

04 Bridges and Tunnels



Key program highlights

Bridges

- Bronx-Whitestone Bridge
- Robert F. Kennedy Bridge
- Throgs Neck Bridge
- Verrazzano-Narrows Bridge
- Henry Hudson Bridge
- Cross Bay Bridge
- Marine Parkway Bridge

Tunnels

- Hugh L. Carey Tunnel
- Queens Midtown Tunnel

Agencywide Projects and Central Business District Tolling Program

Overview of agency and assets

MTA Bridges and Tunnels (B&T) was established in 1933 as the Triborough Bridge Authority. Today, B&T is among the largest of the nation's bridge and tunnel tolling authorities, in terms of both revenue and traffic volume, operating seven bridges and two tunnels in New York City, connecting the boroughs of Manhattan, Brooklyn, Queens, the Bronx, and Staten Island. In 2022, B&T collected more than \$2.3 billion in revenue. With over 60% of this toll revenue dedicated to the MTA's mass transit operations, B&T performs a unique and vital function in support of regional mobility.

B&T operates seven bridges:

- Bronx-Whitestone Bridge
- Robert F. Kennedy Bridge
- Throgs Neck Bridge
- Verrazzano-Narrows Bridge
- Henry Hudson Bridge
- Cross Bay Bridge
- Marine Parkway Bridge

B&T also operates two tunnels:

- Hugh L. Carey Tunnel
- Queens Midtown Tunnel

These facilities are essential links for both regional traffic corridors and major truck routes and serve a vital role in the operation of bus/high occupancy vehicle (HOV) traffic operations within NYC.

By the end of this 20-year planning horizon in 2044, all but the Cross Bay Bridge will be over 75 years old, and several facilities will be over 100 years old. As a result of a planned sequence of steady capital investments complemented by a robust operating program of major maintenance work, B&T's facilities are in overall good condition. However, B&T's facilities continue to age, and as B&T continues to address the remaining infrastructure rehabilitation/replacement needs, a sustained high level of capital investment similar to current levels is necessary to maintain the facilities in good condition while also improving them to better serve the region. B&T's investment needs represent a long-term strategy to renew, rebuild, and modernize B&T's bridges and tunnels with the goals of improving safety, resiliency, regional mobility, and accessibility, while also employing sustainable practices that enhance the environment.

B&T appendix structure

The B&T Appendix provides an overview of the agency's assets, their current replacement/upgrade status, and expected investment focus to maintain these assets over the next 20 years. The appendix is divided into four sections, including program highlights, specific details about our bridges, specific details about our tunnels, and an overview about our agencywide projects and the Central Business District Tolling Program.



Verrazzano-Narrows Bridge..

Investment needs highlights

Over the next 20 years, our investment needs include:

- On all bridges and tunnels, continue to replace original structural components to ensure all components remain in good condition, and where new design criteria are applicable for assets being replaced, upgrade them to meet the new criteria.
- On all bridges and tunnel ventilation buildings, upgrade structures where necessary to meet current seismic requirements.
- On all bridges and tunnels, employ sustainable practices during construction such as requiring the use of low carbon concrete and warm mix asphalt, and upgrade our buildings with new energy efficient systems.
- On the Robert F. Kennedy Bridge, replace the elevated Manhattan Plaza structure (former toll plaza area).
- On the Verrazzano-Narrows Bridge, replace the lower-level suspended span deck.
- Implement major safety improvements on the Queens Midtown Tunnel and the Hugh L. Carey Tunnel by installing in-tunnel fixed fire suppression systems (water mist systems).
- On the Bronx-Whitestone Bridge and the Throgs Neck Bridge, dehumidify the main cables.
- Continue to improve bicycle and fully accessible pedestrian paths on our bridges.

KEY PROGRAM HIGHLIGHTS

→ Key program highlights

Bridges

- Bronx-Whitestone Bridge
- Robert F. Kennedy Bridge
- Throgs Neck Bridge
- Verrazzano-Narrows Bridge
- Henry Hudson Bridge
- Cross Bay Bridge
- Marine Parkway Bridge

Tunnels

- Hugh L. Carey Tunnel
- Queens Midtown Tunnel

Agencywide Projects and Central Business District Tolling Program



A-310



A-311

Extension of service life for suspension bridges

Main cables are the primary load-carrying elements for our suspension bridges (Throgs Neck Bridge, Bronx-Whitestone Bridge, Verrazzano-Narrows Bridge, and Robert F. Kennedy Bridge suspended spans). The main cables at the Bronx-Whitestone Bridge and Robert F. Kennedy Bridge are well over 80 years old, and the main cables at the Verrazzano-Narrows and Throgs Neck Bridges are already over 60 years old. Main cables are extremely difficult and cost-prohibitive to replace and therefore are critical elements that must be preserved and maintained. As with any cable on an older suspension bridge, main cable strength is reduced from its original new condition by various factors including corrosion. Cable dehumidification is a proven technique used around the world to minimize corrosion and preserve these critical elements.



Above, the Robert F. Kennedy Bridge
Right, aerial view of the Verrazzano-Narrows Bridge

We have already initiated installation of cable dehumidification on the Robert F. Kennedy Bridge and the Verrazzano-Narrows Bridge in the 2020-2024 program and will be prioritizing this investment at the Bronx-Whitestone Bridge and Throgs Neck Bridge in the next program.



Split tolling at the Verrazzano-Narrows Bridge

Implementation of Open Road Tolling and Central Business District Tolling

The implementation of Open Road Tolling (ORT) at all MTA B&T facilities in 2017 was a key component of the New York Crossings Project that aimed at reimagining New York's bridges and tunnels for the 21st century. ORT is providing significant and sustained regional improvements in customer service and customer safety and also has environmental benefits — less traffic congestion for motorists also means cleaner air for everyone, and reducing traffic merging and the need to slow down to pay a toll improves safety for B&T customers. In 2019, legislation was signed into law enabling B&T to implement the Central Business District Tolling Program (CBDTP) to reduce congestion and enhance mobility in Manhattan's Central Business District (south of, and inclusive of, 60th Street). The planning, design, construction, operations, and maintenance of CBDTP is primarily the responsibility of B&T and requires the involvement of New York State Department of Transportation (NYSDOT), New York City Department of Transportation (NYCDOT), and various other regional agencies and stakeholders. Once activated, this program is anticipated to collect annual net revenue sufficient to generate \$15 billion for the MTA capital plan.

Over the next 20 years, as toll collection technology improves, we will need to periodically renew the infrastructure required both to support toll collection at the facilities and to support the CBDTP.

Fire safety upgrades

Over recent capital programs, B&T has made significant progress in upgrading our facilities to modern fire safety standards (NFPA 502) adding fire standpipes on bridges that were originally constructed without them, replacing our tunnel standpipes to modern standards and installing supplemental systems to improve fire fighting resiliency on our suspension bridges. At the Hugh L Carey Tunnel we have installed a fixed fire suppression system in a portion of the tunnel to further enhance fire fighting capabilities. Going forward we plan to complete the remaining elements of this program and bring all facilities into compliance with modern fire safety standards as well as completing the installation of fixed fire suppression systems at the remainder of the Hugh L Carey Tunnel as well as the Queens Midtown Tunnel.



Testing of fixed fire suppression system in Hugh Carey Tunnel

We will complete the installation of a fixed fire suppression system in both the Hugh L. Carey Tunnel and the Queens Midtown Tunnel as a top priority in the next program.

Resilience initiatives

In previous programs, as well as the current program, B&T has made significant investments in climate resilience by improving the aerodynamic and wind performance of all four suspension bridges, replacing and/or installing fender protection systems at the Cross Bay Bridge, Marine Parkway Bridge, Bronx-Whitestone Bridge, Robert F. Kennedy Bridge, and Throgs Neck Bridge to protect critical assets against marine vessel collision, installing measures to prevent erosion of soil around bridge piers and abutments due to the water flow (known as scour) at the Throgs Neck Bridge, Cross Bay Bridge and Marine Parkway Bridge, and installing flood mitigation measures at various facilities. In addition, as part of major deck or structural rehabilitation and replacement projects, seismic upgrades have been performed to bring many of the structures into compliance with current seismic codes. Over the next 20 years we will continue to improve seismic resiliency of both our bridge structures and our tunnel ventilation buildings which are critical structures that house life safety systems for the tunnels. We have also improved electrical resiliency at the majority of our facilities to ensure adequate backup power is available for critical systems, and will complete replacement of all remaining original substations within the next ten years.



Night view with lights of the Robert F. Kennedy Bridge, formerly the Triborough Bridge

Sustainability initiatives

Over the past several programs, B&T has included sustainability initiatives as part of its projects wherever possible, resulting in approximately 95% of facility lighting being upgraded to more energy-efficient LED lights. We have also made wetland protection/enhancements at the Bronx-Whitestone Bridge and Robert F. Kennedy Bridge and replaced old, inefficient HVAC systems with new, properly sized, and efficient systems at several facilities. In keeping with the Governor's Executive Order 22 on sustainability and decarbonization, B&T is requiring the use of low carbon concrete, as well as the use of other innovative materials such as warm mix asphalt, on current and upcoming projects to minimize the carbon footprint of the projects. B&T is committed to investing in sustainability and is partnering with the New York Power Authority (NYPA) to identify further potential energy savings, evaluate the potential for solar power generation at our facilities, and transition to the use of zero-emission vehicles. In addition, B&T is developing a pilot program to implement EV charging at the Battery Parking Garage with the ability to expand the number of charging stations as demand grows.



Rendering of new bicycle/pedestrian ramp at the Robert F. Kennedy Bridge

Regional mobility and accessibility

Investments over the past two programs have resulted in major improvements to community and regional mobility and access. Recent roadway projects at the Verrazzano-Narrows Bridge, in coordination with off-property improvements on the Gowanus and Staten Island Expressways, resulted in the completion of a transformative, continuous reversible bus/HOV lane connecting Staten Island to Manhattan via the Gowanus bus/HOV lane. Taken in conjunction with the implementation of ORT, this project significantly improved travel times during peak hours. In addition, B&T widened the at-grade Gowanus Expressway to eliminate a pinch point where two lanes merged into one (called a lane drop) and improved traffic flow on the lower level of the

Over the next 20 years, B&T will continue to improve bicycle and pedestrian access on its facilities.

Verrazzano-Narrows Bridge. At the Robert F. Kennedy Bridge, B&T constructed a new ramp connecting the Harlem River Lift Span directly to the northbound Harlem River Drive, which has reduced congestion on both the bridge and local city streets in Harlem. At the Bronx-Whitestone Bridge, B&T reconfigured the southbound Queens interchange, creating a shared exit lane to the Cross Island Parkway, which helped minimize last-minute weaving movements and improved customer safety.

In the current program, B&T is improving the Verrazzano-Narrows Bridge and Belt Parkway merge to eliminate a lane drop, and reconfiguring the upper-level Brooklyn Approaches to eliminate non-standard left-hand exits to the Belt Parkway, both of which will greatly improve traffic flow and customer safety on the bridge. At the Robert F. Kennedy Bridge, B&T is improving the southbound Franklin D. Roosevelt (FDR) Drive by eliminating the lane drop where the bridge ramp merges with the southbound FDR, further reducing congestion on the bridge while also improving traffic flow on the FDR. Moving forward, B&T will continue to evaluate its facilities for additional improvements in coordination with its regional partners.

In addition to improving regional vehicular mobility, B&T is committed to improving bicycle and pedestrian access at its facilities wherever possible. Improvements have already been made at the Hugh L. Carey Tunnel by replacing the Morris Street pedestrian bridge over the Manhattan plaza with a new ADA accessible bridge and improving bicycle lanes and pedestrian crossings at Lily Pond Avenue on Staten Island near the Verrazzano-Narrows Bridge. Significant accessibility improvements are also underway on the pedestrian walkways at the Robert F. Kennedy Bridge, the Henry Hudson Bridge and the Cross Bay Bridge. Additional bicycle/pedestrian accessibility improvements are being evaluated for the Robert F. Kennedy Bridge's Harlem River Lift Span and the south side of the Queens Suspension Span, as well as the Marine Parkway Bridge and the Verrazzano-Narrows Bridge.

Overweight vehicle issues and impacts

B&T's bridges are utilized by thousands of trucks everyday, of which up to eight percent are overweight. Overweight trucks inflict severe fatigue damage to B&T's infrastructure, which drastically reduces the service life of decks and supporting steel members, and could lead to replacement of these components much sooner than planned. New York State recently passed legislation that will allow overweight trucks to be issued violations and fines as deterrence on a segment of the Brooklyn-Queens Expressway, using data from weigh-in-motion (WIM) systems as a basis for enforcement. B&T is planning to utilize WIM for enforcement and is adding additional WIM systems, upgrading existing WIM systems to be enforcement capable, and coordinating with regional transportation partners to develop a consistent regional approach to this issue.

Investment categories



Throgs Neck Bridge with beautiful reflection between Queens and the Bronx at sunrise

Structures

Investments in this category generally address components of the superstructure or the substructure that supports the superstructure. Over the next 20 years, B&T will address the remaining backlog of major capital renewal needs, primarily at the Robert F. Kennedy Bridge, Throgs Neck Bridge, and the Verrazzano-Narrows Bridge, as well as potential structural upgrades to enhance bicycle and pedestrian mobility at several facilities.

Roadways and decks

Investments in this category rehabilitate the bridge and tunnel roadways, decks, approaches, and drainage systems. Over the next 20 years, B&T will address the remaining deck replacement needs, the largest of which is the replacement of the Verrazzano-Narrows Bridge lower-level suspended span deck. After the completion of the deck projects included in this 20-year period, all of our bridge structures will have received new decks, with the exception of the Throgs Neck Bridge Approaches.



View of the Verrazzano-Narrows Bridge

Over the next 20 years, B&T will continue to upgrade its systems with the most up-to-date technology to enhance customer safety and experience and to protect the revenue stream.

Transportation Systems Management Operations

This category focuses on investments in operational technologies that can improve the efficiency, safety, and utility of existing infrastructure. Some of these systems, many of which are integrated with those of B&T's regional transportation partners, collect data that impact travel, like weather information or travel time information, or provide transportation-related information to our staff or customers, allowing them to respond better to current conditions. In addition, investments in this category address necessary upgrades to, or expansions of, B&T security systems, as well as renewal of B&T's ORT and CBDTP systems, which maximize throughput and revenue generation. Over the next 20 years, B&T will continue to upgrade its systems with the most up-to-date technology to enhance customer safety and experience and to protect the revenue stream.

Utilities

Investments in this category include the replacement, rehabilitation, or upgrade of mechanical, electrical, and lighting systems; installation of dehumidification systems on suspension bridge main cables; and replacement of tunnel ventilation equipment. B&T's largest investments are in main cable dehumidification at the Bronx-Whitestone Bridge and the Throgs Neck Bridge and in fire suppression systems at our two tunnels, all within the next capital program. B&T will also be completing its power resiliency/redundancy upgrades with the replacement of the primary 13 KV substation and anchorage substations at the Robert F. Kennedy Bridge, as well as the replacement of the substations at the Throgs Neck Bridge. In addition, B&T is committed to implementing sustainability initiatives such as transitioning to a zero-emissions fleet, installation of solar power generation, systems upgrades to improve energy efficiency, and other green initiatives as they are identified in partnership with New York Power Authority.

Buildings and sites

Investments in this category include service buildings, ventilation buildings, and garages which are associated with the various bridges and tunnels. B&T's primary investments in this category are the structural/seismic rehabilitation of the ventilation buildings at the Queens Midtown and Hugh L Carey tunnels. B&T is also focusing on space repurposing and site improvements in response to operational changes that have resulted from the implementation of ORT, as well as upgrades to the Battery Parking Garage to ensure it remains in good condition.

Miscellaneous

This category reflects anticipated needs associated with the support and administration of capital work including program contingency, program administration, protective liability coverage, independent engineering, scope development efforts, miscellaneous studies, etc.

Structural painting

Investments in this category address structural painting, a vital ongoing activity that helps prevent corrosion of bridge steel. Work in this category is typically bundled with structural rehabilitation projects to maximize cost effectiveness and minimize customer impacts. With the completion of projects in the current program, the overwhelming majority of B&T's structures will have had their original lead-based coatings replaced, an important safety and environmental goal. The majority of B&T's investments over the next 20 years involve cyclical maintenance and repair of the bridge coatings.

BRIDGES

Key program highlights

→ Bridges

- Bronx-Whitestone Bridge
- Robert F. Kennedy Bridge
- Throgs Neck Bridge
- Verrazzano-Narrows Bridge
- Henry Hudson Bridge
- Cross Bay Bridge
- Marine Parkway Bridge

Tunnels

- Hugh L. Carey Tunnel
- Queens Midtown Tunnel

Agencywide Projects and Central Business District Tolling Program



A-320

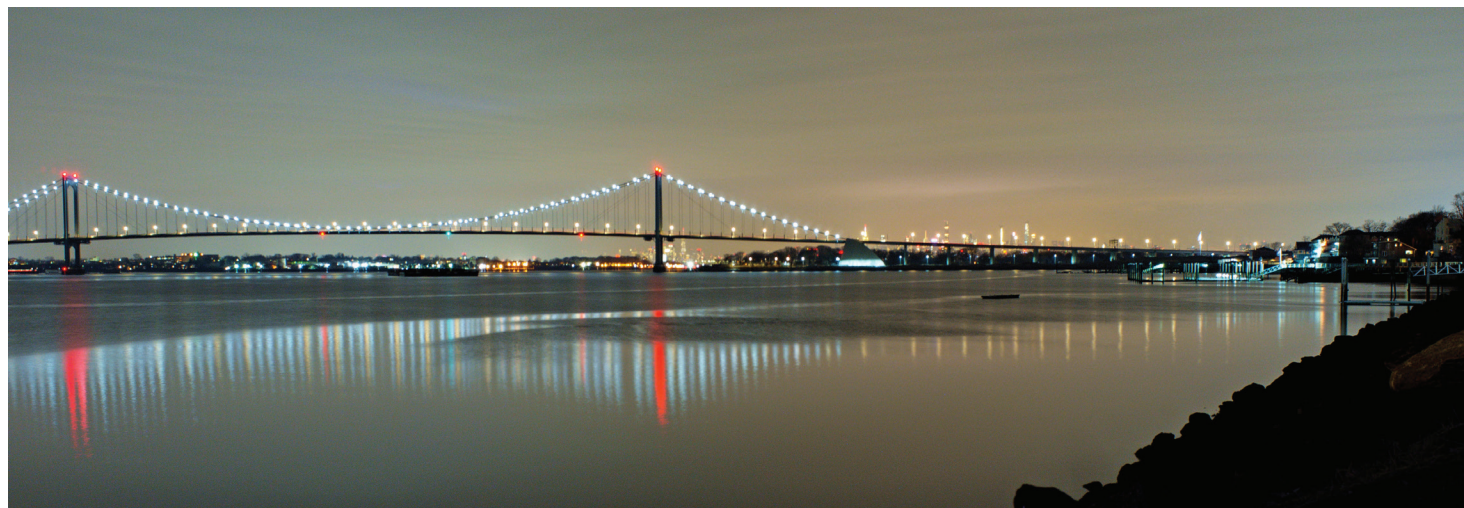


A-321

Bronx-Whitestone Bridge

Bridge facility

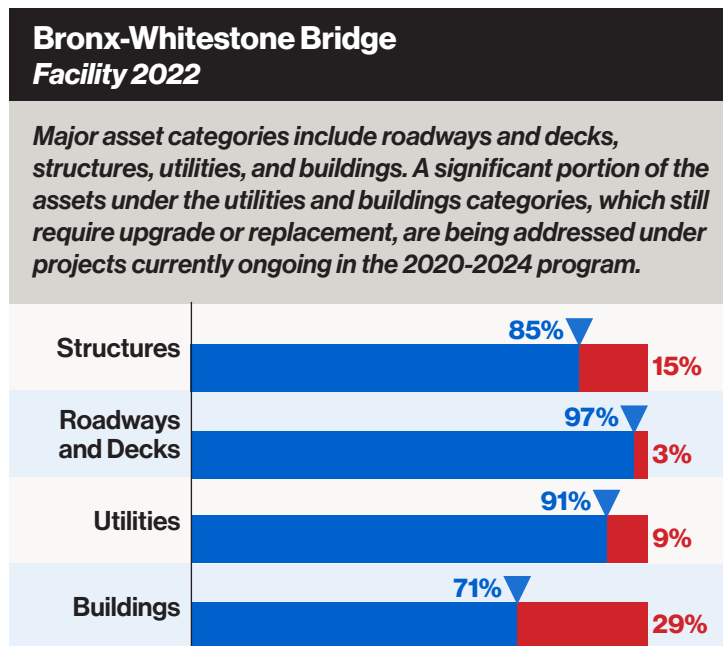
The Bronx-Whitestone Bridge is one of our oldest bridges and one of two B&T suspension bridges connecting upper Queens with the Bronx. It is a critical link and vital artery in the regional network. Along with the Throgs Neck Bridge, the Bronx-Whitestone Bridge serves as a key link to Long Island. It has a single level that carries six lanes of traffic, supporting almost 50.9 million vehicle trips in 2022.



Current status

To date, Bronx-Whitestone Bridge capital investments have focused on replacement and rehabilitation of the bridge's primary structural elements and upgrades to the electrical and communication systems. As a result of investments to date, the Bronx and Queens approach structures have been replaced in their entirety. In addition, we replaced the heavy concrete deck on the suspended span with a lighter steel deck, removed the heavy stiffening truss from the suspended spans and installed a lightweight wind fairing system to improve the wind performance of the suspended spans, all of which significantly reduced the dead load on the main cables. In conjunction with these major structural improvements, the electrical and communication systems on the bridge have been replaced.

In addition, resiliency and security needs have been addressed with a fire standpipe system installed on the structure, expansion and upgrades of the electronic security systems, the installation of protection on main cables and suspender ropes, and construction of fenders to protect the towers from marine impacts. We are currently implementing power and resiliency upgrades, as well as performing structural repairs to the remaining original structural components.



■ Good condition ■ Needs update/replacement

Based upon 2022 assessment



Investment needs

Our investment strategy for the Bronx-Whitestone Bridge over the next 20 years focuses on maintaining the structures and associated buildings in good condition while preserving the main cables. Our top priority in the next capital program is the dehumidification of the main cables, along with installation of a safety fence on the suspended spans. Another high priority is the replacement of the under-deck traveler, which provides access to support under-deck inspections and maintenance. The remaining investments over the 20-year planning horizon include replacing the suspender ropes which will be almost 100 years old, as well as cyclical structural repair projects, periodic rehabilitation of the bridge anchorages, bridge deck overlays, and painting projects all aimed at maintaining the Bronx-Whitestone Bridge in good condition.

Robert F. Kennedy Bridge

Bridge facility

B&T's flagship facility, the Robert F. Kennedy Bridge (formerly the Triborough Bridge), is comprised of three bridges—the Queens suspension bridge, the Harlem River Lift Span (HRLS), and the Bronx Truss—plus elevated viaducts and approach roads that connect Manhattan, Queens, and the Bronx. The three main branches meet on Randall's Island, where an elevated interchange supports traffic flowing in 12 directions, including to Randall's Island. Over 65.2 million vehicles crossed the Robert F. Kennedy Bridge in 2022.

Current status

After completion of the projects in the current 2020-2024 program, the majority of the decks will have been replaced and the superstructure supporting the decks will have been rehabilitated and upgraded to meet current load and seismic criteria. In addition, suspender ropes on the Queens suspension bridge have been replaced and, as part of an upcoming 2020-2024 project, the Queens suspension bridge will have improved wind resiliency and the main cables will be dehumidified. On the Harlem River Lift Span, the mechanical and electrical systems have been replaced or upgraded. A new vehicular ramp connecting the Harlem River Lift Span directly to the northbound Harlem River Drive was recently constructed, greatly improving regional mobility along with significant community benefits such as reduced traffic on local roadways and improved air quality. Two new vehicle ramps to Randall's Island are currently under construction. Additional investments in regional mobility will be completed under the 2020-2024 program with the widening a section of the FDR south of the Robert F. Kennedy Bridge, which will improve traffic flow on both the southbound Harlem River Drive and the bridge.

Significant improvements to bicycle and pedestrian access are also underway as part of the current capital program including shared use paths connecting Queens to Randall's Island, the Bronx Truss to Randall's Island, and the Harlem River Lift Span to both the future

Manhattan Greenway and Randall's Island. In addition, resiliency and security needs have been addressed with investments in fire standpipe systems on the majority of the structures, expansion and upgrades of the electronic security systems, the installation of protection on the main cables and suspender ropes, replacement of the fenders protecting the Harlem River Lift Span towers against marine vessel impacts, installation of safety fencing on the suspended spans, and the replacement and upgrade of several substations servicing the Randall's Island complex and ORT systems.

Investment needs

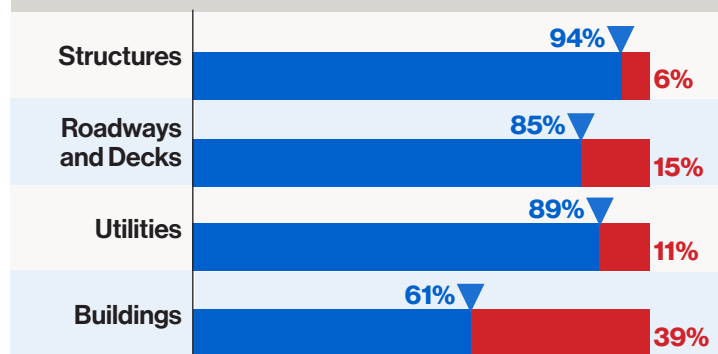
Our investment strategy at the Robert F. Kennedy Bridge over the next 20 years focuses on the continued rehabilitation or replacement of the remaining original roadways in the bridge complex, while also addressing the remaining needs of the supporting assets such as utilities and buildings and continuing to improve accessibility. Our highest priority over the next several programs is the reconstruction of the remaining original roadways, including the Manhattan toll plaza structure and associated ramps, and the FDR ramp. These projects will complete the replacement of all the original 1930s-era roadways at the bridge facility. At the same time, we will focus on a multi-phase substructure retrofit to extend the life of the substructure and improve seismic resiliency of this critical facility.

The bridge also has utility components, as well as buildings, that need to be addressed. The relocation and replacement of its primary 13 KV substation in the next capital program, along with subsequent upgrades to the substations in the anchorages will complete its power resiliency upgrades. In addition, as the center of operations for B&T, the Robert F. Kennedy Bridge facility building and storage space must be upgraded, repurposed, or expanded to accommodate operational changes.

We will continue to construct additional bicycle and pedestrian access where feasible, and continue to work with both NYCDOT and NYSDOT to improve regional mobility where possible. A priority project will be to construct a shared use path on the Harlem River Lift Span, making the Manhattan to Randall's Island connection a fully ADA compliant shared use path from end to end. We are assessing options for improving the Bronx to Robert F. Kennedy Bridge Interchange to address traffic safety, while also improving regional mobility and bicycle/pedestrian accessibility. The remaining investments over the 20-year planning horizon include cyclical structural repair projects, bridge deck overlays, and painting projects all aimed at maintaining the Robert F. Kennedy Bridge in good condition.

Robert F. Kennedy Bridge Facility 2022

Major asset categories include roadways and decks, structures, utilities, and buildings. A significant portion of the assets under the utilities and buildings categories, which still require upgrade or replacement, are being addressed under projects currently ongoing in the 2020-2024 program.



■ Good condition ■ Needs update/replacement

Based upon 2022 assessment



Throgs Neck Bridge

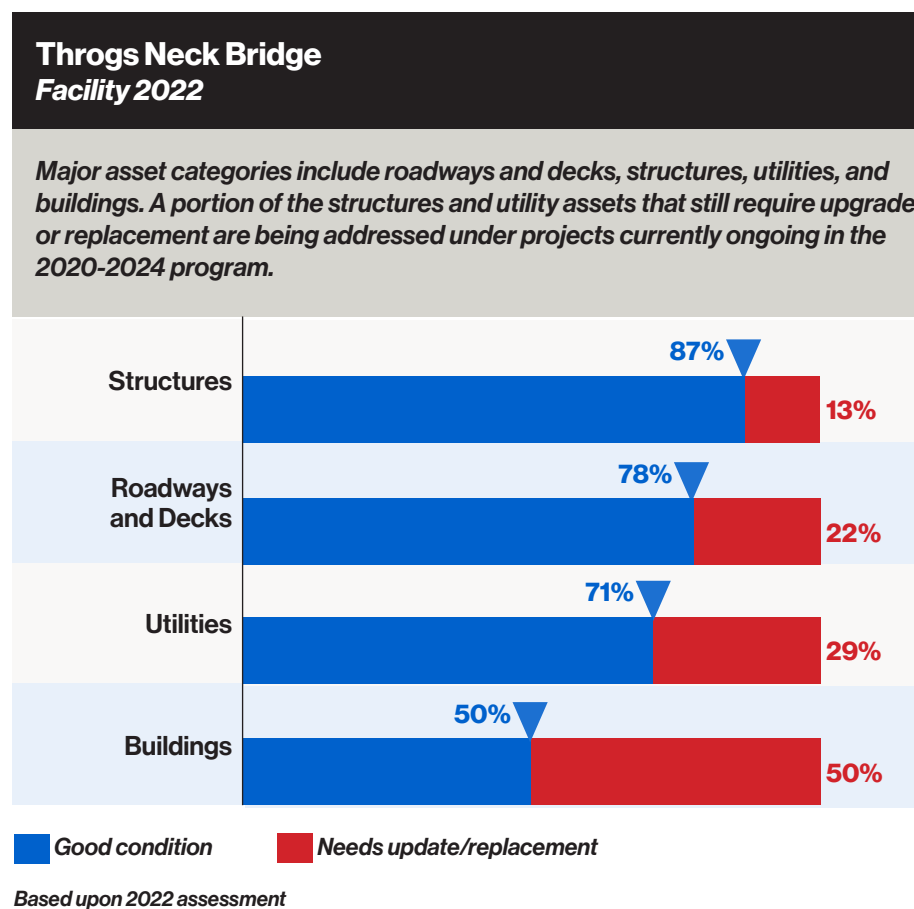
Bridge facility

The Throgs Neck Bridge crosses the East River, connecting the boroughs of Queens and the Bronx via Interstate 295. This bridge is situated in deep water, with one anchorage and both towers constructed on foundations within the river and exceptionally long approach spans. The bridge carries three lanes in each direction as part of Interstate 295, and it has the highest percentage of truck traffic of all B&T facilities. Currently, due to the fact that the structure supporting the right-hand lane on the original approach viaducts cannot carry the heavy truck loads so common today, trucks are restricted to the middle lane while crossing the bridge. In 2022, the Throgs Neck Bridge carried over 39.6 million vehicles.

Master planning of Throgs Neck Bridge projects are carried out in careful coordination with planning at the Bronx-Whitestone Bridge, as these two bridges serve a common transportation corridor. Several studies of the Throgs Neck Bridge corridor and Bronx-Whitestone Bridge performed during previous capital programs have evaluated various means of reducing traffic congestion and improving safety, interoperability, and resiliency of both bridges. The recommended strategy that is most feasible is to plan for the possible future reconfiguration of the Throgs Neck Bridge to a seven-lane bridge similar to the reconfiguration of the Verrazano-Narrows Bridge upper level. The need for the seventh lane could be triggered by traffic growth and/or the need to add additional capacity for an HOV lane. Adding a seventh lane across the bridge requires the replacement of the very long approach structures. Consequently, Throgs Neck Bridge capital investments over the past several programs and those included in the proposed 20-Year Needs Assessment have been aligned so as to allow for the potential implementation of a seventh lane as part of a future replacement of the approach structures.

Current status

Previous investments have focused on rehabilitation of the bridge's superstructure (e.g. roadway decks and supporting steel structures) and primary structural elements. The heavy concrete deck on the suspended spans was replaced with a lighter steel deck which reduced the dead load on the main cables. In addition, the lower half of the Queens Approach has been rehabilitated with a new deck along with substructure strengthening and seismic retrofits. Both the suspended spans and the rehabilitated portion of the Queens Approach are designed to accommodate a future seventh lane on the Throgs Neck Bridge. Extensive steel repairs and drainage improvements, as well as seismic retrofits to the superstructure, have been carried out on the Queens and Bronx Approach structures. In conjunction with these major structural improvements, we have replaced the roadway lighting as well as electrical and communication conduits and wiring on the bridge structure. In addition, resiliency and security needs have been



addressed with fire standpipe systems installed on the structures, expansion and upgrades of the electronic security systems, and the installation of protection on the main cables and suspender ropes. As part of a major investment in the current capital program, we will replace the fenders that protect the bridge towers, paint the towers, and rehabilitate the tower elevators.

Investment needs

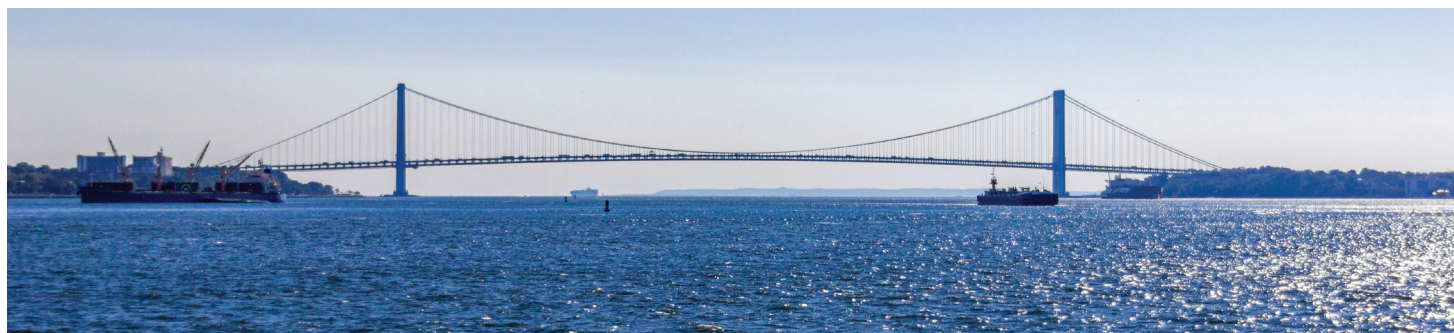
By the end of this 20-year planning horizon, the Throgs Neck Bridge will be over 80 years old. Our investment strategy over the next 20 years focuses on maintaining the structures and associated buildings in good condition, continuing to replace original components as needed, improving resiliency, and preserving the main cables. Our top priorities in the next capital program are the dehumidification of the main cables along with installation of a safety fence on the bridge, power redundancy and resiliency upgrades for all substations servicing the facility, and repairs to the concrete piers supporting the approach structures. Major investments in following programs include reconstruction of the on-bound Cross Island Parkway ramp to improve access to the Throgs Neck Bridge and address flooding issues where the ramp connects with the Cross Island Parkway, as well as replacement of the suspender ropes which will be over 80 years old.

In addition, we will begin design for the full replacement of the approaches to not only allow trucks to return to the right lane but also to allow for the potential creation of a seventh lane end-to-end on the bridge. We are also evaluating the possibility of improving interoperability between the Throgs Neck Bridge and the Bronx-Whitestone Bridge by eliminating the constraints that limit traffic flow between the two bridges, which would in turn, allow better use of the two crossings by bus/HOV traffic while also improving regional transportation resiliency. The remaining investments over the 20-year planning horizon include cyclical structural repair projects, periodic rehabilitation of the bridge anchorages, bridge deck overlays, and painting projects all aimed at maintaining the Throgs Neck Bridge in good condition.

Verrazzano-Narrows Bridge

Bridge facility

Opened to traffic in 1964, the Verrazzano-Narrows Bridge, connecting Brooklyn and Staten Island, is the newest of B&T's suspension bridges. It is a double decked suspension bridge and the longest suspended span in North America. It is also the only link connecting Brooklyn with Staten Island across New York Bay. The Verrazzano-Narrows Bridge serves as a critical transit link in the region between Brooklyn, Manhattan, and Staten Island, with 970 express buses and 677 local buses carrying 36,000 passengers across the bridge each weekday. It carried over 78.2 million vehicles in 2022 and is also a major truck route.



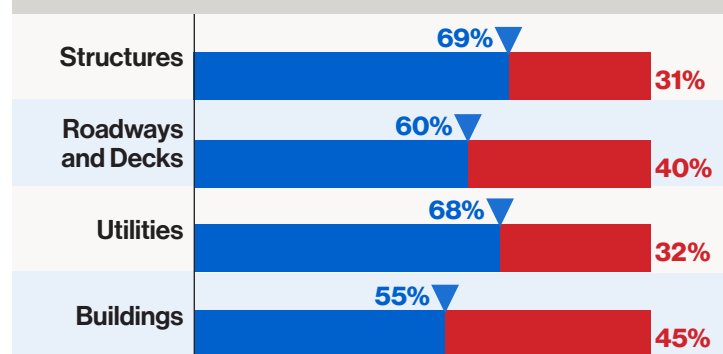
Current status

Given the Verrazzano-Narrows Bridge's status as a critical link in the regional transportation corridor, a significant portion of our investments have been carefully coordinated with NYSDOT's investments on the Staten Island and Gowanus Expressways with the ultimate goal of providing continuous bus/HOV service across the Verrazzano-Narrows Bridge. A series of major investments were implemented over several past programs which included the reconfiguration of the eastbound toll plaza to facilitate bus/HOV access, and the replacement and reconfiguration of the upper-level suspended span deck to meet current loads, improve wind resilience, and provide a reversible bus/HOV peak-travel lane. on the upper level of the suspended spans. These improvements, along with the construction of a new bus/HOV ramp on the Brooklyn Approach and the reconstruction of the Gowanus Expressway connection, resulted in continuous bus/HOV access from Staten Island to Manhattan servicing the express bus network in this transportation corridor. Combined with the conversion of the tolling system to ORT, these projects have transformed regional mobility options and reduced travel time by up to 15-20 minutes between Staten Island and Manhattan for thousands of daily commuters and express bus riders.

In addition, we have been improving Verrazzano-Narrows Bridge traffic flow and safety by constructing improvements to the connecting highways on either end of the bridge to facilitate traffic exiting the bridge. Under a major investment

Verrazzano-Narrows Bridge Facility 2022

Major asset categories include roadways and decks, structures, utilities, and buildings. A portion of the structures and utility assets that still require upgrade or replacement are being addressed under projects currently ongoing in the 2020-2024 program.



■ Good condition ■ Needs update/replacement

Based upon 2022 assessment

in the current capital program, we are reconstructing and reconfiguring the Brooklyn approaches to eliminate substandard left-hand exits to the Belt Parkway.

Not only do these projects improve traffic safety and flow, they also facilitate the eventual replacement of the lower-



level suspended span deck in a future program. In conjunction with these major structural improvements, the majority of the Verrazzano-Narrows Bridge electrical and communication systems have been replaced.

We have also addressed safety, resiliency, and security needs with the installation of safety fences on the suspended spans, replacement of substations and improvement of electrical power backup, installation of electronic security systems, and the installation of protection on the main cables and suspender ropes. A high priority project in the current program is the dehumidification of the main cables to preserve these critical assets.

Investment needs

By the end of this 20-year planning horizon, the Verrazzano-Narrows Bridge will be over 80 years old. Our investment strategy over the next 20 years focuses on continued rehabilitation or replacement of the remaining original portions of the bridge complex, while also addressing the supporting assets such as utilities and buildings.

Our highest priority in the next 20 years is the replacement of the lower-level suspended span deck, along with the fire standpipe system and the under-deck travelers that provide access for maintenance and inspection of the suspended spans. In addition, the suspender ropes will be almost 80 years old and will be replaced, and, if deemed feasible, a bicycle/pedestrian path may be added on the bridge. Other priorities include expanding the electronic security system at the Verrazzano-Narrows Bridge facility and addressing building and site space needs to accommodate operational changes. The remaining investments over the 20-year planning horizon include cyclical structural repair projects, cyclical rehabilitation of bridge roadways, cyclical substation upgrades, bridge deck overlays, and painting projects all aimed at maintaining the Verrazzano-Narrows Bridge in good condition.





Henry Hudson Bridge

Bridge facility

The Henry Hudson Bridge is a double-deck steel arch bridge that crosses the Hudson River and connects the northern tip of Manhattan with the Bronx and points north. The lower level carries Manhattan bound traffic, and the upper level carries traffic from Manhattan to the Bronx. There is an existing pedestrian walkway on the lower level of the bridge. Almost 24.9 million vehicles crossed the Henry Hudson Bridge in 2022. In addition to its main structure, two smaller bridges (the Dyckman Street Bridge and the Staff Street Bridge) and the Henry Hudson Parkway south of the bridge are part of the Henry Hudson Bridge facility and are operated and maintained by B&T.

Current status

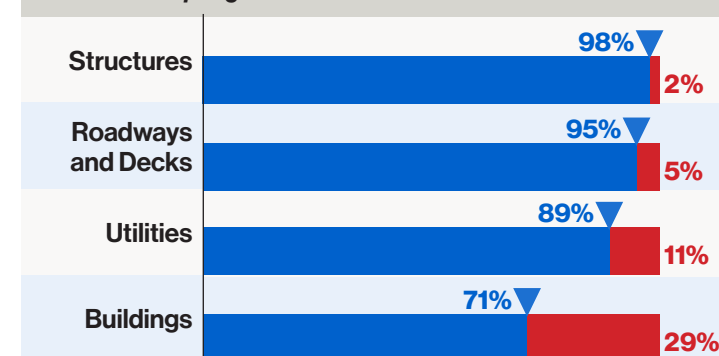
We have replaced all of the original 1930s-era roadway decks on both levels of the Henry Hudson Bridge, painted and rehabilitated the entire steel supporting structure, and upgraded the majority of the substructure to meet current seismic criteria. In conjunction with these major structural improvements, we have replaced the electrical and communication systems on the bridge and eliminated original supporting columns that obstructed driver sight lines on the lower level and impeded traffic flow on the bridge's lower level, greatly improving traffic flow and safety. Significant improvements in the bridge's structural redundancy and longevity have been implemented in a recent major retrofit of the bridge's substructures. Under an ongoing project in the current capital program, we are addressing resiliency needs with replacement of substations and improved electrical power backup. We are also improving bicycle and pedestrian accessibility by enhancing the existing 1930s-era lower-level walkway on the bridge and constructing new connecting ramps on either side of the bridge to provide a shared use path between Manhattan and the Bronx. With the completion of these investments, the Henry Hudson Bridge should continue to serve the traveling public for many years with regular maintenance and consistent levels of capital investments going forward.

Investment needs

Our primary investment strategy at the Henry Hudson Bridge over the next 20-year timeframe is to continue to maintain the facility in good condition. A top priority in the next capital program is to construct a backup operations control center for B&T to create operational redundancy. Other investments include performing traditional structural and concrete repairs and cyclical deck rehabilitation projects to extend the service life of the decks, as well as upgrading the drainage system on the bridge to facilitate maintenance and minimize future impacts of corrosion to the steel supporting structure. Drainage system improvements will also be made on the Henry Hudson Parkway, and the parkway pavement will be rehabilitated toward the end of the 20-year period. In addition, upgrades will be made as necessary on the Dyckman Street and Staff Street structures to ensure they remain in good condition.

Henry Hudson Bridge Facility 2022

Major asset categories include roadways and decks, structures, utilities, and buildings. A significant portion of utility assets that still require upgrade or replacement are being addressed under projects currently ongoing in the 2020-2024 program.



■ Good condition ■ Needs update/replacement

Based upon 2022 assessment



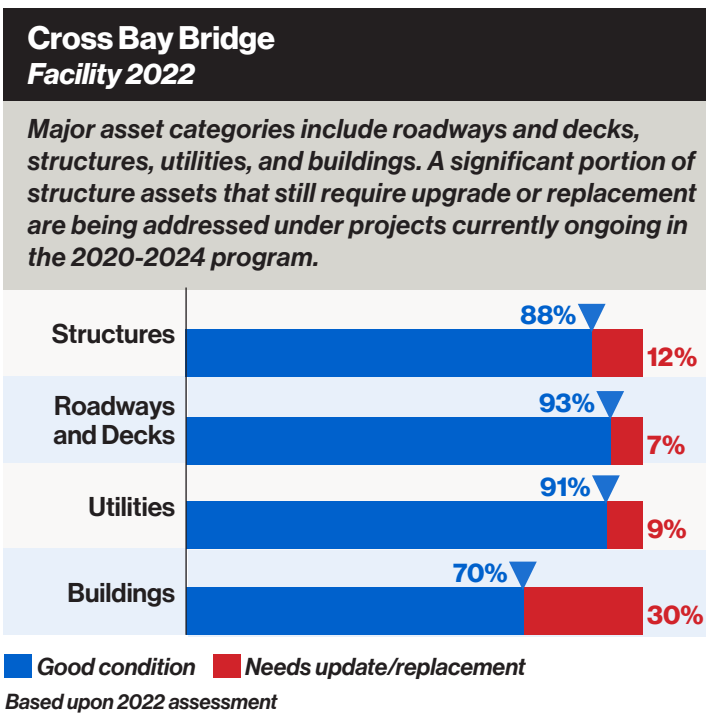
Cross Bay Bridge

Bridge facility

The Cross Bay Bridge (Cross Bay Veterans Memorial Bridge) spans Beach Channel in Jamaica Bay, providing vehicular access from Queens to the Rockaways and area beaches. It was completely reconstructed in 1970 as a high-level fixed bridge with a wide main channel for marine passage. The city of New York's Department of Emergency Management has designated the entire Rockaway Peninsula as Evacuation Zone 1, which contains the first areas to be evacuated in advance of an approaching coastal storm. The Cross Bay Bridge is therefore a crucial lifeline to the Rockaways. Almost 7.9 million vehicles crossed the bridge in 2022.

Current status

We have focused our Cross Bay Bridge investments primarily on structural rehabilitation work including structural rehabilitation of the ramps, rehabilitation of the concrete substructure, and a major rehabilitation of the superstructure/roadway and drainage system. We have also replaced the fender system that protects the navigation span piers from marine vessel impacts and addressed erosion issues at the span piers. After Superstorm Sandy, we replaced all damaged substations and electrical components and studied whether the Cross Bay Bridge and nearby Marine Parkway Bridge should be replaced due to structural conditions and flooding risks. This study recommended replacement of the Cross Bay Bridge due to the condition of critical components on the navigation spans however, we are implementing an innovative rehabilitation of the bridge's navigational span to extend the bridge's life and defer the need for replacement. In addition, we are replacing the existing pedestrian ramp to create an ADA-compliant shared use path across the bridge, which will significantly improve bicycle and pedestrian accessibility.



Rendering of new bicycle/pedestrian Ramp at the Cross Bay Bridge

Investment needs

Our primary investment strategy at the Cross Bay Bridge over the next 20-year timeframe is to continue to maintain the facility in good condition, performing traditional concrete repairs deferring the need for bridge replacement. In addition, we will address the need for an electronic security system to facilitate operations and address building and space needs to accommodate operational changes.



Marine Parkway Bridge

Bridge facility

The Marine Parkway Bridge (Gil Hodges Memorial Bridge) is a vertical lift bridge with two secondary structures, the Rockaway Point Boulevard Overpass and the Jacob Riis Park Pedestrian Bridge. The close proximity of Jamaica Bay affects the bridge due to the low clearance of its approach spans over the bay's corrosive salt water, resulting in accelerated deterioration of its coatings and as well as corrosion of the bridge steel. The entire Rockaway Peninsula lies within Evacuation Zone 1, which contains the first areas to be evacuated in advance of an approaching coastal storm. Therefore, like the Cross Bay Bridge, the Marine Parkway Bridge is a crucial lifeline during any storm evacuation. Almost 7.9 million vehicles crossed the bridge in 2022.

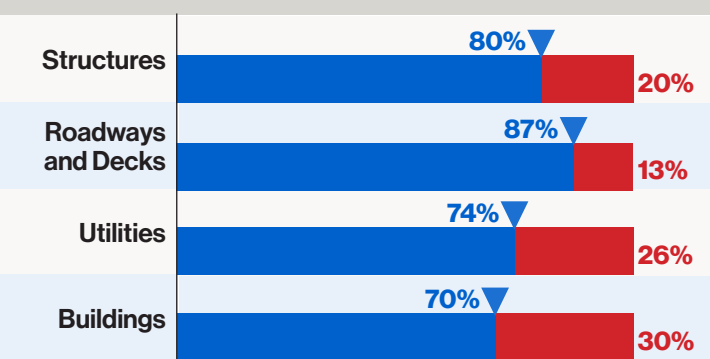


Current status

In earlier capital programs, we addressed the original functional deficiencies of the Marine Parkway Bridge, which included narrow lanes and no center median. The deck was replaced and widened to provide two 12-foot lanes in each direction with a new continuous center median and a cantilevered sidewalk for dedicated pedestrian use on the span's west side. This project also included new lighting and drainage and addressed structural steel repairs. We also have performed extensive steel repairs over several programs, along with an aggressive painting program to protect the steel supporting both the approach spans and the lift bridge. Most recently, we have rehabilitated the lift span electrical and mechanical systems, installed a fire standpipe system on the bridge, replaced the fender system that protects the lift span towers from marine vessel impacts, and addressed erosion issues around bridge abutments and piers. In addition, we rehabilitated the two overpasses in the Rockaways. After Superstorm Sandy, we replaced all damaged substations and electrical components and studied whether the Cross Bay Bridge and Marine Parkway Bridge should be replaced due to structural conditions and flooding risks. This study recommended planning for future replacement of the Marine Parkway Bridge based on its age and load capacity of certain bridge members, however, we recently completed significant painting and steel repairs, and have been able to defer replacement of the bridge.

Marine Parkway Bridge Facility 2022

Major asset categories include roadways and decks, structures, utilities, and buildings. A significant portion of utility assets that still require upgrade or replacement are being addressed under an elevator replacement project currently ongoing in the 2020-2024 program.



■ Good condition ■ Needs update/replacement

Based upon 2022 assessment

Investment needs

Our primary investment strategy over the next 20-year timeframe is to continue to maintain the Marine Parkway Bridge in good condition, performing traditional steel repairs and painting and



deferring the need for bridge replacement. In addition, during the early part of the 20-year period, we will address the need for an electronic security system to facilitate operations and address building space needs to accommodate operational changes.

We will continue cyclical rehabilitation of the electrical and mechanical components of the lift span as necessary. One of the more significant investments in the 20-year timeframe is the replacement of the existing open-grid steel deck on the lift span, which if feasible, may also include bicycle and pedestrian accessibility improvements. A prototype installation of the proposed open grid steel deck replacement will be installed as part of an ongoing capital project at the Marine Parkway Bridge and Cross Bay Bridge. The results of this prototype will inform future strategies for deck replacement on the Marine Parkway Bridge.



TUNNELS

Key program highlights

Bridges

- Bronx-Whitestone Bridge
- Robert F. Kennedy Bridge
- Throgs Neck Bridge
- Verrazzano-Narrows Bridge
- Henry Hudson Bridge
- Cross Bay Bridge
- Marine Parkway Bridge

→ Tunnels

- Hugh L. Carey Tunnel
- Queens Midtown Tunnel

Agencywide Projects and Central Business District Tolling Program



Hugh L. Carey Tunnel

Tunnel facility

The Hugh L. Carey Tunnel (formerly the Brooklyn-Battery Tunnel), the longest underwater vehicular tunnel in North America, is a twin-tube four-lane vehicular tunnel connecting lower Manhattan and Brooklyn. The facility includes two ventilation buildings in lower Manhattan, a third near the Brooklyn portal, and a fourth at Governor's Island, along with the Morris Street pedestrian bridge, and Governor's Island Foot Bridge. The adjacent Battery Parking Garage in Manhattan (the largest self-park garage in Manhattan) is also part of the tunnel facility assets. A critical public transit, private, and commercial vehicle link between Manhattan and Brooklyn, the Hugh L. Carey Tunnel is the terminus of the Gowanus Expressway bus/HOV lane that carries 1,370 express buses with 28,000 riders per weekday from Staten Island and South Brooklyn. During major emergencies, the tunnel also serves as an emergency entry and exit route from lower Manhattan. Almost 21.9 million vehicles traveled through the tunnel in 2022.

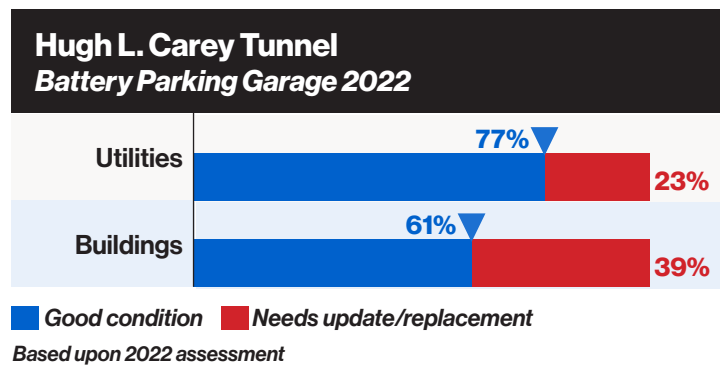
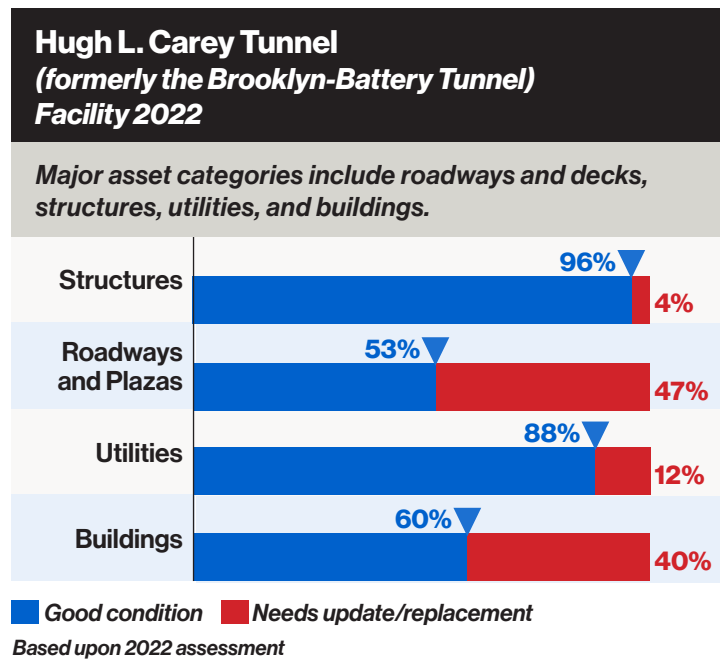
Current status

In 1989, B&T embarked on its first ever comprehensive tunnel inspection, which informed the initial capital tunnel projects under which we replaced the exhaust fans, updated and expanded the power distribution systems, and consolidated the tunnel control systems. We also replaced a portion of the tunnel slab ceiling, ceiling tiles, and traffic signals, as well as rehabilitated the roadway slab. In 2012, Superstorm Sandy caused severe damage to the Hugh L. Carey Tunnel and many of its elements that were replaced in earlier programs, requiring a major reconstruction of the tunnel. Work included complete replacement of wall tiles, tunnel ceiling veneer panels, the fire standpipe system to meet National Fire Protection Agency (NFPA) criteria, as well as all systems in the tunnels such as lighting, wayfinding, and electrical. In addition, the drainage pumps were completely replaced. As a result, the majority of the components within the tunnel itself are essentially new, as are the tunnel systems. The Brooklyn Plaza was also rehabilitated and realigned, and flood doors were installed at each plaza to mitigate the possibility of future flooding.

Once the restoration of the tunnel was complete, we focused on upgrades to the life safety systems, including the ventilation system, control center, electrical upgrades at the service building, installation of smoke and fire detection systems at the various tunnel buildings, and installation of a prototype fire-suppression system in a section of the tunnel. Under the current program, the electronic security system is being upgraded and expanded to facilitate tunnel operations.

Investment needs

Our primary investment strategy at the Hugh L. Carey Tunnel over the next 20-year timeframe is to maintain the facility in good condition while continuing to improve life safety systems and upgrade the critical ventilation buildings to meet current seismic criteria. Our top priority in the next capital program is the completion of the fire suppression system installation within the tunnel along with any necessary in-tunnel structural repairs. In addition, we will begin a phased seismic retrofit of the ventilation



buildings as well as any necessary structural repairs to the buildings, while also continuing to improve electrical resiliency for critical life safety assets and other upgrades to the ventilation system.

We will also make repairs to the Battery Parking Garage. Pedestrian safety and traffic flow continue to be major issues at the West Street Approaches to the tunnel's Manhattan Plaza. B&T will assess various pedestrian enhancements to improve pedestrian safety and traffic throughput. The remaining investments over the 20-year planning horizon include cyclical tunnel repairs to address leaks and rehabilitate tunnel walls, ceiling and air ducts, periodic upgrades to tunnel controls, and rehabilitation of the former plaza areas, all aimed at maintaining the tunnel in good condition.



Queens Midtown Tunnel

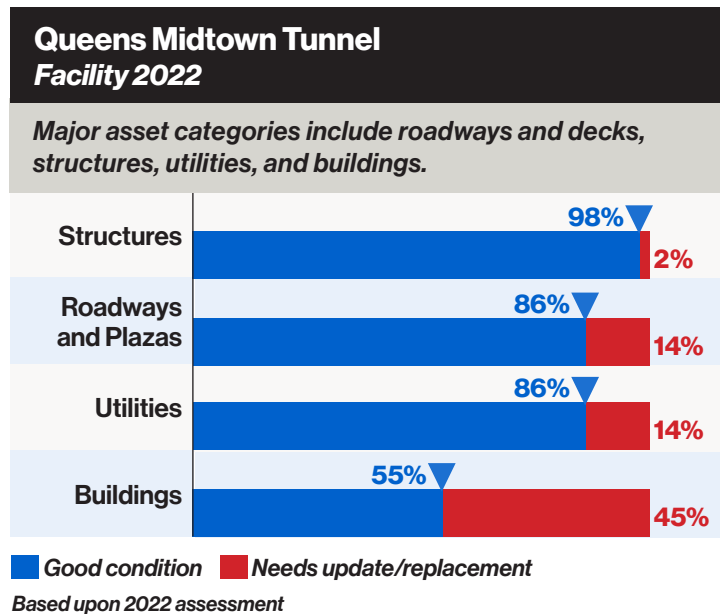
Tunnel facility

Opened to traffic in 1940, the Queens Midtown Tunnel is a twin tube four-lane vehicular tunnel that connects the Long Island Expressway and Midtown Manhattan. Related structures include two ventilation buildings, one in Queens and one in Manhattan. The Queens Midtown Tunnel facility also includes three roadway Manhattan overpasses in Manhattan at 2nd Avenue, 36th Street, and 37th Street entry, along with four approach and exit streets, three entrance and exit plazas, various parking lots, and the Borden Avenue property adjacent to the service building in Queens. The tunnel is a critical transportation link in the region, serving Queens and Long Island. Out of the average of 84,000 daily vehicles, 480 express buses serve approximately 9,600 passengers from Queens each weekday. During major incidents and emergencies, the tunnel serves as an entry and exit route for Midtown Manhattan. It is also an essential link in the interstate highway network, connecting Interstate 495 to the rest of the country via Midtown Manhattan and the Lincoln Tunnel. Over 29.8 million vehicles traveled through the Queens Midtown Tunnel in 2022.

Current status

Major capital investments in the wake of the first comprehensive tunnel inspection in the 1990s included travel roadway slab rehabilitation; replacement of the traffic control wiring; replacement of the ceiling slab, original ceiling tiles, and lighting; and rehabilitation of the ventilation and pump rooms. We modernized the facility power distribution systems, replaced the exhaust fans, and partially rehabilitated the roadway slab. In addition, we completely rehabilitated the roadway drainage system, including the replacement of all pumps and associated power and controls. We also replaced the 37th Street overpass that provides a connection from 37th Street to the south tube, rehabilitated the 36th Street and 2nd Avenue overpasses, and performed work on several buildings to improve functionality for maintenance and operations.

Superstorm Sandy in 2012 caused severe damage, requiring a major reconstruction of the tunnel. Work included complete replacement of wall tiles, ceiling veneer panels, the fire standpipe system to meet NFPA criteria, as well as all systems in the tunnel such as lighting, wayfinding, and electrical. As a result, the majority of the components within the tunnel are essentially new, as are the tunnel systems. The Queens Plaza was also rehabilitated, and flood doors were installed at each plaza to mitigate the possibility of future flooding. Once the restoration of the tunnel was complete, we focused on upgrades to the life safety systems including the ventilation system, controls center, electrical upgrades at the service building, and installation of smoke and fire detection systems in various tunnel buildings. Under the current program the electronic security system is being upgraded and expanded to facilitate tunnel operations. We are also making improvements to the service building, including relocating the fueling station to outside of the building and electrical equipment to above flood levels.



Investment needs

Our primary investment strategy at the Queens Midtown Tunnel over the next 20-year timeframe is to maintain the facility in good condition while continuing to improve life safety systems and upgrade the critical ventilation buildings to meet current seismic criteria. Our top priority in the next capital program is the installation of the fire suppression system within the tunnel. In addition, we will begin a phased seismic retrofit of the ventilation buildings as well as any necessary structural repairs to the buildings, while also continuing to improve electrical resiliency for critical life safety assets and other upgrades to the ventilation system. Within the tunnel tubes, we will rehabilitate the roadway slab along with the Manhattan tunnel entrance plaza and Queens Plaza. We will also replace the mainly original exhaust ports. The remaining investments over the 20-year planning horizon include cyclical tunnel repairs to address leaks and rehabilitate tunnel walls, ceiling and air ducts, periodic upgrades to tunnel controls, and rehabilitation of the former plaza areas and roadway overpasses, all aimed at maintaining the tunnel in good condition.

AGENCYWIDE PROJECTS AND CENTRAL BUSINESS DISTRICT TOLLING PROGRAM

Key program highlights

Bridges

- Bronx-Whitestone Bridge
- Robert F. Kennedy Bridge
- Throgs Neck Bridge
- Verrazzano-Narrows Bridge
- Henry Hudson Bridge
- Cross Bay Bridge
- Marine Parkway Bridge

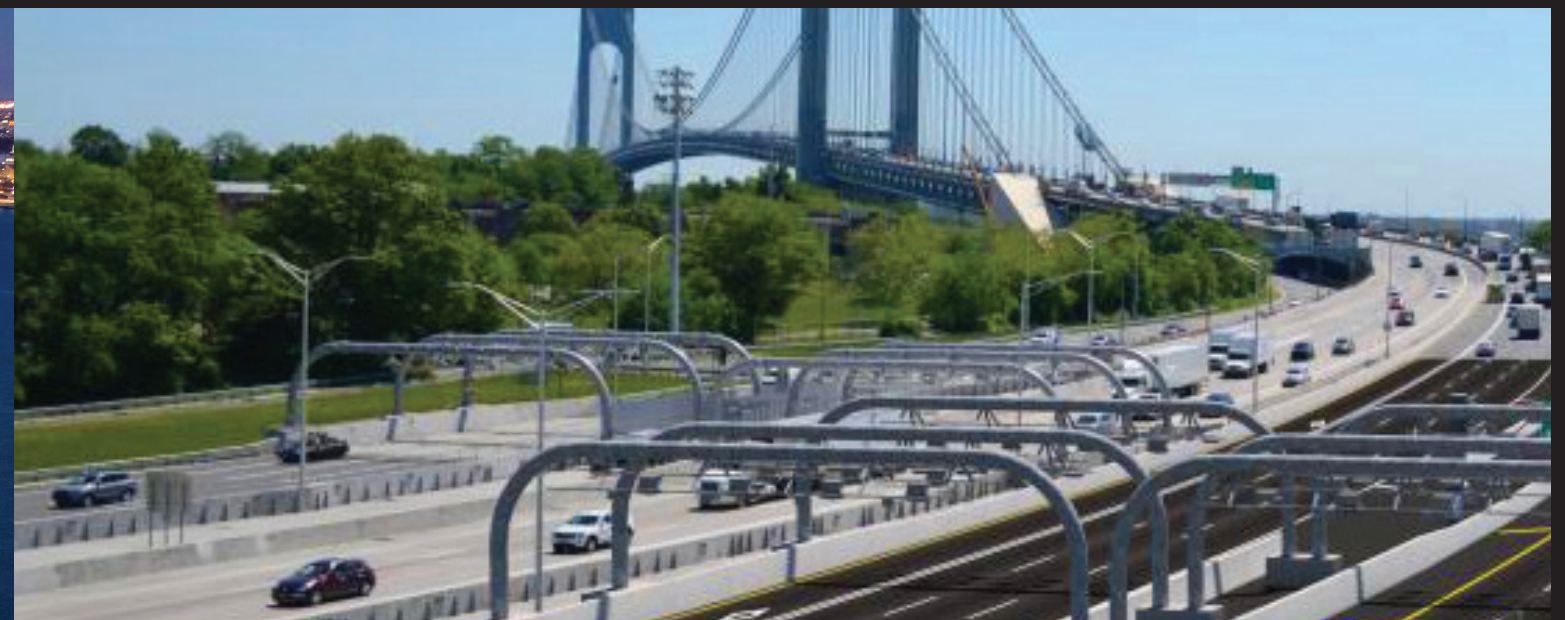
Tunnels

- Hugh L. Carey Tunnel
- Queens Midtown Tunnel

→ Agencywide Projects and Central Business District Tolling Program



A-342



A-343

Agencywide projects

Our needs over the next 20 years include programmatic investments at multiple facilities such as tolling projects, intelligent transportation systems (ITS), security systems, and sustainability as well as efforts for the support and administration of the capital programs.



Verrazzano-Narrows Bridge and Belt Parkway

Current status

B&T has been at the forefront of ITS technology implementation since the introduction of E-ZPass in 1997. In 2017, we completely modernized B&T toll collection with the conversion of all conventional tolling facilities to ORT. In addition to advances in tolling, we are keeping pace with the changing technical advances in vehicular travel. In 2018, we opened the B&T Operations Command and Communications Center (OCCC) facility on Randall's Island, a state-of-the-art command center that allows for improved traffic management at all nine B&T facilities and provides critical transportation services to customers, including travel time advisories and safety alerts. The OCCC has dedicated links to other regional transportation agencies that enable the agency's regional partners to effectively coordinate their transportation incident management activities with B&T.

Agencywide ITS systems implemented in the recent past include Closed Circuit Television (CCTV) traffic cameras; variable message signs, which disseminate real-time traffic conditions to motorists; travel time information systems such as TRANSMIT, which allow us to provide live travel time estimates; vehicle traffic detectors, which can measure speed, volume, occupancy, and vehicle classification, allowing for quicker detection and clearance of incidents; over-height vehicle detection systems; and roadway weather systems, which can plan for resource allocation for weather events, particularly in the winter months. Another important investment in this category has been the installation of weigh-in-motion (WIM) systems at each facility. By the end of the current capital program, all bridge facilities carrying truck traffic will have enforcement ready WIM systems in place.

On the security front, we upgraded and expanded the electronic security systems (ESS) at the Throgs Neck Bridge, Bronx-Whitestone Bridge, and Robert F. Kennedy Bridge, and we are currently upgrading and expanding the ESS at the tunnels. We have made strides toward improving the energy footprint of B&T facilities by replacing approximately 95% of the facility lighting with more energy-efficient LEDs and installing energy-efficient HVAC systems at the tunnel service buildings as well as the Bronx-Whitestone Bridge service building. We are partnering with NYPA to perform energy audits on B&T-owned buildings to identify further potential energy savings, to evaluate B&T-owned properties for installation of solar power generation, and to develop a plan for transitioning to the use of zero emission vehicles.



Zoom in of tower cameras.



Cashless tolling and Gateway Towers at the Robert F. Kennedy Bridge

Investment needs

Our primary investment strategy for agencywide projects over the next 20-year timeframe includes the renewal of our ITS systems, periodic renewals of the ITS toll collection technologies at our ORT tolling locations, installing any necessary infrastructure to support the transition to zero-emission vehicles, and implementing sustainability initiatives including solar power generation and replacement of inefficient building systems. We will also expand the security systems at the Verrazzano-Narrows Bridge, as well as plan for security system improvements at the Henry Hudson Bridge, Cross Bay Bridge, and Marine Parkway Bridge. Finally, future programs will need to upgrade WIM systems as necessary to meet the most current performance criteria and allow for coordinated enforcement action against overweight trucks on B&T crossings.

Central Business District Tolling Program

Major investments in the upcoming programs include a series of periodic renewals of its toll collection technologies for the CBDTP system so as to ensure the safe and reliable collection of revenue in the future.