

Increasing Stormwater Resilience in the Face of Climate Change: Our Long Term Vision



**Environmental
Protection**

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The background of the page is a photograph of an urban park area. On the left, a multi-story brick building with several windows is visible. To the right of the building is a dense line of green trees and bushes. In the foreground, there is a concrete sidewalk and a large, vibrant bush of purple flowers with some red roses interspersed. The overall scene is bright and green, suggesting a park setting.

Our Vision

Hurricane Henri arrived in New York on August 21, 2021 and set a record for the most intense rain event in the city's history at 1.94" inches in one hour. Previously, the most intense rainstorm — in 2004 — had dropped 1.76" in a single hour, and the record prior to that had been 1.58" in an hour in 1967. Only a few days after Henri, Ida shattered Henri's record, with 3.15" of rain falling in Central Park in an hour. Ida's rainfall was most intense—up to 3.75" per hour—in several parts of the city.

These two storms in quick succession are the latest evidence that the climate is changing and bringing more frequent, intense storms to New York City that our current stormwater infrastructure was never intended to manage. While sewers are the backbone of urban drainage systems – and we will be implementing programs to expand sewer capacity and improve the performance of our 7,000 miles of sewers – we will simultaneously spur the installation of a citywide network of blue and green infrastructure to intercept stormwater before it reaches the sewer system. Over time, these two strategies will work in concert to limit dangerous flooding during extreme weather events.



Climate change is bringing more intense storms to New York City. We will make the City resilient to these storms through an approach that combines traditional sewers and green infrastructure.

Interim Measures

The reality is it will take time before our infrastructure will be able to manage the intensity of storms we face today. As a result, we need to embrace interim measures that are far from perfect but will prevent deaths and reduce losses while we undertake the long term work. We also must better understand and predict where flooding will take place.

Rainfall Ready NYC

Earlier this year, the City released Rainfall Ready NYC — an action plan that outlines short-term steps New Yorkers and city government can take to combat extreme weather together. Some of the actions outlined in that plan include:

- Improving communication to New Yorkers before, during, and after a storm.
- Inspecting chronic flooding locations and clearing debris from catch basins in at-risk locations prior to predicted storms. New Yorkers are encouraged to clear litter and debris from the curb line and nearby catch basins and deploy barriers to protect low-lying areas.
- Offering free sandbags and flood barriers to more than 20,000 residents in at-risk neighborhoods.

The city has engaged Los Deliveristas Unidos/Workers Justice Project, Uber Eats, GrubHub, and DoorDash in a working group to create new strategies for ensuring extreme weather messaging reaches delivery workers and developing protocols to ensure that delivery workers are kept safe during extreme weather.

What has been done?

- Released Rainfall Ready NYC

What is happening right now?

- Deployable flood barrier distribution
- Backwater valve study
- Developing protocols to protect delivery workers during extreme weather

What is our vision?

- Deploy a backwater valve program in targeted neighborhoods



In addition, the City, funded by the Federal Emergency Management Agency, will soon launch a backwater valve study. These valves help to prevent wastewater from the sewer from backing up into homes during intense storms. The study will also identify neighborhoods that will benefit from a backwater valve and to strategically deploy backwater valves to protect residents and reduce damages caused by sewer backups during extreme events.

Monitoring and Awareness

Earlier this year, the Department of Environmental Protection (DEP) released a new set of maps of where we expect stormwater flooding to be most likely. These new interactive stormwater flood maps help New Yorkers better understand the likelihood of flooding on an individual block or neighborhood.

In addition, the Mayor's Office of Climate and Environmental Justice launched FloodNet, a new network of flood sensors that will provide real-time information about where streets are flooded. As this network is built out to a total of 500 sensors around the City by 2027 it will also yield valuable data that will allow us to refine our understanding and be able to predict flooding with greater accuracy.

What has been done?

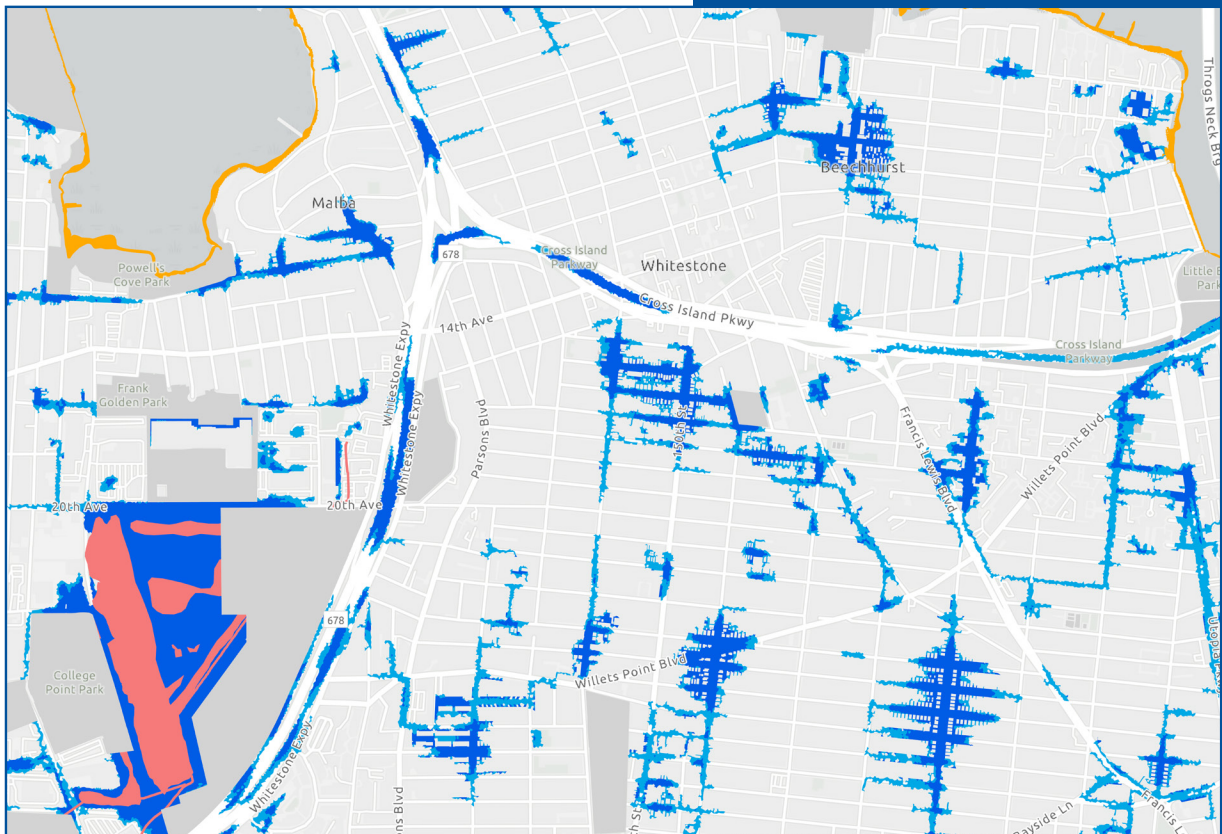
- Published new current day stormwater flood maps

What is happening right now?

- Launching Floodnet Sensor Pilot
- Expanded reach of FloodHelpNY to raise awareness of flood insurance options.

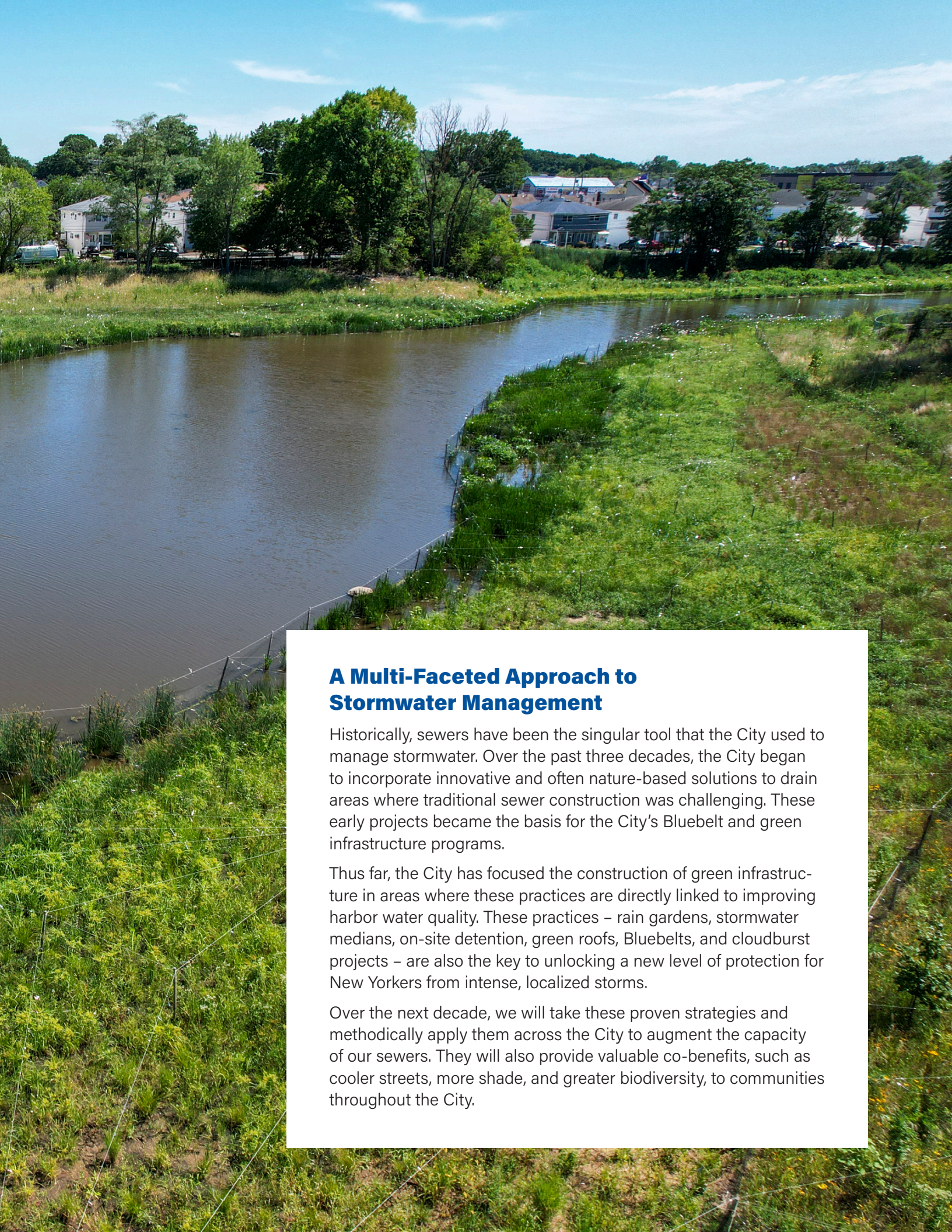
What is our vision?

- Floodnet sensor system citywide (500 sensors in the next 5 years)
- Updated maps available to New Yorkers based on latest information available
- Broad awareness of resiliency options and resources, like flood insurance, that can protect New Yorkers and reduce damages



New stormwater flood maps show, which identify where we expect stormwater flooding to be most likely, can be accessed at nyc.gov/stormwater-map





A Multi-Faceted Approach to Stormwater Management

Historically, sewers have been the singular tool that the City used to manage stormwater. Over the past three decades, the City began to incorporate innovative and often nature-based solutions to drain areas where traditional sewer construction was challenging. These early projects became the basis for the City's Bluebelt and green infrastructure programs.

Thus far, the City has focused the construction of green infrastructure in areas where these practices are directly linked to improving harbor water quality. These practices – rain gardens, stormwater medians, on-site detention, green roofs, Bluebelts, and cloudburst projects – are also the key to unlocking a new level of protection for New Yorkers from intense, localized storms.

Over the next decade, we will take these proven strategies and methodically apply them across the City to augment the capacity of our sewers. They will also provide valuable co-benefits, such as cooler streets, more shade, and greater biodiversity, to communities throughout the City.

Sewers

New York City's 7,000 miles of sewers are not designed to handle the quantity of rain brought by the extreme storms we began to see in 2021.

Before 1977, sewer standards were set by borough presidents, and different boroughs had different standards for sewers, leaving some parts of the City less protected than others. For example, most sewers in Queens are only built to handle 1.5" of rain per hour. Today's standard for sewer construction is ~1.75" of rain per hour, although the City is evaluating that standard given the realities of climate change.

In addition, some parts of the City, including much of South-east Queens and parts of Staten Island, do not have a fully built sewer system. We must continue to invest in those unserved areas. Over the long-term, we also need to upgrade all sewers to today's standard of ~1.75" of rain per hour.

While a full system upgrade to this standard make take decades to complete, we will use data on flooding likelihood, historical records, and topography to prioritize neighborhood capacity upgrades in the near term. When planning for future drainage infrastructure, DEP will also consider projected sea level rise and rainfall intensity as well as environmental justice.

What has been done?

- Built ~125 miles of new/upgraded sewers in the last five years
- Completed emergency upgrades and repairs to resolve chronic flooding conditions at 14 locations in Staten Island and Queens since September 2021
- Adopted new catch basin designs to allow more stormwater to flow into the sewers during extreme weather



Upgrading our sewer system is a multi-decade effort.

To ensure that our sewers, both new and old, perform at optimal levels, we will continue or expand existing data-driven approaches to system maintenance and monitoring. For example, in 2021, DEP developed an optimized catch basin inspection protocol that uses historical trends and maintenance records to place the 150,000 catch basins citywide on an individualized inspection and cleaning cycle. This means that DEP's field crews are strategically inspecting catch basins before they get filled up with debris – reducing flooding for New Yorkers and increasing efficiencies for our field staff.

DEP is currently evaluating a wide range of technologies to gain more analyzable insights into our sewer system – allowing us to target our inspection and maintenance efforts and reduce flooding and sewer backups. For example, we are exploring leveraging machine learning to gather details from historical as-built drawings that can be incorporated into our mapping and analysis tools as well as developing a flow monitoring program to identify emerging issues in our sewers before they become bigger issues.

What is happening right now?

- Building sewers in Southeast Queens
- Implementing enhanced catch basin cleaning and inspection schedule
- Partnering with MTA to reduce flooding in subways

What is our vision?

- Upgrade at least 70 miles of sewers per year (1% of the sewer system), using data to target the most at risk communities
- Complete sewer build out in unserved areas



A sewer upgrade project in Queens.

Rain Gardens and Medians

Rain gardens are planted areas designed to collect and manage stormwater that runs off the streets and sidewalks when it rains. In addition to managing stormwater, these assets beautify neighborhoods, purify the air, and reduce temperatures during hot weather.

Through partnerships with the Department of Design and Construction, NYC Parks, the Department of Transportation (DOT), and the Economic Development Corporation, the City has constructed more than 11,000 rain gardens across the City – with more to come.

Similarly, large medians within our streets are an untapped resource for stormwater management. Turning these into stormwater assets by adding bioretention and storage chambers will revitalize these spaces and help mitigate stormwater flooding by creating space for the water to drain.

What has been done?

- Built 11,000 green infrastructure assets, nearly all in combined sewer areas

What is happening right now?

- Constructing stormwater medians in the Rockaways and Floral Park
- Completing an additional 1,000 rain gardens in Brooklyn and Queens

What is our vision?

- Expanding green infrastructure, including curbside rain gardens and the stormwater median program, to all parts of the City
- Partnering with the State and Federal government to financially support these projects with grants
- A robust maintenance program that develops and grows a green workforce



Rain gardens intercept stormwater before it enters the sewers, allowing it to infiltrate into the ground below.

Porous Pavement

More than a quarter of the City is covered with roadways and sidewalks – impervious areas that, rather than merely funneling immense quantities of water towards the sewer system during heavy rains, can do double duty, absorbing the water where it falls. Porous pavement can manage more stormwater runoff than typical curb side green infrastructure like rain gardens and infiltration basins. It also can be sited in areas where these typical practices can't be sited due to other sidewalk infrastructure or land use constraints.

Over the past few years, the City has completed a number of pilot projects to understand how this strategy will work in such a dense environment. DEP has incorporated pre-cast porous panels in the roadway as a stormwater management practice and is installing them on a widescale. DOT has updated their siting guidelines to expand the areas where these panels can be installed. Similarly, NYC Parks has updated their design guidelines to minimize the installation of pavement where possible and incorporating porous pavement where feasible.

What has been done?

- 17,000 linear feet of porous pavement constructed in pilot areas within streets in Queens and the Bronx
- Permeable pavers installed in more than 30 parks

What is happening right now?

- 300,000 additional linear feet of porous pavement entering design in Brooklyn and the Bronx
- Designing porous pavers in an additional 10 parks

What is our vision?

- Expansion of porous pavement to more parts of the City



Pre-cast porous panels can be sited in the roadway, unlocking additional areas to absorb stormwater.

Bluebelts and Daylighting

New York City is a global pioneer in large-scale green infrastructure called bluebelts — lakes and streams that are integrated with storm sewers to provide natural paths for stormwater to follow.

The City has constructed 94 Bluebelts – mostly in Staten Island, but also in Queens and the Bronx to solve localized drainage challenges. We are also continuing to complete the full network of Bluebelts in the Mid-Island and North Shore sections of Staten Island.

As a response to climate change, the next phase of this strategy is to identify areas across the city where Bluebelts might provide the large scale stormwater capacity. This citywide strategy will also consider how to balance competing land use demands in an dense urban environment – balancing the risk of flooding and poor drainage with the needs for housing, space for economic development, and parkland serving other ecological or recreational purposes.

Because Bluebelts and daylighting projects re-establish historical waterways, this network is likely to expand beyond current, publicly owned streams and wetlands onto the sites of former streams, floodplains, ponds and wetlands. Together with a core team of advisors, the City will release more details on this citywide vision in the spring.

What has been done?

- Constructed 84 Bluebelts in Staten Island, Queens, and the Bronx

What is happening right now?

- Construction ongoing for the Mid-Island Bluebelt in Staten Island
- Design underway for Tibbets Brook in the Bronx

What is our vision?

- Citywide bluebelt plan to prioritize evaluation and investment



Sweet Brook Bluebelt in Staten Island.

Cloudburst Infrastructure

In areas where the City's sewers and green infrastructure are unable to provide the capacity we need during extreme storms, the City must redesign our streets and public spaces to help store or channel water. This is the approach that Rotterdam, Amsterdam and Copenhagen have pioneered: turning streets into rain channels, and places like basketball courts and playgrounds into temporary holding tanks.

We have taken our first steps at a series of sites around the city, starting with pilots partnering with the New York City Housing Authority (NYCHA) at South Jamaica Houses in Queens and at the Clinton Houses in East Harlem, where green and grey infrastructure is being combined to reduce risks and improve amenities. These designs, developed in conjunction with residents, demonstrate that cloudburst designs can be attractive and have additional community and environmental benefits.

In the roadway, the City has begun preliminary design of a cloudburst project in St. Albans that will pilot depressed gutters, creating capacity in the street to hold stormwater while also conveying the stormwater to higher capacity sewers nearby. We are also working with partner agencies to identify opportunities to incorporate cloudburst designs into planned capital projects on city-owned land.

Over the next year, the City will be working towards protocols that will make cloudburst designs a standard part of the City's built environment wherever feasible.



What has been done?

- South Jamaica Houses designs
- Clinton Houses feasibility study
- Secured federal resiliency funding for two projects at NYCHA developments

What is happening right now?

- Identifying the next four cloudburst hubs for design (December 2022)
- Designing a cloudburst project at the Clinton Houses
- Expanding cloudburst installations to seven additional NYCHA developments in high stormwater vulnerability areas
- Actively advocating for federal funding for stormwater resiliency efforts

What is our vision?

- Incorporating cloudburst design principles where feasible into all city construction – Parks, NYCHA, DOT, Schools

Design Renderings for Cloudburst Pilot at NYCHA: South Jamaica Houses

Retaining Stormwater on Private Property

In addition to maximizing the stormwater capture within City-owned infrastructure, we must also keep stormwater on private property to the greatest extent possible. In 2022, DEP released the Unified Stormwater Rule that requires developers of large parcels across the City to retain as much stormwater as possible and detain the rest of stormwater onsite — through tanks, green roofs, permeable pavement, vegetated bioretention systems or similar treatments. We are also working with the Department of City Planning to align zoning regulations with innovative stormwater management practices.

For existing developments, we are incentivizing on-site stormwater retrofits for large, privately owned parcels through Resilient NYC Partners, which funds design and construction of green infrastructure that manages 2" of stormwater runoff.

What has been done?

- Enacted the Unified Stormwater Rule
- Launched Resilient NYC Partners

What is happening right now?

- Exploring opportunities to align zoning regulations with policy goals
- Piloting enhanced stormwater management practices through the LL41 (2021) Climate Resiliency Design Guidelines program

What is our vision?

- Citywide Resilient NYC Partners program



Green roofs are one way that property owners can manage stormwater on-site.

What comes next?

The hard work is still ahead of us. Over the next eight months, we will be working across city agencies to transform the ideas articulated in this document into a comprehensive plan that lays the foundation for the level of aggressive action that is needed to ensure that our children and grandchildren can continue to live, and thrive, in this great City. This work will culminate in the release of the City's next sustainability plan in April 2023.

While that planning effort is underway, we will continue to push ahead with the critical work already underway.

Commitment to Environmental Justice

The City is fiercely committed to environmental justice and prioritizing communities made disproportionately vulnerable to stormwater flooding.

What has been done?

- Launched a study on environmental justice to identify and describe opportunities for and means of promoting environmental justice in the City

What is happening right now?

- Developing an environmental justice portal that will provide easy access to data, maps, and other information relating to environmental justice concerns
- Developing an Environmental Justice Plan to be released in 2023
- Proactively incorporating social vulnerability into cloudburst and Bluebelt assessments

What is our vision?

- Prioritize stormwater investments considering environmental justice
 - Embed environmental justice into the fabric of the City's decision making
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