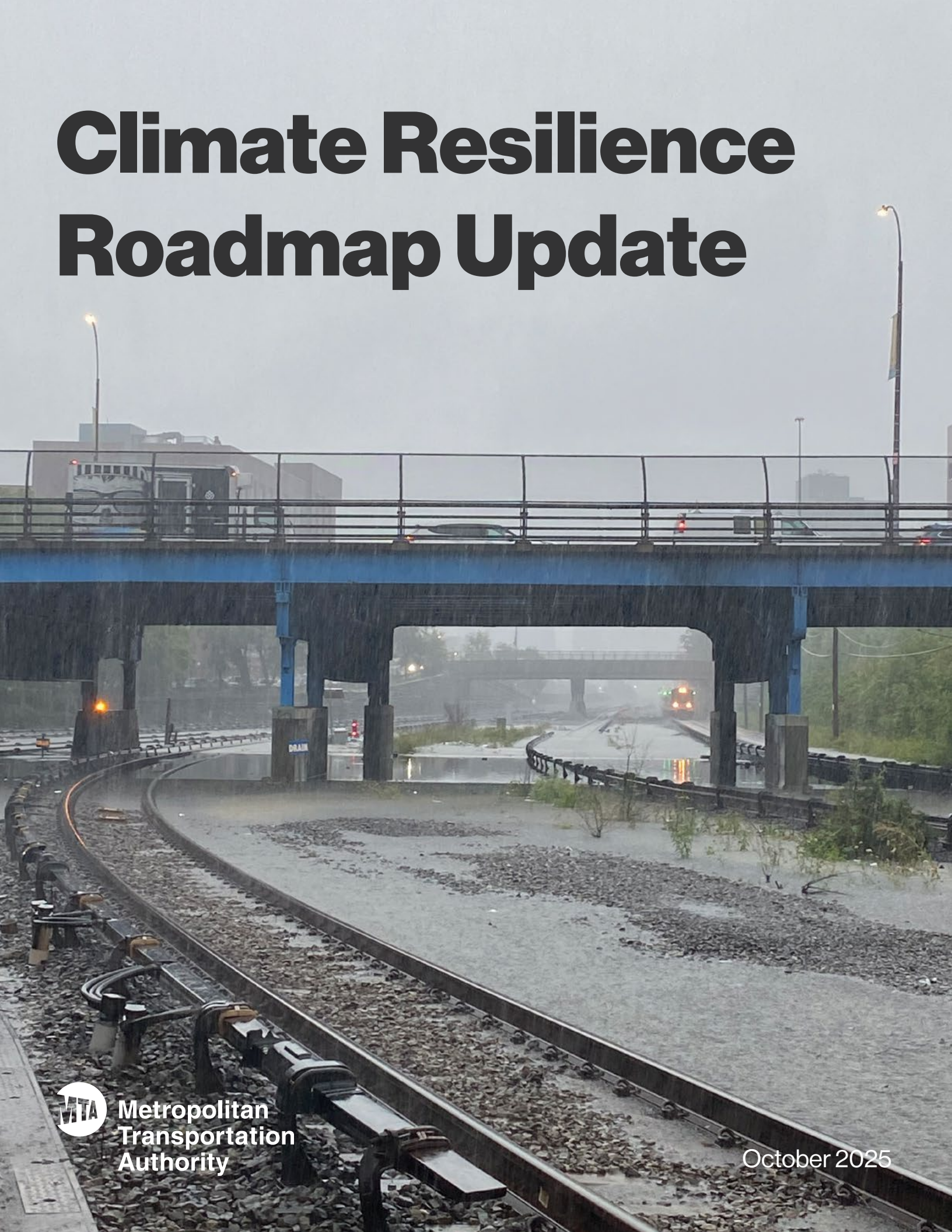
Climate Resilience Roadmap Update



Metropolitan Transportation Authority

October 2025

Contents

Cover image: Metro-North Mott Haven Yard in the South Bronx during a heavy rainstorm. The yard flooded most recently in July 2025.

Rockaway Line Resiliency and Rehabilitation project under construction, March 2025

Letter from the President

In April 2024, we released the MTA Climate Resilience Roadmap. Both a multi-factor analysis and strategic plan, it was the culmination of years of work to lay out a comprehensive vision for how we will protect New York's transit infrastructure from increasingly frequent and intense storms, flash floods, heat, and other weather events.

It was also just the beginning. In the 18 months since its release, the MTA has turned our plans into action, most notably through the 2025-2029 Capital Plan and its more than $1.5 billion in investments in climate resilience.

This document is an update to reflect the actions we are taking and the progress we are making. It is also a call to sustain and expand these efforts—including at our partner agencies, particularly within New York City.

The transit system that sustains our region today is an asset valued at $1.5 trillion, but its value to the region is much greater. With an investment of this magnitude, we have no choice but to adapt the entire system to climate risks so it can continue to serve New Yorkers during and after periods of weather extremes.

Our vulnerabilities were laid bare 13 years ago when Superstorm Sandy became the single most destructive coastal storm surge event ever to hit our region. Sandy's catastrophic impacts catalyzed a $7.6 billion federal partnership to adapt all MTA systems to coastal flood threats. These projects complimented additional City and Federal investments in coastal protection infrastructure. Together, MTA infrastructure and several NYC neighborhoods are much better prepared to withstand the next coastal storm.

However, the pernicious impacts of climate change are driving increasingly frequent and intense heavy rains and extreme heat and humidity into our region. These present varied threats to our transit systems and to vulnerable New Yorkers.

The MTA is acting. Our 2025-2029 Capital Plan outlines a $700 million program to protect the subway system from heavy rains that often impact inland areas outside of the coastal floodplain along with $800 million to protect Metro-North's Hudson Line. Projects now underway and described in this Climate Resilience Roadmap Update will protect the system from runoff and from track floodings that can cause service impacts during storms.

But the MTA cannot act alone. Our infrastructure relies on the city's stormwater infrastructure to convey larger volumes of water. This means that significant updates are required to manage the future extreme weather events we anticipate. In this Climate Resilience Roadmap Update, we focus on 10 locations in New York City where stormwater flood risks pervade not only transit infrastructure, but entire neighborhoods.

This work is more urgent than ever. In the 18 months since the Roadmap's initial release, the impact of climate change hasn't slowed down either: another 6 heavy rain events, 6 heatwaves, and a drought that saw brush fires even within New York City all took place. The MTA is committed to meeting this challenge and we invite our municipal partners to join forces so that our urban infrastructure continues to serve New Yorkers for many years to come.

Sincerely,

Jamie Torres-Springer,
President, MTA Construction & Development

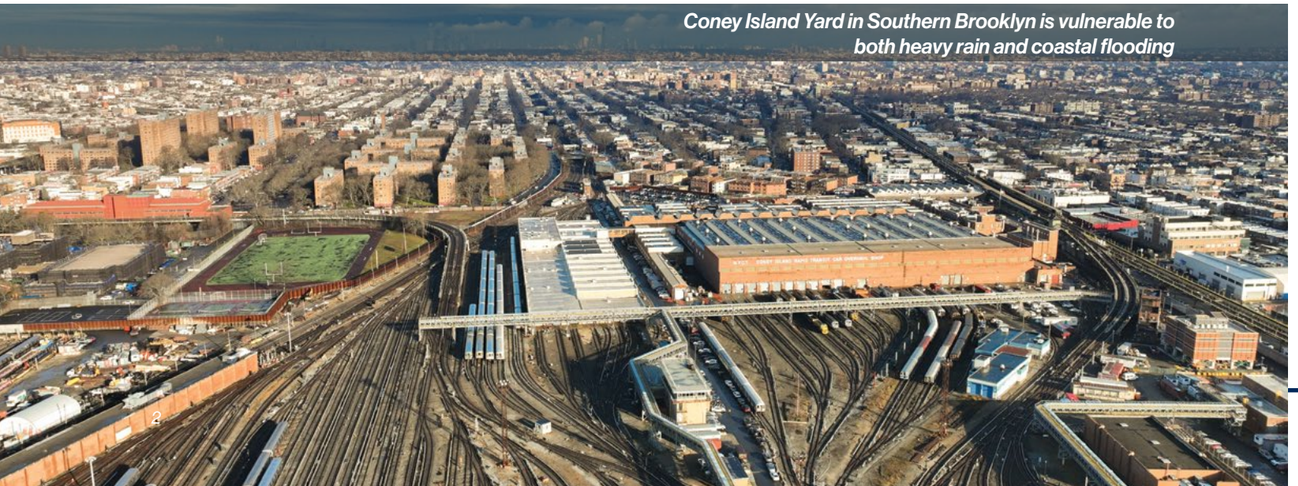
Executive Summary

The MTA's Climate Resilience Roadmap, published in April 2024, charted a proactive and comprehensive approach to incorporate extreme weather protections into our capital and operating processes. In 2025, the MTA committed $1.5 billion towards measures that will protect our critical transportation assets from heavy rain, coastal flooding, and extreme heat. New Yorkers depend on the safe and reliable functioning of the transit system to carry out their daily activities. Our work is urgent because extreme weather events already stress our systems. Since the publication of our first Roadmap 18 months ago, New York City has experienced six floods, six extreme heatwaves, and a significant drought, underscoring the accelerating pace of extreme weather events.

In this Roadmap Update, we report on the actions taken by the MTA and our CIty partners, and also call upon the City of New York to coordinate around extreme weather challenges that transcend the city's multiple infrastructure systems.

This Climate Resilience Roadmap Update identifies **10 priority locations** within New York City where City action is needed to control stormwater flood impacts on highly vulnerable communities and adjacent transit infrastructure. In particular, we call upon the New York City Departments of Environmental Protection (NYCDEP) and Transportation (NYCDOT) to protect from stormwater impacts in the following vulnerable communities across the five boroughs:

- 4 Av between Union St & 36 St, Brooklyn
- Canal/Lafayette/Centre Streets, Manhattan
- Castleton Depot, Staten Island
- Central Flatbush, Brooklyn
- Central Harlem, Manhattan
- Chelsea/Midtown South, Manhattan
- Cross Island Parkway, Queens
- Grand Av-Newtown, Queens
- Longwood Av, Bronx
- Mott Haven Yard, Bronx



Coney Island Yard in Southern Brooklyn is vulnerable to both heavy rain and coastal flooding

The Climate Resilience Roadmap Update also outlines **9 interagency climate resilience actions for New York City**. With substantive collaboration, the MTA and the City of New York can deliver high-performance protections against heavy rain, coastal flooding, and extreme heat.

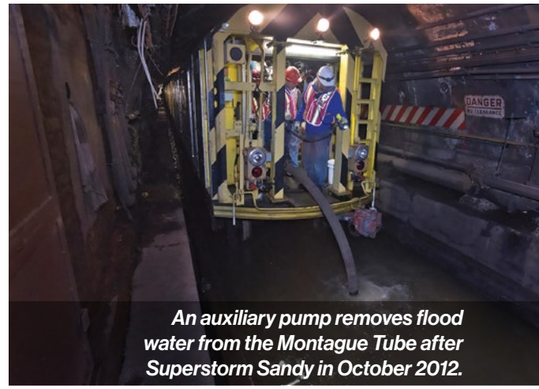
Heavy rain:

- Accelerate the pace of capital investments to increase stormwater management capacity, particularly in vulnerable communities adjacent to transit infrastructure.
- Maintain sidewalk curbs of sufficient size and catch basins of sufficient capacity to manage intense rain.
- Optimize storm sewer networks to send excess stormwater away from overloaded locations adjacent to MTA infrastructure to areas with spare capacity.

Stormwater runoff into the sidewalk and subway station entrance at Union St (R), July 2025

Coastal flooding:

- Sustain leadership and future-forward strategy towards coastal resilience in the New York City region.
- Manage the coordinated design and deployment of the city's flood mitigation measures and deepen coordination with the MTA on emergency operations planning.
- Continue to advance City-led climate data collection and monitoring.



An auxiliary pump removes flood water from the Montague Tube after Superstorm Sandy in October 2012.

Extreme heat:

- Facilitate the development of thermal energy networks between public and private properties that can utilize waste heat from sources like the subway.
- Encourage new heat recovery and geothermal technologies that pull heat from vulnerable sites like subway stations.
- Provide consistent shade for transit customers by increasing tree canopy.

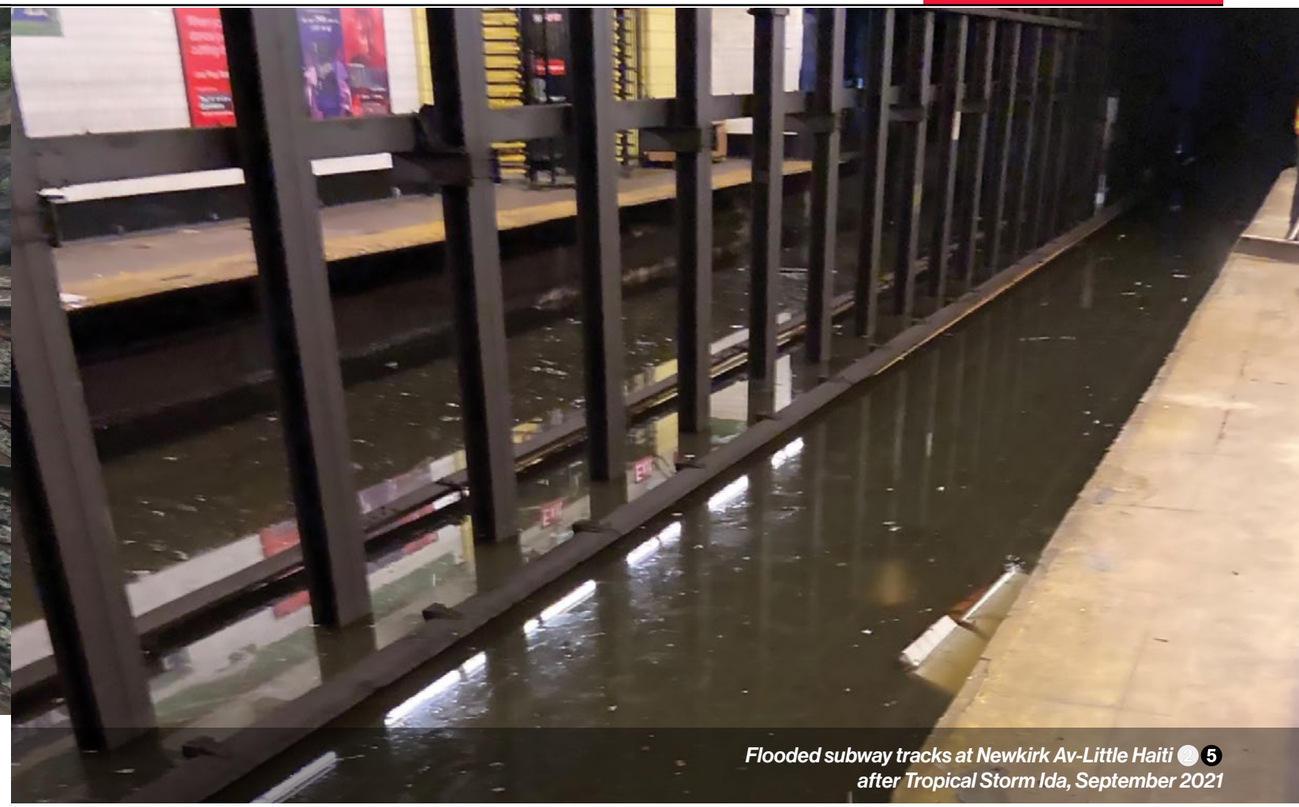
Q37 at Queens Blvd and 78th Cres, June 26, 2025

Urgent call for action

The MTA's Climate Resilience Roadmap, published in April 2024, charted a proactive and comprehensive approach for incorporating climate resilience into the MTA's capital and operating processes. The Roadmap arrived as the MTA completed its 2025-2029 Capital Plan, which committed $1.5 billion to protect critical assets from extreme weather. The risk-informed approaches outlined in the Roadmap have already resulted in tangible interventions to protect riders and MTA infrastructure, including elevated steps at subway stations to reduce stormwater runoff risks, initiating a Climate Resilience Blueprint for the Metro-North Hudson Line with multiple near term actions already underway, and advancing protections against stormwater flooding on the Throgs Neck Bridge ramps.

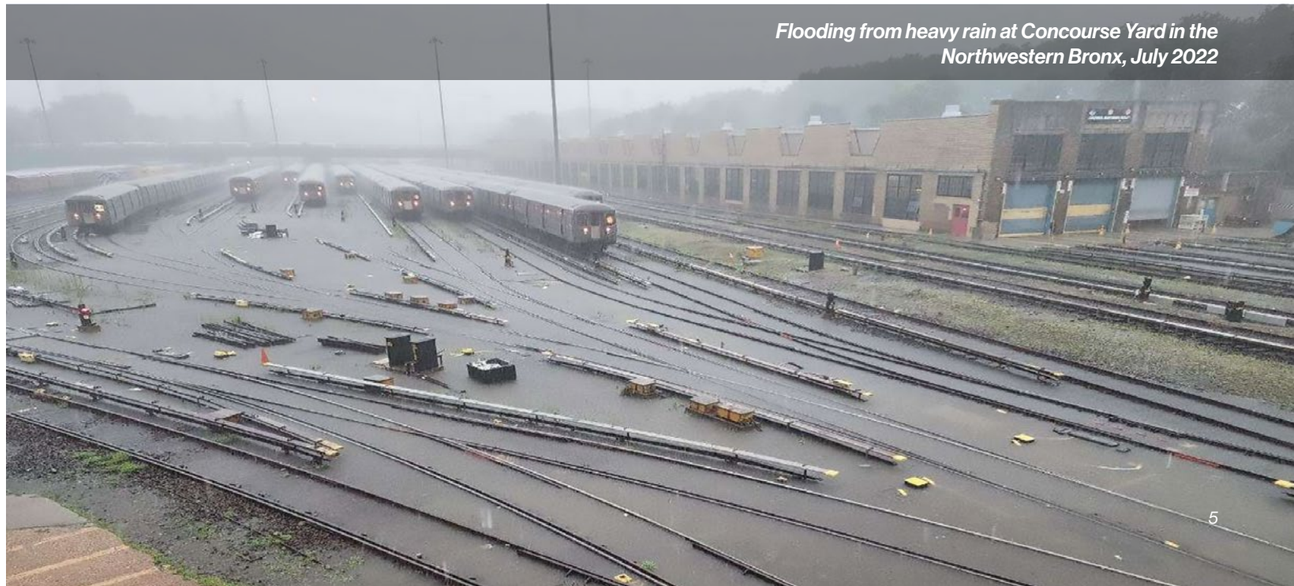
The dynamic threats posed by extreme weather are already acutely felt by MTA customers and employees, and the MTA is rising to the challenge. Since the inaugural MTA Climate Resilience Roadmap was published, New York City has experienced six flooding events, six heatwaves, and a significant drought. These extreme events stress urban and regional infrastructure that supports millions of New Yorkers' daily activities.

Even as the MTA acts with urgency, the scale of these challenges transcends multiple infrastructure systems, particularly those managed by our municipal partners. This Climate Resilience Roadmap Update identifies **10 priority locations** within New York City where New York City government (City) action is needed to control stormwater flood impacts on highly vulnerable communities and adjacent transit infrastructure. We also outline **9 climate resilience actions** for the City to proactively reduce impacts of heavy rain, coastal flooding, and extreme heat.



Flooded subway tracks at Newkirk Av-Little Haiti [5] after Tropical Storm Ida, September 2021

In our 2025-2029 Capital Plan, the MTA committed $1.5 billion to protect critical assets from the impacts of heavy rain, coastal flooding, and extreme heat.



Flooding from heavy rain at Concourse Yard in the Northwestern Bronx, July 2022

New York City and the surrounding region are already facing extreme weather events in line with climate projections.

In the last year, New York City has been impacted by several extreme weather events that have strained both MTA and City infrastructure.

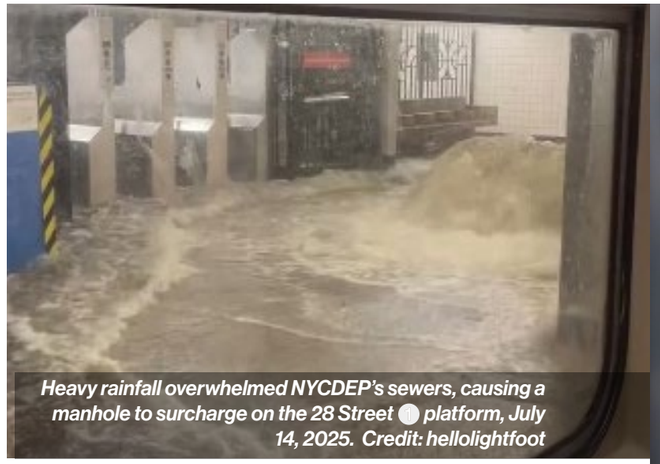
Heavy rain

On **July 14, 2025**, a heavy rainstorm inundated New York City with over 2 inches falling in a single hour. The City's sewer system backed up at **28 St** 1 and **34 St-Penn Station** A C E, flooding the platform and track. Stormwater flooding caused delays and suspensions at multiple subway stations across 10 lines. Nevertheless, full service was restored ahead of the morning rush on July 15. The July 14 storm was a profound reminder that even routine events, such as a summer thunderstorm, are more impactful than in the past due to climate change.

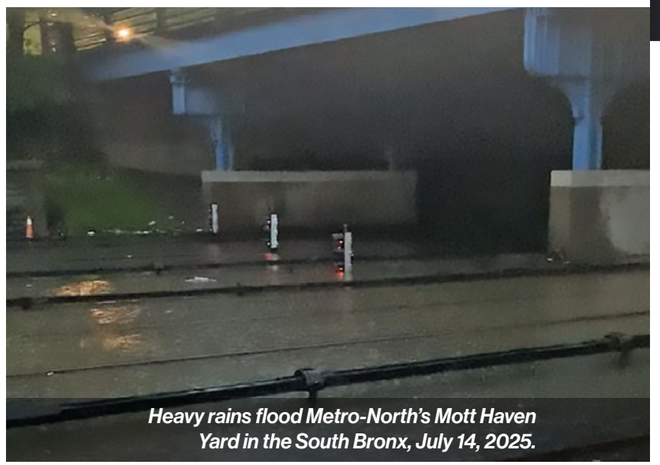
Less than one month later, on **July 31**, the region experienced yet another heavy rain event. Intense rain in Eastern Queens and Long Island led to flooding at the **LIRR Bayside Station** in Queens, and cascading stormwater into **Great Neck Station** in nearby Nassau County. Floods submerged tracks and the third rail, resulting in the emergency evacuation of an LIRR train car and service suspensions along the entire Port Washington Branch for 15 hours as response crews restored track and power systems overnight.

Extreme heat

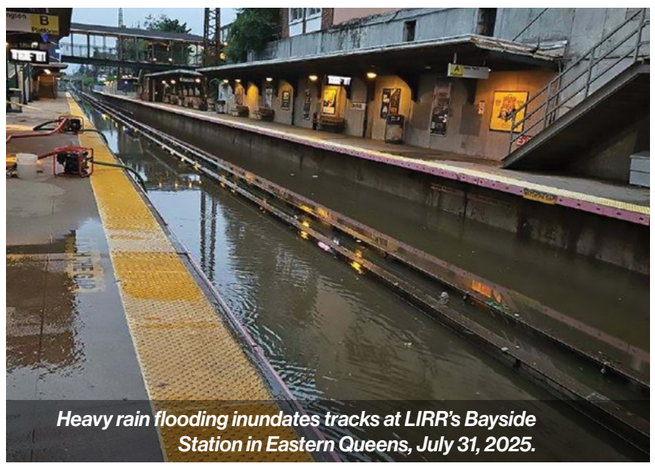
During **Summer 2024**, New Yorkers faced 21 days over 90°F, including a prolonged 12-day heatwave (a period with sustained temperatures over 90°F for several days or more) in July. **Summer 2025** was comparable, with 14 days over 90°F and three heatwaves. The late June 2025 heatwave caused maximum daily temperatures as high as 103°F and saw 323 patients report to emergency rooms in New York City with heat-related illnesses.[1]



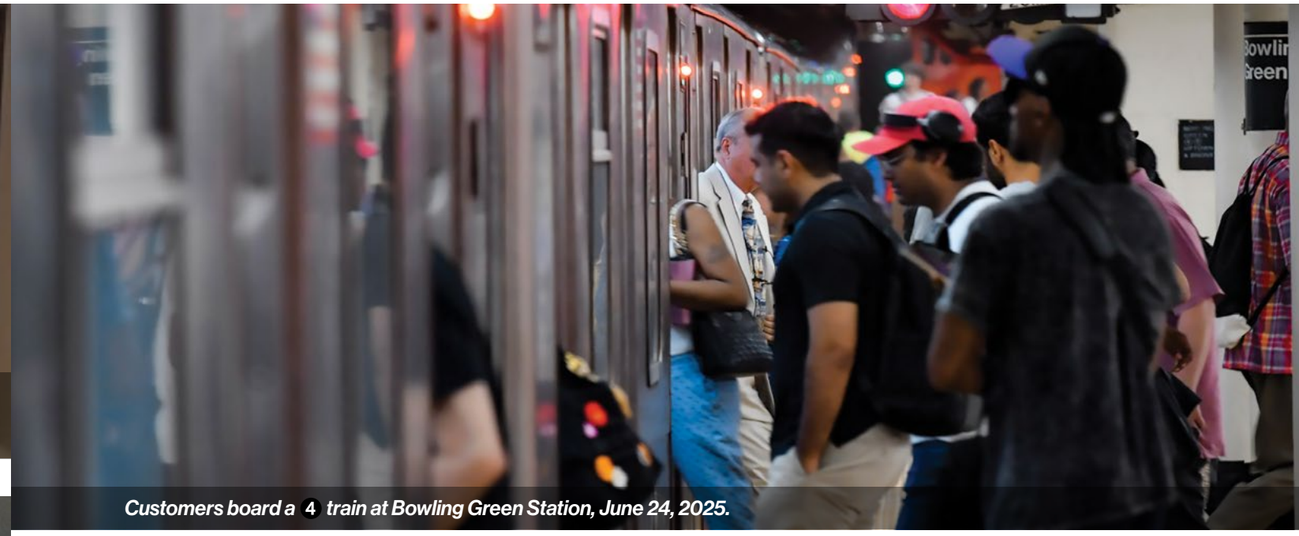
Heavy rainfall overwhelmed NYCDEP's sewers, causing a manhole to surcharge on the 28 Street 1 platform, July 14, 2025. Credit: hellolightfoot



Heavy rains flood Metro-North's Mott Haven Yard in the South Bronx, July 14, 2025.



Heavy rain flooding inundates tracks at LIRR's Bayside Station in Eastern Queens, July 31, 2025.



Customers board a 4 train at Bowling Green Station, June 24, 2025.

In addition to widespread public health impacts, heat also strains rail infrastructure. During **Summer 2024**, Amtrak and NJ Transit experienced significant heat-related delays and impacts along the Northeast Corridor rail line within New Jersey.[2] Many delays were due to heat-related impacts on power infrastructure, including sagging overhead catenary lines which become prone to snags and damage. Notably, the portion of the Northeast Corridor served by the MTA, which also uses catenary power, was not impacted. This is likely due to recent upgrades to a constant tension catenary system, which incorporates counterweights and pulleys to respond to changes in temperature.

Drought & brush fire

Climate change triggers meteorological extremes, characterized by alternating periods of intense rainfall and abnormal dry spells. **October 2024** was paradoxically the driest month on record for New York City, with 29 days without significant rainfall.[3] Under these conditions, the New York City Fire Department responded to 225 brush fires over the course of two weeks.[4] Besides creating acutely dangerous conditions for transit workers and riders, fires can disrupt subway and railroad power systems, potentially risking service delays across the system. Though the fires were ultimately contained, they highlight the compound climate risks facing New York City.

Extreme weather events in New York City

Summer 2024 - Summer 2025

6 heavy rain events

6 heatwaves

1 drought

Extreme weather impacts transit systems worldwide

New York City is not alone in the challenge to adapt legacy infrastructure to a changing climate. Extreme weather is impacting urban transit and regional railroads around the world.

Paris Métro

The Paris Métro has flooded almost every year since 2016 due to heavy rainfall.[5] The RATP Group, which operates Paris' metro and regional rail lines, is implementing passive protections across its system, including drainage improvements and elevated structures around station entrances. Paris Métro is also using hydrological models to inform design of drainage facilities throughout the system.

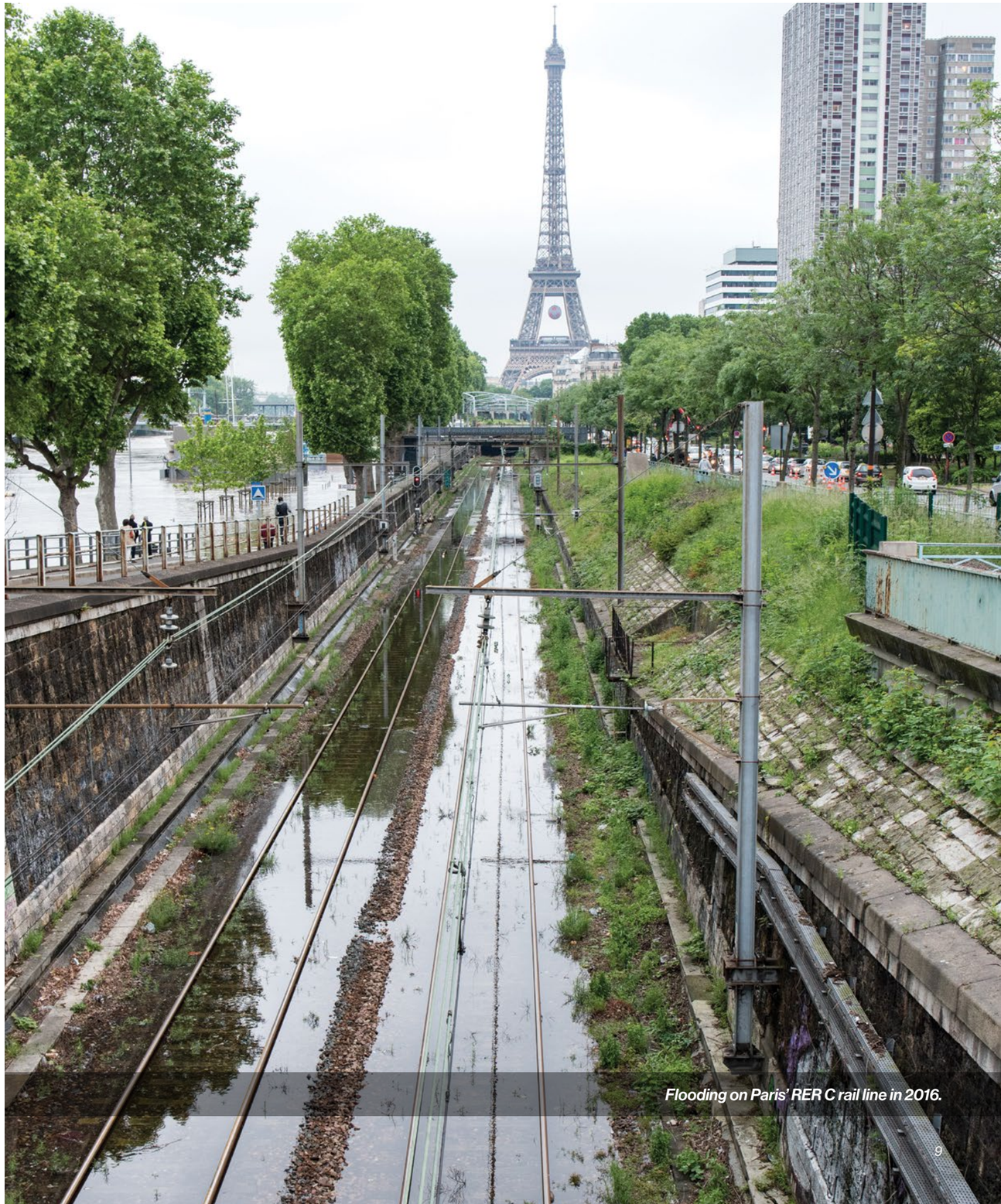
Berlin U-Bahn

In Berlin, intense rainfalls in June 2023 temporarily shuttered regional rail service and flooded the Spichernstraße U-Bahn station.[6] In response to disruptions from heavy rain, Deutsche Bahn, which operates regional and long-distance trains, began developing a master plan for heavy rainfall precautions.[7]

Flooding at U-Bahnhof Spichernstraße in Berlin, June 2023. Credit: Wikimedia Commons

London Tube

As summer temperatures become more extreme, riders of the London Tube experience "sauna"-like heat conditions in their system's platforms and train cars.[8] The Tube's narrow underground tunnels, constructed in the 1860s, have proven challenging to retrofit, underscoring a common issue faced by legacy subway systems. Nevertheless, Transport for London, the Tube's governing agency, is evaluating fan systems and heat transfer technologies.



Flooding on Paris' RER C rail line in 2016.

Adapting to extreme weather threats

The MTA is preparing infrastructure for the heavy rain, coastal flooding, and extreme heat challenges to come. Our goal is to mitigate service disruptions and costly damage, all while maintaining critical transportation lifelines for New Yorkers across the region. **The MTA is urgently adapting to future extreme weather events with $1.5 billion in new investments in the 2025-2029 Capital Plan.** In this section, we detail the MTA's risk mitigation strategies.

However, the MTA's actions will not be successful in isolation. We need equally urgent action from the municipal agency partners upon which we depend, particularly New York City Departments of Transportation (NYCDOT) and Environmental Protection (NYCDEP). NYCDOT is responsible for overseeing the city's streets, sidewalks and curbs. NYCDEP is responsible for managing the city's drinking water, wastewater, stormwater resources and infrastructure, and the City's coastal resilience assets.

MTA and City partners have collaborated extensively to address extreme weather vulnerabilities in recent years, as detailed more fully below. As we move forward, continued collaboration and both joint and separate investment are required to adress the magnitude of these problems for both communities and the transit system.

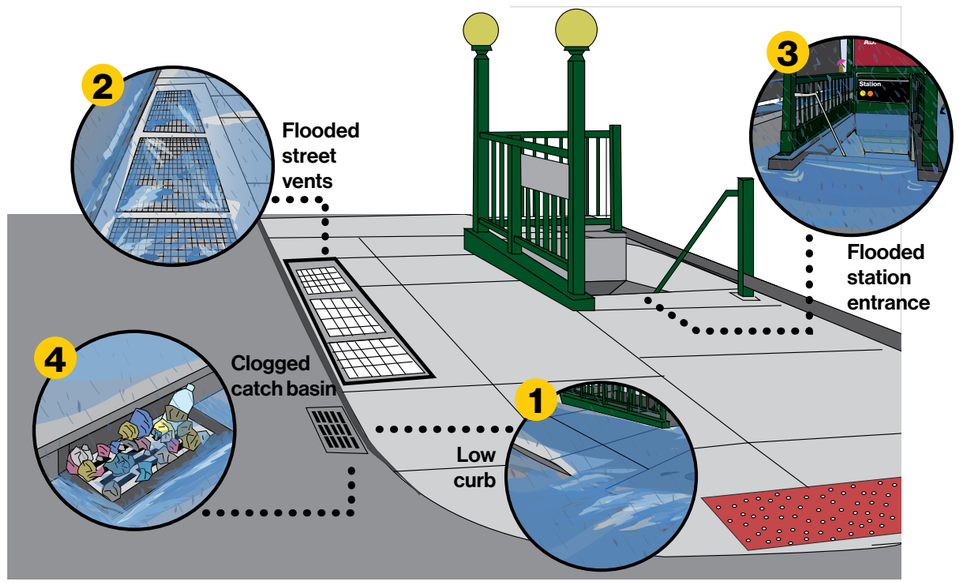
Heavy Rain

Heavy rain overwhelms municipal sewer infrastructure, leading to flash floods. When streets flood, the excess stormwater is prone to runoff into MTA infrastructure like subway stations, tunnels, and open-cut tracks.

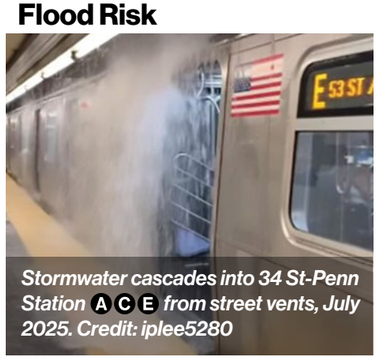
Why subways are vulnerable to stormwater runoff during heavy rain

Low curbs (1) | NYCDOT's sidewalk curbs act as the first line of defense for subway stations when it rains. Water naturally flows to the lowest point, and when curbs are too low, stormwater overtops curbs and flows into ***street vents (2)*** and ***station entrances (3)***. Curbs with sufficient height keep stormwater flowing to sewer catch basins, instead of into the transit system.

Clogged catch basins (4) | Catch basins collect stormwater runoff, but are easily clogged by trash and debris, particularly during heavy rains. When catch basins near MTA infrastructure become clogged, excess runoff can enter and flood subway stations through ***street vents (2)*** and ***station entrances (3)***.



Flood Risk



Stormwater cascades into 34 St-Penn Station A C E from street vents, July 2025. Credit: iplee5280

Flood Risk Mitigation

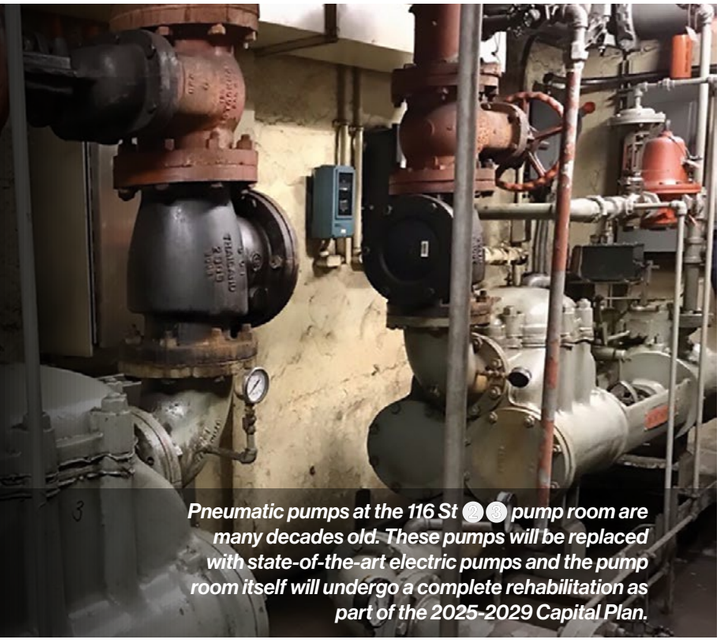
Elevated subway street vents prevent stormwater from entering the station.

MTA IS ACTING

Subway

The 2025-2029 Capital Plan allocates **$700 million** to continue adapting the century-old subway system to 21st century stormwater flood risks, including:

- **$477 million** to rehabilitate aging pump rooms that move stormwater out of the subway into the City's sewer system. Expanding pump room capacities and achieving a state of good repair will increase the subway's ability to handle heavy rain events.
- **$223 million** in protections against stormwater runoff. This includes measures such as elevating subway steps and street vents at chronically impacted stations.



Pneumatic pumps at the 116 St 2 3 pump room are many decades old. These pumps will be replaced with state-of-the-art electric pumps and the pump room itself will undergo a complete rehabilitation as part of the 2025-2029 Capital Plan.

Stormwater mitigation projects recently completed or underway:

- New elevated steps across more than **45** flood-prone subway stations and launched an initiative to elevate vents at **more than 30** locations.
- Stormwater retention and detention at **3 Av-138 St 6** .
- Combined flood mitigations at **Westchester Yard**, which will entail stormwater detention tanks and a four-pump pumping station to mitigate flooding from heavy rain.
- Improved sewer connection to reduce track stormwater flooding at **79 St** 1 .
- New storm sewer drain system at Staten Island Railway's **Prince's Bay Station**, which has historically had flooding issues.

An elevated step at Northern Blvd 7 R shields the entrance from stormwater flooding.

Steep slopes exacerbate flooding from stormwater runoff and are at risk of landslides.

Regional Railroads

The 2025-2029 Capital Plan allocates **$800 million** to implement stormwater flood protections and other extreme weather mitigations throughout the Metro-North system.

- Within New York City, these projects include **$170 million** to improve stormwater drainage at **Mott Haven Yard**. MTA investments at Mott Haven Yard must be paired with NYCDEP efforts to upgrade the city sewer system to prevent sewer surcharge.
- The MTA also commenced design on the **Metro-North Hudson Line** Slope Stabilization project in Yonkers just north of New York City, which will address stormwater drainage and slope stabilization along run-off and landslide-prone slopes.

New York City Transit personnel cover street vents at 42-St Bryant Park B D F M ahead of a forecasted Nor'easter in October 2025.

Bridges & Tunnels

The MTA is investing **$20.1 million** in stormwater drainage improvements and other efforts for the **Henry Hudson Bridge** and **Throgs Neck Bridge** to improve traffic flow and safety during heavy rainfall events.

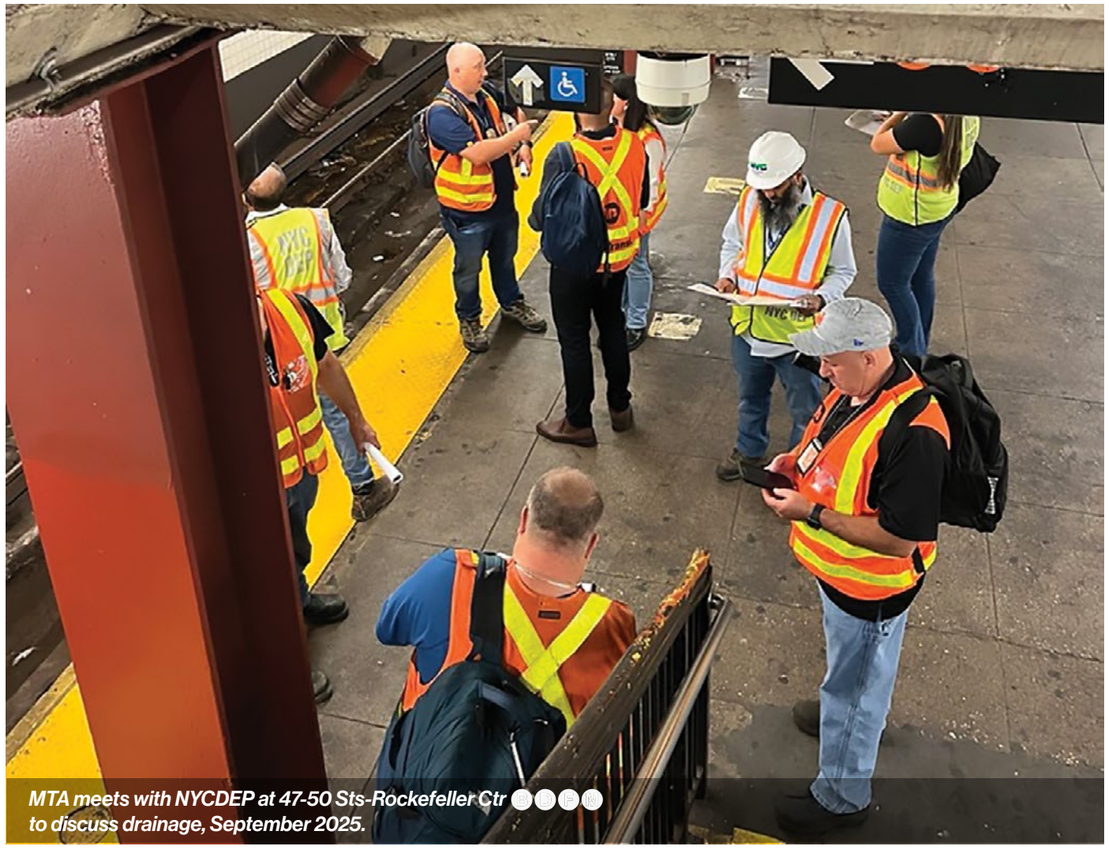
Throgs Neck Bridge

MTA IS ACTING IN COLLABORATION

The MTA coordinates with municipal partners like NYCDOT and NYCDEP to identify actions to protect transit infrastructure from stormwater impacts. Following major storms that disrupted MTA service in the summer of 2021, including Tropical Storm Ida, the MTA and City of New York initiated an Interagency Stormwater Task Force to investigate MTA locations with elevated flood risks or historical flooding significance, and propose actions. Since 2021, we have met more than 30 times and have conducted more than 8 site visits with our City partners.

Immediate "tactical" actions include but are not limited to sewer siphon cleaning and pre-storm catch basin cleaning (NYCDEP), selective milling to deepen the curb (NYCDOT), and track drain cleaning (MTA). **Since 2021, the City and the MTA have worked together to make tactical improvements across more than 73 subway stations and other locations of vulnerability.**

These short-term tactical actions have proven successful in many locations. For example, **157 St** was heavily impacted by Tropical Storm Ida in September 2021, with extensive flooding in the station mezzanine. After the storm, the MTA installed drainage enhancements within the station, and NYCDEP reinforced a catch basin at 157 St and Broadway, adjacent to the station. With these efforts, the station has not experienced subsequent flooding impacts during heavy rain.

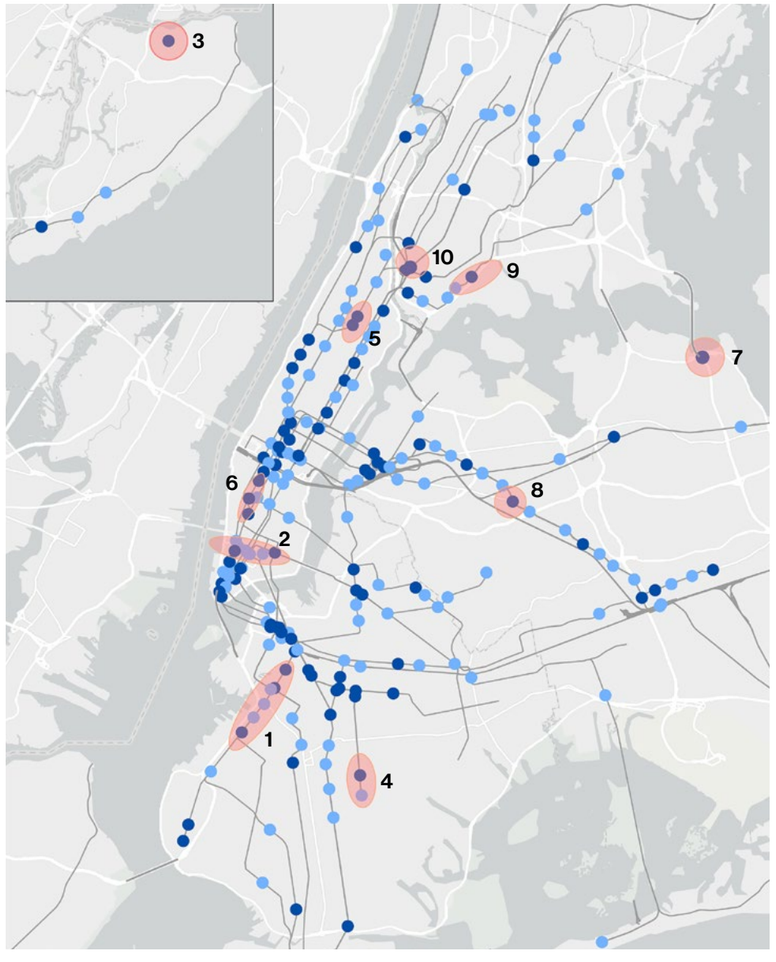


MTA meets with NYCDEP at 47-50 Sts-Rockefeller Ctr to discuss drainage, September 2025.

Vulnerable communities where City agencies must act

Since 2007, at least 200 subway stations as well as other MTA infrastructure has been impacted by one or more heavy rain events. The map below shows where stormwater impacts have occurred and 10 adjacent vulnerable communities. These 10 locations experience chronic flooding, where short-term tactical actions alone may not be sufficient.

MTA stormwater impacts and chronically impacted communities



- 1 impact on MTA infrastructure
- 2 or more impacts on MTA infrastructure
- Chronically impacted community
- MTA service line, track, bridge, or tunnel

1. 4 Av
2. Canal/Lafayette/Centre
3. Castleton Depot
4. Central Flatbush
5. Central Harlem
6. Chelsea/Midtown South
7. Cross Island Parkway
8. Grand Av - Newtown
9. Longwood Av
10. Mott Haven Yard

The following 10 communities served by transit infrastructure are vulnerable to stormwater flooding risks. We urge City agencies to expedite stormwater flood protections in these locations to protect both transit infrastructure and communities. We recognize the magnitude of this undertaking. In fact, NYCDEP has cited the need to address deficient sewer infrastructure in more than 80 locations citywide, estimating a capital expense of $30 billion over 30 years.[9] We urge the City to accelerate these capital investments to protect both communities and the transit infrastructure they depend on.

1 **4 Ave between Union St and 36 St, Brooklyn –** This stretch of 4 Avenue Brooklyn is served by five stations that have been impacted by heavy rainfall: **Union St** R, **4 Av-9 St** R, **Prospect Av** R, **25 St** R, and **36 St** D N R.

***Why City action is needed*:** This area of the Gowanus neighborhood is prone to chronic flooding and is also under-sewered. NYCDEP has made investments in the Gowanus neighborhood and we urge additional investment to further alleviate flooding.

What the MTA is doing: We have installed elevated steps at entrances to help mitigate flooding impacts from street and sidewalk stormwater runoff.

2 **Canal/Lafayette/Centre Streets, Manhattan –** The blocks along Canal Street between Centre Street and Varick Street are among the lowest lying in Manhattan, contributing to chronic stormwater flooding at **six Canal Street stations** covering 11 lines 1 A C E J Z N Q R W 6.

***Why City action is needed*:** In addition to being low-lying, sidewalks in this neighborhood also have low curb heights in places, particularly adjacent to subway station entrances. Increasing curb heights would reduce this vulnerability for the community.

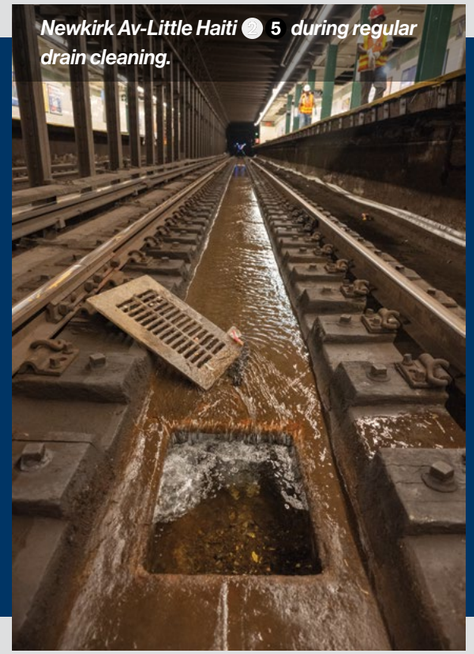
What the MTA is doing: We have installed elevated steps at entrances to mitigate flooding from street and sidewalk stormwater runoff. We are installing street vent mitigations at the J Z and 6 stations.

Street ponding due to a clogged catch basin adjacent to Canal St 1 street vents.

3 **Castleton Depot, Staten Island –** This bus depot in Staten Island's Port Richmond neighborhood is situated above a historic waterway, Bodine Creek, which now runs through a sewer below the depot. During heavy rains, stormwater flows downstream from Clove Lakes Park and overwhelms the City's sewer system, leading to flooding in the community and in the depot.

***Why City action is needed*:** The Port Richmond community and our depot would benefit from increased City sewer capacity and drainage improvements. NYCDEP has invested heavily in the Staten Island Bluebelt program for stormwater management and we support similar investments that may alleviate flooding in the Port Richmond community.

What the MTA is doing: We have optimized operational actions to reduce the impacts of flooding at Castleton Depot. We are looking at stormwater storage opportunities at the depot to help offset sewer capacity issues in the neighborhood.



Newkirk Av-Little Haiti 2 5 during regular drain cleaning.

4 **Central Flatbush, Brooklyn –** Central Flatbush's **Newkirk Av-Little Haiti** 2 5 is vulnerable to flooding during heavy rainfall. Notably, this station's track and tunnel were flooded following Tropical Storm Ida in September 2021.

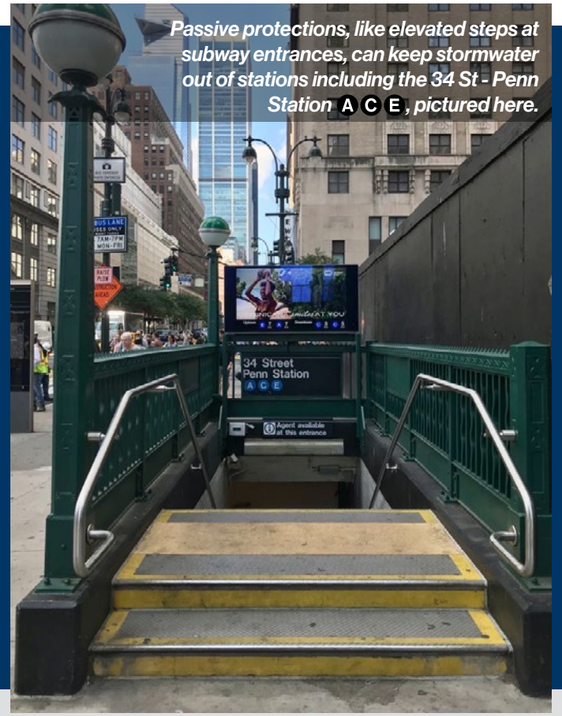
***Why City action is needed*:** Along with the subway station, the Central Flatbush community experiences chronic flooding during heavy rain.

What the MTA is doing: We have optimized operational actions, such as drain cleaning, to prepare for flooding when it occurs. We are installing elevated steps and street vent mitigations.

5 **Central Harlem, Manhattan –** Central Harlem's **Central Park North-110 St** 2 3 and **116 St** 2 3 are located in a former wetland and are subject to stormwater flooding during heavy rain. **116 St** 2 3, in particular, has experienced flooding from cascades of stormwater entering street vents.

***Why City action is needed*:** Because Central Harlem is low-lying and in a former wetland area, this community and our stations would benefit from increased sewer capacity and drainage improvements.

What the MTA is doing: We have two elevated steps in construction at **116 St** 2 3 to mitigate flooding impacts from street and sidewalk stormwater runoff. We are also installing additional elevated steps and street vent mitigations.



Passive protections, like elevated steps at subway entrances, can keep stormwater out of stations including the 34 St - Penn Station A C E, pictured here.

6 **Chelsea/Midtown South, Manhattan –** Chelsea/Midtown South is served by several subway stations, including **23 St** 1, **28 St** 1, and **34 St-Penn Station** A C E. The community relies heavily upon these stations, which have all been impacted during heavy rain. NYCDEP sewer manholes have also surcharged multiple times at **28 St** 1 and **34 St-Penn Station** A C E, sending large amounts of water onto the platform and track and disrupting service.

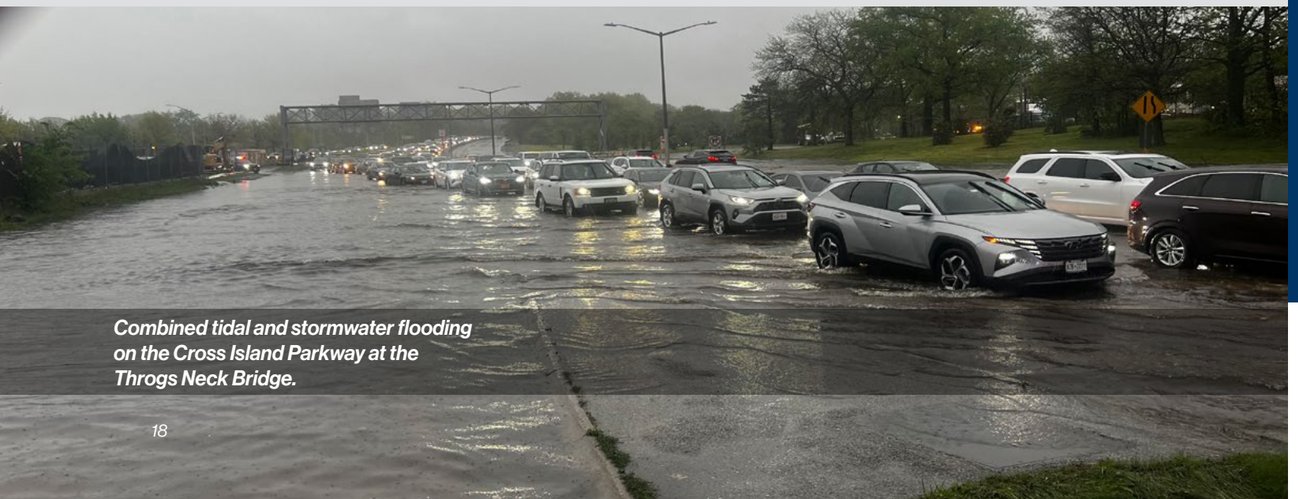
***Why City action is needed*:** Excessive stormwater has overtopped curbs adjacent to these stations, causing flooding through subway vents. Increased curb reveal can help mitigate this vulnerability.

What the MTA is doing: We have installed elevated steps at entrances across all three stations to help mitigate flooding impacts from street and sidewalk stormwater runoff. We are also installing street vent mitigations.

7 **Cross Island Parkway, Queens –** The Cross Island Parkway, particularly near the Queens approach of the **Throgs Neck Bridge**, experiences chronic flooding when it rains, forcing the MTA to restrict traffic flow on the bridge's on-ramps.

***Why City action is needed*:** Improving drainage on the Cross Island Parkway would reduce flooding impacts to the Throgs Neck Bridge and service impacts for the many communities that travel on this bridge.

What the MTA is doing: We are advancing feasibility studies to reconfigure the **Throgs Neck Bridge** ramps to reduce flooding and ramp closures.

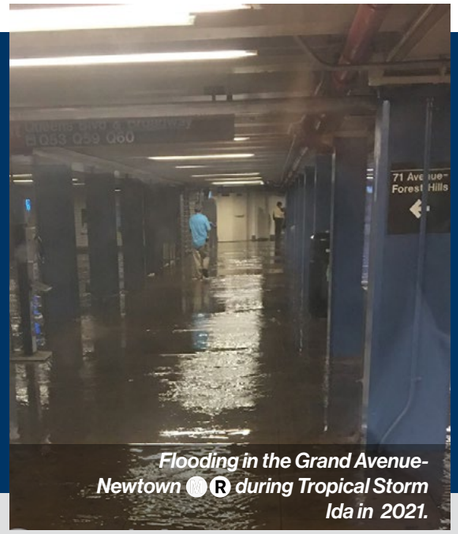


Combined tidal and stormwater flooding on the Cross Island Parkway at the Throgs Neck Bridge.

8 **Grand Av-Newtown, Queens** – Elmhurst's **Grand Av-Newtown** M R is chronically vulnerable to heavy rain, including during Tropical Storm Ida when it experienced significant flooding throughout the station.

***Why City action is needed*:** Elmhurst experiences flooding and portions of this neighborhood also have reduced sewer capacity. Additionally, our station is at a localized low point, exacerbating vulnerability.

What the MTA is doing: We have installed elevated steps at entrances to mitigate stormwater runoff. We are also installing street vent mitigations.



Flooding in the Grand Avenue-Newtown M R during Tropical Storm Ida in 2021.

9 **Longwood Ave, Bronx** – **Longwood Av** 6 in the Southeast Bronx has been impacted by heavy rainfall multiple times since 2007, including during Tropical Storm Ida and Tropical Storm Ophelia.

***Why City action is needed*:** The Longwood neighborhood has chronic sewer capacity issues, exacerbating flooding in the community and at our station.

What the MTA is doing: We are installing elevated steps at entrances to mitigate stormwater runoff. We are also installing street vent mitigations.

10 **Mott Haven Yard, Bronx** - This Metro-North (MNR) yard is a critical junction that carries 98% of all MNR service. It has flooded over 20 times since 2016. Stormwater drainage from the yard relies on the city's sewer system to convey water away from the on-site drainage system; however, when rainfall rates exceed 1.5 inches per hour, the city sewers can surcharge into the yard, contributing to floodwaters that impact service.

***Why City action is needed*:** The yard is in a natural depression and currently serves as stormwater retention and sewer overflow for the neighborhood. Tactical and capital measures including backflow prevention, sewer lining, siphon cleaning, and NYCDEP sewer capacity expansion are critical to MNR's ability to run reliable service.

What the MTA is doing: We elevated tracks up to 6 inches in the lowest part of the yard to mitigate flood impacts on service. We are also scoping in-yard stormwater drainage improvements.

Coastal Flooding

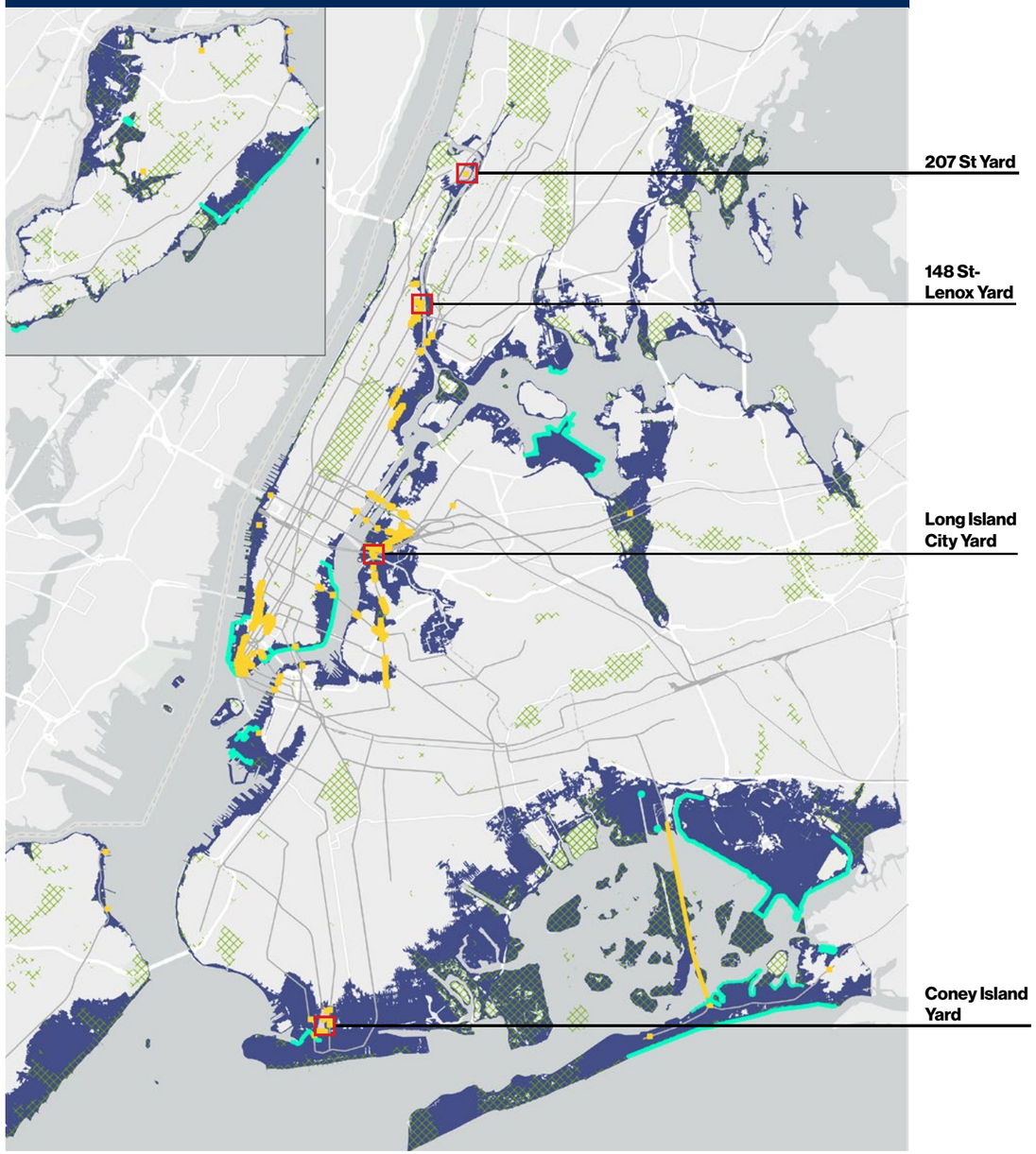
With the memory of Superstorm Sandy's catastrophic damage in October 2012, the question of the next major coastal flooding event is "when" not "if." Mitigating coastal flood risk to infrastructure is an MTA priority and has been the focus of **$7.6 billion** in investment collaboration with the Federal government since Superstorm Sandy.

Climate projections show that the risk of storm surge events will triple by the 2050s.[10] Tidal flooding, which is expected to worsen with sea level rise, can also severely disrupt transit service, infrastructure, and equipment – even in the absence of coastal storms. High tides expose vulnerable infrastructure such as the **LIRR Long Beach Branch**, **MNR Hudson Line**, and **NYCT Rockaway Line** to corrosion.

Ongoing investments in coastal protections for the region's infrastructure are necessary, even as we complete the major post-Sandy projects. The map on the right highlights coastal protections that are completed or underway. MTA protections complement a broader network of neighborhood-scale protections operated by the NYCDEP Bureau of Coastal Resilience and other partners. Despite substantial progress in the city's coastal resilience, ongoing planning, coordination and investment are needed to protect the most vulnerable communities and public infrastructure.

Following Superstorm Sandy, the MTA installed a 1,500 linear-foot marine floodwall at 207 St Yard in Manhattan along the Harlem River.

Coastal protection infrastructure completed or underway



MTA IS ACTING

In the wake of Superstorm Sandy, the MTA raced to harden critical transit and roadway infrastructure. However, as coastal storms grow in intensity and frequency, and rising sea levels expand the extent of the region's coastal floodplains, we are actively examining the new coastal flood risk landscape. Looking forward, we are ensuring that capital projects account for risk posed by both existing and future water levels in coastal areas. By factoring coastal flooding and sea level rise into our capital planning and design processes, we are reducing the risks posed by future flood events.

Subways

In Summer 2025, the MTA completed coastal surge protections on the **Rockaway Line** as part of a comprehensive $393 million project. The Rockaway Line serves more than 100,000 residents of Broad Channel and the Rockaway Peninsula in addition to an estimated 1.7 million visitors. After Rockaway Line infrastructure was critically damaged during Superstorm Sandy, the MTA worked quickly to restore service in 2013. Additional coastal surge protections in 2019 and 2020 hardened the line's substation and protected the **Hammels Wye Campus**. In addition to repairs to the Rockaway and Hammels Wye Viaducts, which carry **A** and **S** trains to the Rockaways, the South Channel Bridge's mechanical and electrical components were overhauled. The Line's tracks also received new, 12-foot wave barriers and erosion protection to reduce debris impacts during storm surges.

Coastal surge resilience improvements to the Rockaway Line.

Coastal surge protections at Corona Yard in Queens.

The MTA has also nearly completed coastal surge protections at **Corona Yard** in Queens, on time and on budget. This project includes hardening and equipment relocation at the signal relay building, signal tower, car wash facility building, circuit breaker house building, and maintenance shop building.

Metro-North Railroad

As part of the 2025-2029 Capital Program, the MTA will invest $800 million to protect **Metro-North's Hudson Line** from the effects of climate change through investments that will fortify the line against future stormwater runoff tidal floods and other risks. In particular, the Hudson Line Climate Blueprint will rebuild critical infrastructure – including culverts, drainage, retaining walls, slopes, shorelines, and track – with attention focused on a segment along the Lower Hudson that is vulnerable to the impacts of extreme weather.

The Blueprint will also outline design guidance and actions to protect the entirety of the Hudson Line, and ensure a coordinated approach is taken for all future Hudson Line projects. This includes target track elevations, standards for waterfront shoreline improvements, and performance criteria for drainage.

Crews work to repair storm damage on the Metro-North Hudson Line.

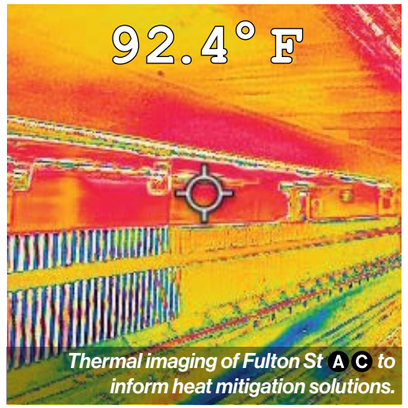
Long Island Rail Road

The Long Island City Yard Resiliency project provides coastal flood protection to a LIRR facility in Western Queens.

In December 2024, the MTA completed the $63 million **LIRR Long Island City Yard** Resiliency project, which installed new floodwalls, floodgates, and pumping stations to protect a flood-vulnerable LIRR yard and station servicing the Montauk, Oyster Bay, and Port Jefferson branches near the western Queens waterfront. The MTA is also installing perimeter flood protection and drainage improvements at **West Side Yard** in Manhattan, as well as flood mitigations at the Queens Portals of the East River Tunnels.

Extreme Heat

By 2050, New Yorkers could experience up to nine heatwaves per year, compared to the current baseline of two heatwaves per year.[11] Customers experience extreme heat most viscerally on underground subway platforms, but also at outdoor locations like subway and regional rail platforms and at bus stops. MTA infrastructure is also sensitive to heatwaves, as prolonged extreme heat can impact subway communication and power systems below ground. Above ground, tracks that are exposed to extreme heat are at risk of buckling, leading to potential service delays and emergency repairs.

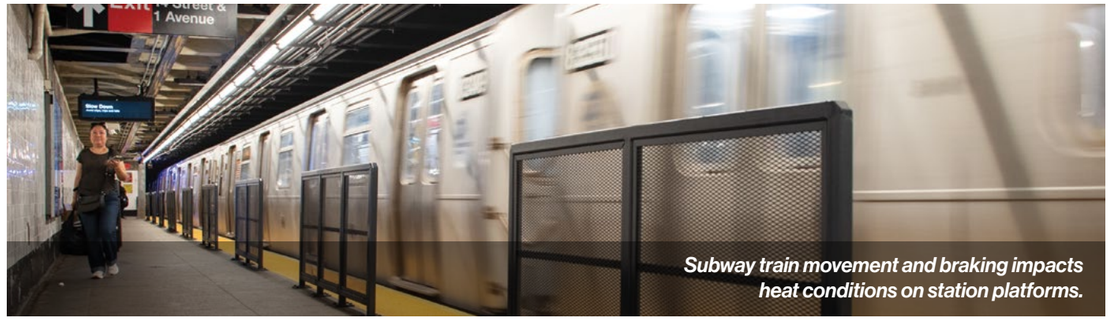


Thermal imaging of Fulton St A C to inform heat mitigation solutions.

Understanding the subway's thermal environment

The subway's thermal environment results from interactions between moving trains, ventilation systems, and underground conditions surrounding stations and tunnels.

- Train movements through subway tunnels cause the "piston effect" that push and pull air in front of and behind the trains. Vents at street level help circulate air in and out of subway tunnels.
- Air conditioners on subway cars and in station rooms vent hot air into the station environment. Temperatures increase significantly when trains idle in stations, particularly at terminal stations where trains are staged before beginning their routes.
- Electronic components from communications equipment and signboards, train braking, and underground utilities generate heat that can be felt in stations.
- Variation in subway construction methods have pronounced effects upon the thermal environment. Some subway lines were built with extensive waterproofing or have fewer sidewalk vents, each reducing dissipation of heat.

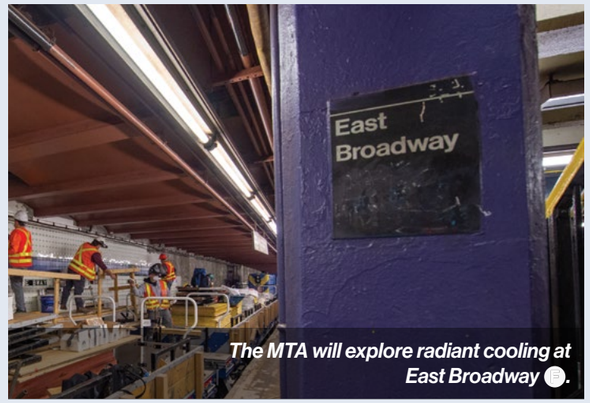

Subway train movement and braking impacts heat conditions on station platforms.

Researching new technologies to mitigate heat

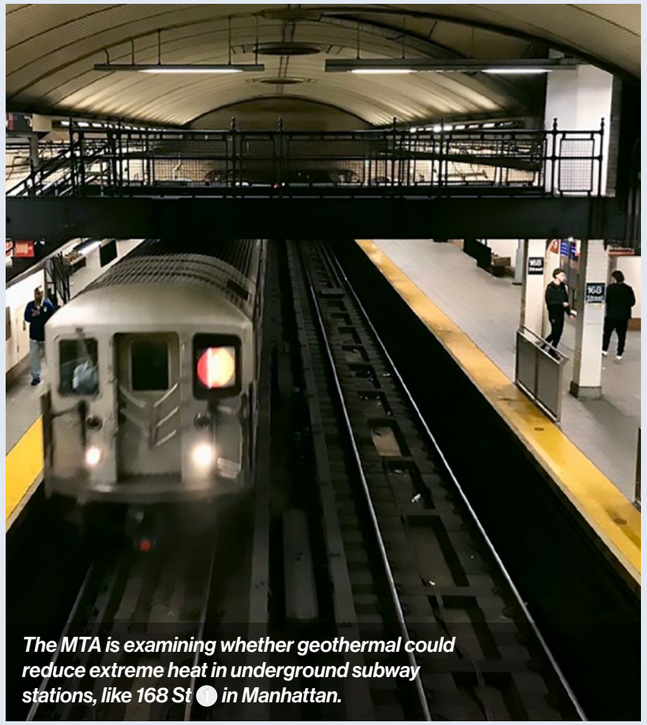
Reducing heat conditions in underground and above ground environments is a priority for the MTA. However, cost-effective mitigations are particularly challenging in dynamic underground subway stations and tunnels. A 2020 study determined that platform screen doors are not possible to install in 75% of stations and cost-prohibitive in the remaining 25%.[12] The MTA is therefore evaluating new technologies that could decrease heat in underground stations.

Heat recovery

The MTA is currently working with Cascara Energy to explore an innovative, high-efficiency radiant cooling solution in the station mezzanine at **East Broadway** F. This system leverages heat recovery technology, where thermal energy in the station is captured and redirected or stored for use elsewhere. Capturing ambient subway heat could make stations more comfortable and potentially provide a source of heat for off-takers, a benefit for both the MTA and New York City as a whole.



The MTA will explore radiant cooling at East Broadway F.


The MTA is examining whether geothermal could reduce extreme heat in underground subway stations, like 168 St 1 in Manhattan.

Geothermal

Geothermal energy is heat from within the Earth's crust, a renewable resource for direct heating and cooling. Geothermal energy is used in homes, businesses, greenhouses, pools, and for various industrial processes. Although geothermal is a common cooling strategy for buildings, there are no national or international examples of geothermal retrofits within legacy subway systems.

The MTA released a Request for Information (RFI) in 2025 to obtain information related to geothermal cooling capacity, models, and technologies. The RFI will help to determine whether low-cost geothermal interventions could reduce heat in legacy underground subway stations.

Track sensors

Through partnerships with the Transit Tech Lab, the MTA is leveraging remote sensors to measure outdoor subway track temperature in select locations. Track temperatures are collected every 10 minutes and are used for operational planning and response.

Sensors monitor outdoor track temperatures during high heat days.


The MTA pilots painting MNR rails white to reduce the risk of impacts from extreme heat.

White rails

New York City Transit (NYCT) is also testing white-painted rails on exposed, outdoor subway track - a measure that has also been piloted on vulnerable Metro-North tracks. The goal is to measure the efficacy of white paint at lowering outdoor track temperature and reducing expansion risk. If successful, NYCT Subways may scale up application to other locations.

MTA IS ACTING

As we learn about new technologies, we're advancing cost-effective projects to mitigate extreme heat within the **281** underground subway stations in New York City:

Platform fans in older stations

We are installing platform fans in areas where we know they can effectively circulate air on station platforms, including new locations such as **Christopher St-Stonewall** 1 and **Chambers St** 1 2 3. To date, seven stations feature platform fans.

Air tempering in new stations

Air tempering, which entails the use of pumping air cooled by water chillers, has been deployed at new subway stations, such as along the Second Avenue Subway. This technology can reduce air temperatures in deep stations where passive air circulation is not achievable due to the vertical distance between the platform and the street. While air tempering is a proven technology, it is currently only practical at new stations where it is factored into initial design. Implementation in older stations requires prohibitively complex and costly retrofits.

Air tempering equipment at 86 St Q

Interagency climate resilience actions

NYCDEP personnel cleans stormwater catch basin. Credit: NYCDEP

In this section, we outline 9 interagency climate resilience actions. Tackling the novel challenges of extreme weather will not be easy, but with continued substantive collaboration and coordinated action, the MTA and the City of New York can deliver high-performance protections for New Yorkers.

Actions for heavy rain

Accelerate the pace of capital investments to increase stormwater management capacity, particularly in vulnerable communities adjacent to transit infrastructure. New York City urgently needs greater stormwater capacity to manage the magnitude and intensity of present-day heavy rains.

Maintain sidewalk curbs of sufficient size and catch basins of sufficient capacity to manage intense rain. A major contributor to stormwater flooding in the subway is runoff from city streets. When the tops of curbs are too close to the street (and in some cases, nearly flush with the street), runoff pours onto the sidewalk and can flow into underground stations through vents, staircases, and other entry points. Through actions to maintain 7-inch curb height adjacent to subway vents, NYCDOT can help ensure that runoff is properly routed away from underground infrastructure and toward catch basins.

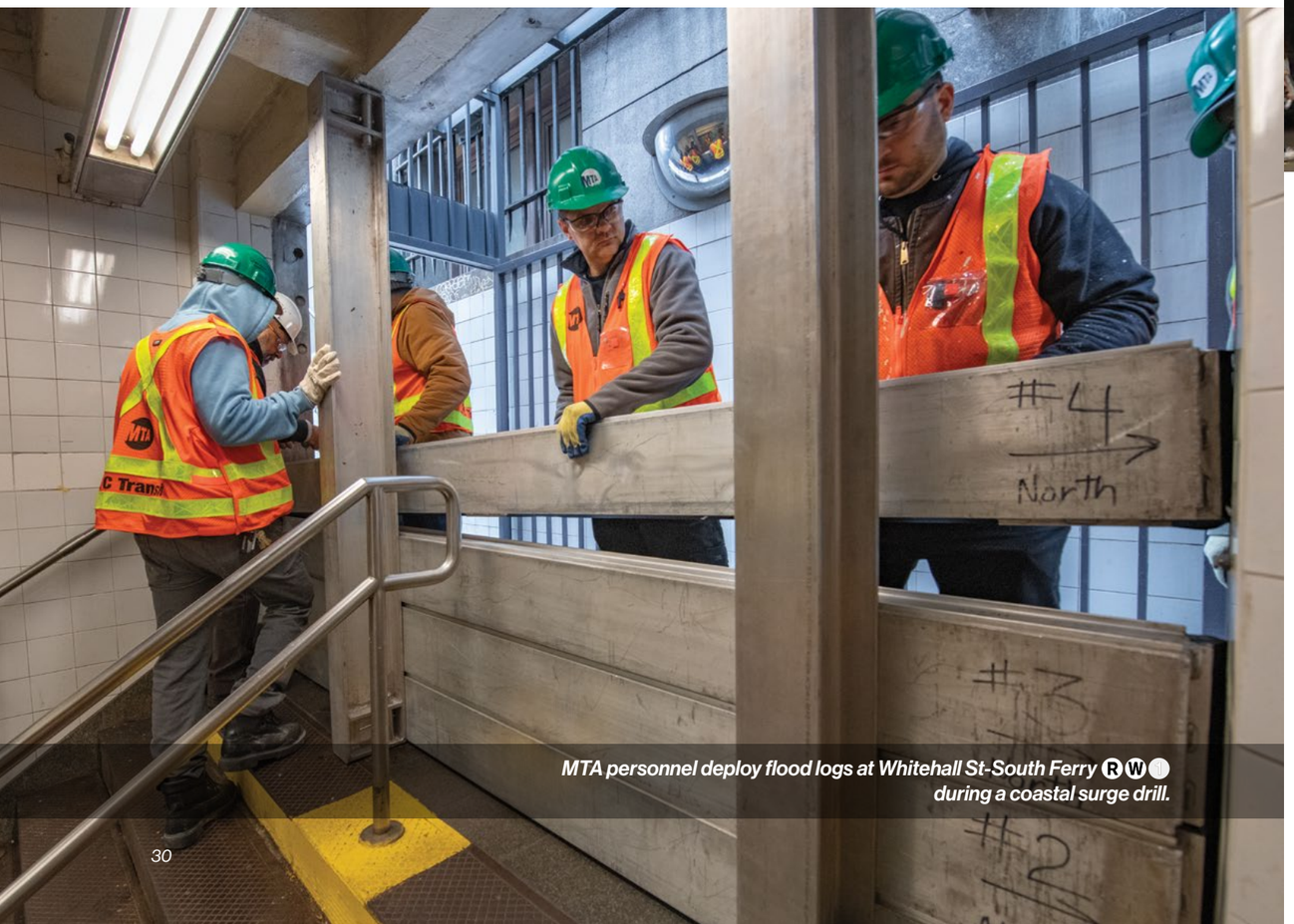
Optimize storm sewer networks to send excess stormwater away from overloaded locations adjacent to MTA infrastructure to areas with spare capacity. NYCDEP should expedite new technologies that identify overburdened trunk mains, siphons, and other sewer infrastructure adjacent to MTA infrastructure. These technologies enable dynamic management of stormwater runoff, potentially relieving overburdened sewer networks and shortening the duration of disruptions.[13]

Low curbs adjacent to subway infrastructure can be quickly overtopped during heavy rainfall.

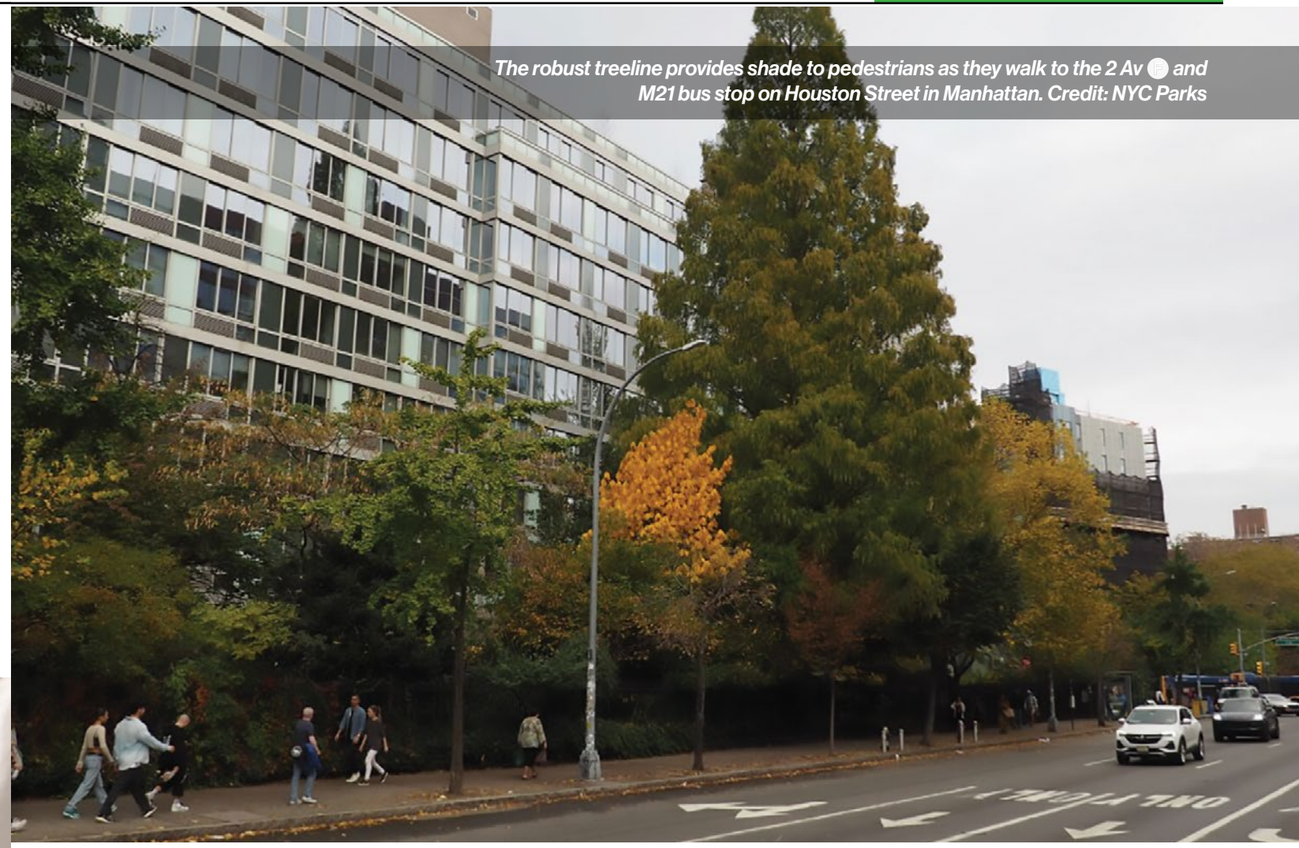
High curbs protect station elevators from flooding.

Actions for coastal flooding

- **Sustain leadership and future-forward strategy towards coastal resilience in the New York City region.** As New York City evolves its governance of coastal protections, it is crucial for the City to solidify its role as the champion of and chief planner for future mitigations. This role is also a coordinating and convening one. There is opportunity to deepen collaboration and cooperation, and incorporate the lessons learned from Superstorm Sandy's recovery to ensure that the next generation of coastal protections are effectively scoped, funded, and implemented.
- **Manage the coordinated design and deployment of the city's flood mitigation measures and deepen coordination withthe on emergency operations planning.** Operational readiness and regular exercises enable agency partners to successfully deploy flood protection countermeasures during a coastal storm.
- **Continue to advance City-led climate data collection and monitoring.** Storms are becoming more frequent and intense. With high-quality projections, New York City can better predict and respond to extreme events, ensuring that New Yorkers can depend upon reliable service despite weather disruptions. New York City has been a leader in local climate science, and the MTA supports localized climate and weather data collection, monitoring, modeling, and sharing.



MTA personnel deploy flood logs at Whitehall St-South Ferry Ⓡ Ⓦ ⓘ during a coastal surge drill.



The robust treeline provides shade to pedestrians as they walk to the 2 Av ⓘ and M21 bus stop on Houston Street in Manhattan. Credit: NYC Parks

Actions for extreme heat

- **Facilitate the development of thermal energy networks (TENs) between public and private properties that can utilize waste heat from sources like the subway.** TENs are networks of pipes that share heat between buildings and other structures. When networked with subway infrastructure, this technology has the capacity to divert unwanted heat from subway stations and tunnels and repurpose it for other uses, such as hot water or space heating for neighboring buildings.
- **Encourage new heat recovery and geothermal technologies that pull heat from vulnerable sites like subway stations.** There are several promising thermal energy technologies emerging in the marketplace. While these technologies have been deployed in buildings, they have yet to be used in infrastructure like subway stations. Strategies to accelerate heat recovery projects include reforming regulatory mechanisms, deploying new financing incentives, and encouraging adjacent public and private entities to incorporate subway waste heat.
- **Provide consistent shade for transit customers by increasing tree canopy.** Increasing tree canopy along paths to transit stops is an ecologically sound and cost-effective strategy to reduce temperatures and absorb stormwater, simultaneously benefiting commuters, local residents, and businesses. This is also consistent with the City's goal of increasing tree canopy coverage to 30% by 2035.

MTA Climate Resilience Roadmap: Progress Update

In the approximately 18 months since we released the MTA's inaugural Climate Resilience Roadmap, we have made significant progress in initiating and completing numerous actions under the Roadmap's 10 goals and related strategies.

Goal 1: Shield subway stations and tunnels from stormwater

Strategy	Progress Update
Keep stormwater out **Boost collaboration with City agencies**	» Priority catch basin cleaning by NYCDEP completed before heavy rainfall events. Additional priority catch basins identified for pre-storm cleaning. » Continued frequent coordination with NYCDEP on drainage planning and aligning our respective capital programs. Additional siphons and sewers cleaned by NYCDEP. » Continued engagement with NYCDOT on priority locations for curb reveal increase.
Keep stormwater out **Protect subway tunnel walls from leaks**	» Continued tunnel inspection and grout application.
Keep stormwater out **Install sidewalk-level protections**	» Funding identified in 2025-2029 Capital Program for sidewalk-level protections at priority stations.
Keep stormwater out **Develop new technologies to prevent stormwater overtopping into sidewalk vents**	» Exploring new street vent protection typologies in the 2025-2029 Capital Program.
Remove stormwater that enters **Upgrade subway drainage system equipment**	» Funding identified in the 2025-2029 Capital Program for rehab of at least 14 priority pump rooms in poor or marginal condition, and in chronically impacted locations. » Identifying locations that could benefit from expanded pumping and can be prioritized in future Capital Programs.
Remove stormwater that enters **Reduce subway drainage system constraints**	» Expanding and improving vent drains as part of relevant capital projects in the 2025-2029 Capital Program. » Continued check valve inspection and overhaul program.
Remove stormwater that enters **Continue proactive track drain cleaning programs**	» Continued track drain inspection and cleaning program, bundled with construction-related shutdowns, where feasible.
Remove stormwater that enters **Retain stormwater until the city sewer capacity recovers**	» Progressed design at 3 Av-138 St 6. Construction anticipated to be awarded in 2026. » Identifying additional opportunities for stormwater detention.

Goal 2: Protect subway yards from flooding

Strategy	Progress Update
Upgrade and expand yard drainage systems in anticipation of future coastal surge and torrential rainfall floods	» Identifying additional opportunities in 2025-2029 Capital Program for drainage improvements at vulnerable yards.
Install combined coastal surge and torrential rainfall protections under the Westchester Yard Flood Control Project	» 100% design achieved, construction anticipated to commence in 2026.
Mitigate flood impacts as yard equipment is replaced	» Identifying sensitive equipment at yards that may need to be elevated as part of 2025-2029 Capital Program.

Goal 3: Protect open subway infrastructure from flooding

Strategy	Progress Update
Design tidal/inland flood and coastal erosion mitigations, including shoreline protections and equipment elevations	» Funding committed in 2025-2029 Capital Program for SIR drainage improvements. » Funding committed in 2025-2029 Capital Program for portal improvements at 3 Av-149 St 2 5.
Coordinate with external partners on regional and neighborhood-scale protections that intersect with MTA infrastructure	» Coordinating with NYCDEP on Bluebelt projects with benefit to MTA locations.

Goal 4: Safeguard bus depots from flooding

Strategy	Progress Update
Install site-specific stormwater flood mitigation and detention strategies at chronically impacted depots	» Coordinated with NYCDEP and identified stormwater mitigation opportunities for Castleton Depot in Staten Island and Jackie Gleason Depot in Brooklyn.
Implement coastal surge protections at vulnerable depots	» Continued identification of coastal surge protections that may be needed as part of 2025-2029 Capital Program investments at depots.

Goal 5: Work with partners to manage floods on city streets

Strategy	Progress Update
Address chronic flooding at B&T approaches	» Completed feasibility studies for reconfiguration of the Throgs Neck Bridge ramps on the Cross Island Parkway to address off-property stormwater flooding conditions. » Coordinated with NYCDEP on its drainage planning effort near the Throgs Neck Bridge to reduce flooding.
Prepare for tidal flood impacts on bus operations	» The MTA has developed alternative bus routes for deployment during emergencies.

Goal 6: Mitigate Long Island Rail Road flooding

Strategy	Progress Update
Install protections from sea level rise and torrential rainfall flood risks along the Long Beach and Far Rockaway Branches	» Completed coastal flood protection of Long Island City Yard. » Coordinated with NYCDEP to complete siphon cleaning near Mid-Day Storage Yard.
Address torrential rainfall risks along the Port Washington Branch and in the Long Island City area	» Partnering with NYCDEP to investigate drainage near Bayside Station on the Port Washington Branch.

Goal 7: Reduce Metro-North Railroad flooding

Strategy	Progress Update
Implement Hudson line resilience measures	» Funding provided in 2025-2029 Capital Program for Hudson Line Resilience measures. » Progressing design on Hudson Line Slope Stabilization measures at flood-and landslide-prone area in Yonkers. » Releasing RFP for Hudson Line Climate Resilience Blueprint, with design for critical infrastructure improvements and resilient design guidance. » Elevated flood-prone tracks near Garrison over 20 inches.
Advance drainage improvements at vulnerable locations	» Funding committed in 2025-2029 Capital Program for Mott Haven Yard stormwater drainage improvements. » MTA and NYCDEP partnering to identify and implement tactical and capital measures including backflow prevention, sewer lining, siphon cleaning, and NYCDEP sewer capacity expansion to mitigate NYCDEP sewer surcharge into Mott Haven Yard. » Elevated tracks up to six inches near lowest point in Mott Haven Yard to boost operational resilience.
Address flooding, runoff, and erosion risks by stabilizing and protecting vulnerable segments of right of way	» Elevated a flood-prone signal house on the Upper Harlem Line over four feet.
Expand understanding of how extreme weather impacts infrastructure and service	» Piloted water detection sensors in known areas of water intrusion.

Goal 8: Expand underground air circulation and cooling

Strategy	Progress Update
Install air circulation equipment to keep hot air moving off platforms	» Installed new platform fans at Chambers St 1 2 3 and Christopher St-Stonewall 1. » Piloted remote heat and humidity sensors at five stations.
Pilot evolving platform cooling strategies	» Released Geothermal Tech RFI. » Initiated design of heat recovery pilot at East Broadway 1.

Goal 9: Protect outdoor infrastructure from heat

Strategy	Progress Update
Pilot strategies to mitigate extreme heat on vulnerable outdoor track	» Piloting white rail paint on the Rockaway Line in Brooklyn.
Improve real-time monitoring of heat conditions	» Piloted rail temperature sensors on the Dyre Line in the Bronx and the Brighton and Rockaway Lines in Brooklyn.

Goal 10: Address heat and wind impacts on bridges

Strategy	Progress Update
Reduce the impacts of heat and wind on bridges	» Identifying additional materials to pilot as part of 2025-2029 Capital Program.

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To learn more about the MTA's climate initatives,
please visit **MTA.info/climate**