removable flood barriers prior to extreme precipitation events.
- Inspection of concrete imperfections and repair of vulnerable cracks and expansion joints.
- Flood proofing of areas containing critical infrastructure (e.g., electrical rooms).

[3] Compared to the average boardings from other Tuesdays in July 2024 (July 2, 9, 23, 30)
[4] Refers to a single entry onto a TTC revenue vehicle (e.g., bus, subway, streetcar, etc.)

- Redesign of brass trench drain covers and baskets located at Line 1 stations between Wellesley and Queen's Park to deter tampering and decrease repair times.
- Engagement with adjacent property owners.

1.1.2 Streetcar Network

The July 2024 heavy rainfall event disrupted nine (82% of all) streetcar routes, causing delays ranging from 38 to 59 minutes per route. Over half (55%) of affected routes experienced water accumulation along the right of way (ROW), 22% experienced leakage into vehicles, and 22% were indirectly impacted due to flood-stranded vehicles obstructing the ROW.

Historically, areas most susceptible to flooding are the Atlantic Avenue underpass on King Street West east of Dufferin Street; Bathurst and Fleet; Queen Street underpass at Dufferin Street; Spadina and Queens Quay; Union Station; and Lakeshore Blvd at Legion Road; affecting the 501 Queen, 504 King, 507 Long Branch, 508 Lake Shore, 509 Harbourfront, 510 Spadina, and 511 Bathurst routes.

Opportunities to enhance resilience include:

- Initiate TTC/City infrastructure resiliency assessments.
- Acquisition of emergency backup generator(s) to maintain system operations, including powering streetcars and non-revenue vehicles.
- Onboarding of multiple generator service providers to enhance redundancy and electricity availability during peak demand periods.
- Monthly inspections of battery-powered equipment to ensure sufficient charge.

1.1.3 Bus Network

The July 2024 heavy rainfall event rain event disrupted 34 (21%) bus routes, causing an average delay of 1.5 hours across all affected routes. Additionally, 26 (16%) bus routes were diverted, and power outages occurred at Mount Dennis Garage, Queensway Garage, and McNicoll Garage. While power was lost, the backup power generator at McNicoll functioned as expected and service was unaffected, and portable generators were used to power the fuel islands at Mount Dennis and Queensway.

Locations that are most likely to require diversions for corresponding routes due to flooding conditions are Dufferin & Queen; Dufferin & Dupont; Davenport & Caledonia; Ossington & Dupont, Dovercourt & Dupont; Symington & Dupont; Symington & Bloor; Dupont & Lansdowne; and Wilson & Murray underpasses.

Opportunities to enhance resilience include:

- Deployment of permanent emergency back-up generators at all garages. Note: this is within scope and is partially funded through the Green Bus Program.
- Initiate TTC/City infrastructure resiliency assessments.

1.2 February 2025 Heavy Snowfall Events

Due to the February 2025 extreme snowfall events (February 13-17), the TTC observed a reduction[5] of approximately 1.3 million boardings resulting in an estimated $1.6 million revenue loss from decreased ridership.

Common challenges observed across the network include:

- Snow windrows where the road meets the sidewalk, decreasing passenger accessibility and safety for passengers at surface transit stops.
- Snow clearing of roadways and surface transit stops.
- Weather data from Environment Canada does not have sufficient resolution to identify which areas within the city to prioritize.
- Limited ability to provide real-time communication to customers.
- Decreased ability to return to standard operations after the snowfall events, due to delay of scheduled SOGR work to prioritize snow mitigation efforts, and many employees reaching their maximum hours under the *Employment Standards Act* (ESA).

Preliminary impacts of the February 2025 snowfall events on the subway, streetcar and bus networks are detailed below.

1.2.1 Subway Network

Despite adopting storm preparation that have proven effective historically, such as anti-icing of the third rail, running storm trains to keep the right of way clear, clearing snow from open cut tracks, and storing trains on the mainline so they do not get snowed in[6], the February 2025 snowfall impacted 31 (45%) stations. Subway service was halted on Line 1 from Lawrence to Bloor for 18 hours[7], primarily due to loss of traction power from excessive snow accumulation. Delays continued on Line 1 for an additional eight hours after the snow had stopped falling due to blowing snow from the adjacent open field at Wilson Yard. Service on Line 2 was halted between Woodbine to Kennedy for 18 hours.

The most common causes of delays and turn backs were slippery rail conditions and snow and ice buildup on infrastructure components. The back-to-back snowfall events caused snow accumulation that outpaced removal efforts along the open cut sections of Lines 1 and 2. Limitations to TTC's snow clearing abilities were primarily due to operators reaching their maximum working hours under ESA, limiting the number of storm trains in operation. Another cause of delays was limited space on the mainline for train storage, resulting in delays during the re-start of service.

Opportunities to enhance resilience include:

- Continue investigating new equipment and technological solutions for snow clearance and switch protection in open cut areas in inform future procurements.

[5] Compared actual boardings to projected boarding for the same period, assuming no snowstorm, and using a growth rate based on Week 6 boardings in 2025 vs 2024.

[6] Refers to the active subway tracks where trains operate during regular service.

[7] The impact duration and active station closure are measures based on active operating hours and do not include overnight closures.

- Enhance communications to passengers during service disruptions.
- Identify ways to mobilize additional workforce to enable running trains during non-service hours to minimize snow accumulation at open cut areas.
- Explore options for increased mainline train storage.
- Implement snow fences at TTC yards to decrease blowing snow from adjacent properties.

1.2.2 Streetcar Network

The streetcar network was the most affected mode with thirteen (72%) streetcar routes impacted, with an average delay of approximately 30 minutes across all impacted streetcar routes. During the event, two major issues were encountered: auto fouling and a lack of snow storage. The increase in auto fouling was caused by reduced parking space from snow windrows along street edges and parking infractions. Between February 12-17, 234 instances of auto fouling[8] were recorded, causing 84% of the streetcar delays during that period.

The limited snow storage capacity within streetcar yards was further strained by the scale of the February 2025 snowstorm. As a result, the TTC quickly reached maximum storage capacity at both its own yards and City-designated sites, necessitating the search for alternative storage locations and causing delays in snow removal. The City of Toronto's Transportation Services has noted that its snow storage sites have finite capacity, with priority given to storing snow collected from the City's right-of-way, including streetcar routes and transit stops. During major snowstorms, there is a risk that both TTC and City snow storage sites may exceed their capacity.

Although snow was stored at the Obico/Western Yard, that location will not be available in the future due to upcoming on-site construction.

In 2016, the City increased fines for vehicles blocking streetcars from $60 to $200. Those penalized must also pay towing fees ranging from $250 to $325. These fine amounts are higher than those in comparable jurisdictions.

Opportunities to enhance resilience include:

- Temporarily replace select streetcar routes with buses during severe snow events to maintain greater flexibility. Note: This would require an increase in bus fleet and advancement of construction of the 10th garage.
- Periodically revise the priority routes with the City based on lessons learned – a practice that is in place today.
- Increase plowing resources for key streetcar routes.
- Review snow storage and snow melter requirements in major snowstorms and coordinate with the City on potential access to snow storage and snow melter sites, including clear volume thresholds and contingency plans for when thresholds have been exceeded.
- Review parking prohibitions and parking enforcement on streetcar routes when snow events are declared by the City to reduce obstruction and coordinate and

[8] Where parked or stranded vehicles obstruct streetcar ROW.

collaborate with the City and Toronto Police Services to review the activation protocols and public communications.
- Review fines for vehicles obstructing streetcar routes and the justification for a fine increase.

1.2.3 Bus Network

The snowfall event disrupted 100 (63%) bus routes, resulting in an average delay of approximately one hour across all impacted bus routes. Most delays (40%) were attributed to buses stuck in snow. An additional 30% of delays were due to bus collisions[9], while 20% were a result of bus diversions caused by blocked roadways. The remaining 10% of reported incidents included route cancellations, suspensions or turn backs due to heavy snowfall, collisions with stationary objects, and a singular case where a bus was unable to climb uphill.

The biggest challenge for reliably operating the bus network was interdependence with snow clearing and removal along roadways. Additionally, the significant amount of shuttle buses required to replace subway service, along with the need to substitute articulated buses with standard (12m) buses, and deploy buses for those stuck in snow, limited the availability of both buses and operators.

1.2.4 Snow Clearing of Surface Transit Stops

The accessibility of streetcars and buses was hindered by snow accumulation at surface transit stops during and after the snowfall events in February. Specifically, snow accumulation at the points where the road meets the sidewalk obstructed vehicle doors and made it difficult for passengers to access sidewalks.

Current snow clearance procedures for surface transit stops and pedestrian crossovers involve salting and plowing operations triggered by 2 cm or more of snowfall. The maximum time allowed to complete one round of these operations is 12 hours. The TTC will collaborate with the City to review the current procedures and propose improvements to the Advisory Committee on Accessible Transit (ACAT) for feedback. The costs and resources to implement the improvements shall be transmitted to City Council for consideration as part of the 2026 Budget process.

2. Toronto's Future Climate Projections

In December 2024, the City of Toronto released revised climate projections based on the latest climate models. The projections outline the following regional changes by the end of the century, as compared to conditions observed in the 1970-2000s, under the business-as-usual greenhouse gas (GHG) emissions scenario:

- *Precipitation:* A 27% increase in maximum one-day precipitation and a 25% increase in winter precipitation over Lake Ontario.
- *Extreme Heat:* A 6°C increase in average annual temperature.

[9] The majority of which were minor and deemed unlikely to be preventable.

- *Maximum Snow Load:* A 17% decrease in the 50-year ground snow load.[10]

While warmer temperatures are anticipated to reduce average snowfalls, increased winter precipitation over an increasingly ice-free Great Lakes may lead to more frequent lake effect snowfall events.

The TTC will continue to utilize climate projections to improve our understanding of the climate that Toronto's infrastructure must be designed to withstand in the future, as outlined in Section 5.

3. Extreme Precipitation Risk Mitigations Strategies

3.1 Extreme Precipitation Preparedness Measures

TTC departments conduct periodic preparation activities, including proactive checks on equipment and infrastructure, and training refreshers to increase readiness before heavy precipitation events. For example, the Low-Lying Areas Preventative Maintenance program is activated in anticipation of heavy rain events, directing streetcar maintenance crews to high-priority vulnerable areas to clear clogged track and switch drains. A similar process is adopted for the stations drainage system.

Prior to extreme snowfalls, the following key proactive measures are adopted:

- *Bus network:* Replace in-service articulated (18 m) buses with 12 m buses to reduce the number of stuck buses and remove 56 stops[11] from service that cannot be safely operated due to steep hills or known slippery conditions.
- *Subway network:* Deploy anti-icing trains, snow blowers, and snow brush cars, and perform mainline train storage.[12]
- *Streetcar network*: Spray overhead streetcar cables with anti-icing and deploy storm cars to clear the cables.

3.2. Emergency Response Protocols

3.2.1 Rainfall Emergency Response Protocol

TTC follows internal and inter-agency emergency response protocols. A summary of the protocols is provided below with additional details available in Attachment A.

During severe rain events, the TTC may enact changes to service to ensure safe operations. A standard checklist is followed to ensure key activities are done during immediate event preparation and real-time event management to minimize impacts from service interruptions, power disruptions, asset damage, and safety risks.

Key decision-making processes, actions, and resource deployment are coordinated by departments and activated based on specific triggers, such as 20 mm per hour

[10] Associated with global warming levels of 3.5°C, compared to a business-as-usual scenario which assumes no major emissions reductions, leading to uncontrolled warming.
[11] Corresponding to 0.6% of total bus stops.
[12] Where trains are stored along the line overnight to ensure vehicle availability for start of service.

forecasted rain.[13] Notifications of service adjustments, precipitation, identified flooding, accumulation of water affecting customer safety or near the third rail, power outages, and water leakages are coordinated through Transit Control.

Additionally, the plan includes temporary redeployment of resources to support, speed reductions, staff deployment to impacted areas, shuttle services, station bypasses diversions, increase in staffing levels, backup generator management, standby crew mobilizations, station monitoring, operator briefings, spare vehicle preparations, and external stakeholder and customer communication.

3.2.2 Snowfall Emergency Response Protocol

TTC's Corporate Severe Weather Plan establishes the decision-making framework for preparing and responding to severe winter events. It outlines triggers for the deployment of mitigation measures across the environment, equipment, staffing, service, and communication themes, ensuring a structured and coordinated response.

The Transit Control Centre acts as the Corporate Emergency Operations Centre, monitoring external information,[14] communicating with internal business units,[15] and hosting storm calls before, during, and following events.

Winter weather events are assigned a level, from 1 to 4, based on the average steady rate of snowfall over a 12-hour period and, when unusually high snowfall rates occur, based on the hourly snowfall quantities. These event levels activate department-specific[16] severe weather plans, activity checklists, and key decision-making protocols, including service adjustments, resource redeployment and the use of storm trains to maintain operations and minimize disruptions.

TTC shares information with various media channels (e.g., CP24) and through updates to TTC's website and social media.

During extreme events, Instructors from the Operations Training Centre, Special Constables and Fare Inspectors are allocated to assist with incident management and impacted vehicles and operators.

Snow and ice management is the responsibility of both TTC and the City's Transportation Services. The City is responsible for managing snow and ice on roadways, bridges, high priority intersections, and surface stops. When snow first accumulates, roadways are salted and sprayed, and plowing begins between 5 cm for arterials and 8 cm for collectors and local roads of accumulated snow. The City will clear surface transit stop pads and a path for pedestrians to walk from the stop to the sidewalk.

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[13] Transit Control Centre monitors weather alerts received from Environment Canada (EC). EC issues warning for heavy rainfall when 50mm or more of rain is expected within one hour. TTC uses a lower threshold (20mm per hour) to trigger emergency heavy rainfall response for Operations.
[14] Including EC alerts and advisories, Toronto Police Services social media, Toronto Hydro alerts, and Toronto Water alerts.
[15] Including Safety, Public Relations, Subway System, Streetcar Network, Bus Network, and Support Areas.
[16] Including Bus Maintenance, Bus Transportation, Rail Cars & Shops, Streetcar Overhead, Streetcar Transportation, Subway Transportation, Wheel-Trans, and Corporate Communications.

A total of 78 (38%) surface routes have been identified by TTC as a high priority for salting and plowing to ensure service maintenance. Among these, 15 routes (7%) are categorized as the highest priority. These routes were selected based on several factors, including high ridership corridors, access to critical services such as hospitals, participation in the Ten-Minute-or-Better Service Network, and geographical challenges.

The TTC is responsible for managing snow and ice conditions as follows:

- *Stations:* Clear entryways and salt station entrances.
- *Subway:* Operate storm trains and utilize subway snow clearing equipment, including snow blowers and brush cars.
- *Streetcar:* Run storm cars along routes to ensure tracks and overheads are cleared of ice and snow buildup, platforms, loops, and dedicated right of way.
- *Rail Yards & Bus Garages*[17]: Clear and remove snow and apply anti-icing.

3.3 Inter-Agency Collaboration

The TTC and City currently collaborate at various levels and through a number of forums to address extreme weather events.

TTC Emergency Management (EM) engages with Toronto Emergency Management (TEM) along with other relevant stakeholders such as Toronto Water and Metrolinx. As part of this collaboration, TTC participates in the Toronto Emergency Management Program Committee and Toronto Emergency Management Working Group. TTC EM staff support the development of City of Toronto emergency response plans for various hazard types, ensuring the plans align with TTC's ability to provide resources and do not contravene TTC policies and procedures.

TTC is considered a key partner by TEM, particularly in extreme weather events, and is included in initial Joint Assessment Meetings during the warning phase to enhance situational awareness. If the event meets pre-determined activation thresholds, TEM will activate the City's Emergency Operations Center (EOC), operating within the Incident Management System. This approach ensures a unified communication stream and central coordination point, enabling divisions, agencies and corporations to work together efficiently while minimizing miscommunication. Part of TTC EM's role is to liaise between the City's EOC and TTC's response structure, facilitating information transfers and supporting bilateral resource requests.

In 2024, the TTC and Toronto Water established a Memorandum of Understanding to augment coordination. TTC proactively bundled Toronto Water's sewer inspection along the ROW into planned service diversions, enabling timelier sewer inspections to address SOGR and reducing service diversions.

TTC staff participate in the City of Toronto's Transportation Services Accessibility Sub-Committee with the purpose of identifying, addressing, and reviewing accessibility-related issues to improve safety and mobility for vulnerable road users in Toronto, especially those who live with disabilities.

[17] All snow clearing and removal is completed by internal TTC staff, with the exception of bus garages, for which an external plowing contract is in place.

Furthermore, the TTC is co-chairing the City of Toronto's Inter-Divisional Climate Resilience Team to develop joint resilience solutions across agencies. Lastly, the TTC engages with other transit agencies that are further along in their resilience journeys to gather lessons learned and best practices, facilitate knowledge sharing, and drive innovation to inform the TTC's approach to addressing current and future climate challenges.

The TTC will continue to coordinate and collaborate with the City and interdependent agencies to address extreme weather events and resilience planning, including report backs to the Board and City Council.

3.4 Investments in Adaptation

TTC's current capital projects, operational programs and actions contributing to precipitation resilience are summarized below:

- *Submersible Cables:* Replacement of underground cables servicing streetcars with submersible cables to remain operational when submerged and reduce the risk of outages during flood events.
- *Storm and Sanitary Pump Replacement Program:* Replacement of sump pumps in 3–5 stations each year to support the removal of excess water from stations and along the subway ROW.
- *Streetcar Drainage Maintenance Program:* Composed of the Track Drain Program and the Switch Drain Snaking and Flushing Program which utilize vacuum trucks to service drains across the network, clearing debris from lines that connect to sewer systems. The effectiveness of these programs in reducing flooding along streetcar routes is therefore interdependent on maintenance of the City's drainage system.
- *Subway Drainage Preventative Maintenance:* Composed of the Subway Station Drainage Preventative Maintenance and the Subway Infrastructure Drainage Preventative Maintenance to provide cleaning for both the drains at stations and along the subway ROW, primarily during non-revenue hours, to ensure unobstructed flow.
- *Trackside Heating Preventative Maintenance:* All trackside heaters are tested annually to ensure they are operational before the winter season, allowing any issues to be identified and addressed in advance.
- *Tire Optimization and Winter Performance Program:* Ongoing evaluation of tire solutions to improve winter performance, safety, and traction based on historical experiences. For instance, the January 2022 snowfall prompted an evaluation of alternative tire technologies and resulted in piloting of snow tires. The TTC currently utilizes all-season tires.
- *Winter Spraying of Overhead Streetcar Cables Program:* Spraying of overhead cables every 7–14 days from November to April to protect cables from freezing rain and deploying of storm cars to clear cables in problem areas.

Several challenges currently hinder the successful implementation of capital and operational programs aimed at enhancing precipitation resilience. Such challenges include:

- Unfunded and partial funding for SOGR programs. For instance, neither the Subway Station Drainage Program nor the Subway Infrastructure Drainage Program, are currently able to conduct drain cleaning at a sufficient frequency to proactively unclog drains prior to anticipated heavy rainfall events. Many of TTC's assets are past the end of life and not proactively maintained. Investing in SOGR is essential to reducing their vulnerability to extreme weather events. Attachment B outlines the funding status of identified SOGR programs that contribute to flood resiliency.
- Access and limited work windows for assets along the subway ROW limit SOGR programs. For instance, inspections and replacements associated with the Storm and Sanitary Pump Replacement Program require power shutdowns and consequently can only occur during non-revenue hours. ROW time restrictions and partial funding have resulted in 60% of pumps operating over 20 years past the expected end of life. In addition, there are interdependencies involving the City's ROW and associated stormwater infrastructure over which the TTC has limited control. For example, the City's drainage system often reaches capacity, preventing water from TTC's sump pumps from flowing into it.
- Limited opportunities for mainline train storage without causing operational issues, such as restricting trains' ability to turn around or bypass stations, and meeting morning service time.
- Accessibility requirements may conflict with engineering solutions to limit water infiltration into at-grade vents and entrances (e.g., re-grading, adopting curbs).
- Lack of systemic data collection procedures to track impacts of extreme weather events, hindering data-informed decision-making.
- Understanding of vulnerabilities across TTC's entire asset portfolio being in early phases.

3.5 Future Climate Resilience Planning

TTC is committed to a systematic approach to integrating climate resilience across all aspects of the organization, which will be comprehensively detailed in an upcoming Climate Adaptation Plan (CAP). The TTC's forthcoming CAP will be designed to align with and complement the Asset Management Plan and will be developed in multiple phases. It will prioritize immediate, actionable adaptation measures based on vulnerabilities identified in past and future climate risk and vulnerability assessments (CRVAs). The first phase of the CAP, targeted for Board approval by the end of 2025, will focus on:

- Defining capital and operational programs that will yield immediate benefits, with pilots to be included in the next budget cycle.
- Developing criteria to identify capital projects that impact resilience, ensuring they are included in the Capital Improvement Plan and considered under the City's Climate Lens.
- Creation of a standardized process for determining which projects should complete CRVAs.

Subsequent phases of the CAP will concentrate on asset-specific resilience efforts (i.e., buildings, subway infrastructure, streetcar systems, and vehicles). These efforts will be informed by CRVAs and subject matter expert knowledge and result in the integration of adaptation measures into master specifications, design manuals, and operational procedures, as well as the creation of asset-specific resilience programs. Also, the TTC will continue working with the City of Toronto's Environment and Climate Division to identify and prioritize critical infrastructure locations as the City deploys its network of local weather stations. Access to localized weather data will enhance real-time response, improve flood risk mitigation and support long-term climate resilience planning across the network.

TTC will adopt a data-driven and educational approach, including engaging with internal departments, interconnected City divisions and agencies, and peer transit agencies, in addition to enhancing data quality by addressing existing gaps and implementing monitoring procedures.

Additional funding is required to complete and implement the CAP and will be outlined in future budget submissions.

Building climate resilience is an ongoing process requiring cultural change and a multidisciplinary approach, with each TTC employee having a role to play. Climate adaptation efforts are not intended to be standalone; they will be pursued in parallel with GHG emissions reduction efforts necessary to mitigate more severe climate impacts. Improving the resilience of TTC's assets is a goal that presents challenges; however, adaptation is paramount for the safety of riders and TTC employees.

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Attachments

Attachment A – Corporate Severe Weather Plan
Attachment B – Funding Status of SOGR Projects