

NYC GREEN INFRASTRUCTURE

2023 Annual Report



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RAIN GARDEN IN THE RIGHT-OF-WAY, QUEENS

Developed over a decade ago to improve Harbor water quality, the NYC Green Infrastructure Program provides local flood resiliency in our rapidly changing climate. Green infrastructure practices are designed to slow down, absorb, and filter stormwater by capturing it at the source before it can enter the sewer system or contribute to flooding. With over 13,000 green infrastructure assets constructed and over \$1 billion encumbered towards CSO reduction, the NYC Green Infrastructure Program is now the largest of its kind in the nation and continues to expand. Under modified regulatory obligations, DEP is implementing the NYC Green Infrastructure Program citywide, beyond the combined sewered areas, while also incorporating equity into the planning stages for siting assets, applying a broader selection of nature-based solutions, and integrating program recommendations from recent community plans. Additionally, DEP implemented a new stormwater rule in 2022 that requires a retention-first approach to on-site stormwater management for many new construction and redevelopment sites. DEP is committed to spending \$3.5 billion on the NYC Green Infrastructure Program to improve water quality and to support climate change resiliency objectives in adapting to increasing risks of flooding caused by extreme rain events.

CSO Order Objectives

Over the past decade, DEP has developed 11 drainage basin specific Long Term Control Plans (LTCP) with federal and state regulators for NYC waterways impacted by combined sewer overflow (CSO). With the 2012 CSO Consent Order, DEP included the NYC Green Infrastructure Program as part of its regulatory milestones to complement traditional gray infrastructure investments and committed to reduce CSOs by 1.67 billion gallons annually by 2030 through green infrastructure. DEP has been leading the NYC Green Infrastructure Program in areas served by the combined sewer system (CSS) by constructing green infrastructure practices in the public right-of-way, on City-owned property, on private property through financial incentive programs, and through stormwater regulations. The use of green infrastructure is expanding on public and private properties citywide through updates to stormwater regulations, such as the implementation of the Unified Stormwater Rule in 2022.

In 2023, DEP and the New York State Department of Environmental Conservation (DEC) signed a modification to the Consent Order. Major changes between the 2012 CSO Order and the 2023 Citywide Green Infrastructure Modification (2023

Modification¹) include expanding the definition of green infrastructure, extending the NYC Green Infrastructure Program's timeline, updating the Program's certification metrics and interim milestones, and increasing the Program's total funding commitment to include resiliency projects. The Program's regulatory goal is to reduce CSOs by 1.67 billion gallons per year (BGY) in combined sewer areas by December 2040 and, building on current investments, expend \$3.5 billion on green infrastructure in both combined and separately sewered areas by December 2045.

The modification allows DEP to track green infrastructure constructed in areas served by the municipal separate storm sewer system (MS4) towards the new financial milestones. Prior to the 2023 Modification, DEP had been strategically constructing green infrastructure in MS4 areas as necessary under MS4 permit obligations, as well as through DEP's financial incentives and partnerships, and median projects. Going forward, as part of the Program's regulatory goal under the 2023 Modification to the CSO Order, DEP can consider multiple benefits of green infrastructure for neighborhoods, in addition to CSO volume reduction, such as flood management and water quality improvements.

The definition of green infrastructure in the 2023 Modification includes a wide array of practices at multiple scales that manage stormwater by infiltration, evapotranspiration, capture and reuse, filtration, and detention. On a local scale, green infrastructure includes site- and neighborhood-specific practices, such as rain gardens.

With the 2023 Modification, the NYC DEP Green Infrastructure Program expanded to cover CSS and MS4 green infrastructure practices

PROGRAM HIGHLIGHTS

2,363

Managed Acres in CSS Areas

13,723

Assets constructed in CSS Areas

Over 50%

of both CSS and MS4 assets in Environmental Justice Areas²

On a larger scale, green infrastructure includes maintaining and restoring ecosystems, as well as policies to regulate stormwater management on private property and practices to mitigate risks from large rain events known as cloudbursts. With the 2023 Modification, DEP now has the flexibility to capture more parts of the city by targeting areas with green infrastructure practices designed to balance flood risk reduction and water quality improvements while complying with regulatory obligations.

Certification Metrics

The metrics DEP uses to certify the NYC Green Infrastructure Program have also been updated in the 2023 Modification. While DEP will still measure progress towards the CSO volume reduction goal by tracking green infrastructure practices constructed in CSS areas of the City, DEP will also now track practices that meet the expanded definition of green infrastructure that are constructed in both the CSS and MS4 areas of the City for its funding commitment goals. The new milestone schedule and goals are listed in Table 1.

¹ 2023 Citywide Green Infrastructure Modification, https://extapps.dec.ny.gov/docs/water_pdf/2023nycgiordermod.pdf

² The Mayor's Office of Climate & Environmental Justice updated the data source for defining EJ areas in NYC in 2024. EJ areas are now defined by the NYS Disadvantaged Communities dataset, https://opdgig.dos.ny.gov/datasets/2579112b69b04b4c9a09f4cf013983dc_0/explore

TABLE 1: 2023 MODIFICATION CUMULATIVE MILESTONES

Milestone	CSO Volume Reduction (MGY) ¹	Funds Encumbered or Expended ²
December 2025	668	\$1.4 billion encumbered
December 2030	700-800	\$1.8 billion encumbered
December 2035	850-1,220	\$2.8 billion encumbered
December 2040	1,670	\$3.5 billion encumbered
December 2045	--	\$3.5 billion expended

1 CSO volume reduction for green infrastructure in combined sewer areas based on average rainfall year of 2008

2 Public green infrastructure in CSS and MS4 areas

In previous reporting years, DEP used a concept called Greened Acres, which is the volume of runoff managed by a green infrastructure practice if the stormwater is spread out at a depth of 1” over an impervious area. DEP will now report on CSO volume reduction by first calculating annual stormwater capture volume using practice-specific Stormwater Capture Equivalency Rates, then converting the stormwater volume to CSO volume reduction by applying Waterbody Drainage Area Specific Equivalency Rates, which represent how much stormwater needs to be managed to reduce the resulting CSO volume in each LTCP waterbody.

The different Stormwater Capture Equivalency Rates illustrate how green infrastructure practices that are retention-based (i.e., designed to manage larger storms, allowing stormwater to infiltrate into the ground) can manage more stormwater than detention-based practices. The varying Waterbody Drainage Area Specific Equivalency Rates are based on models developed for the 2016 Green Infrastructure Performance Metrics Report, where each waterbody receives CSO contributions from one or more watersheds. At a high level, Waterbody Drainage Area Specific Equivalency Rates is a result of a combination of factors that include underlying soil conditions, groundwater table elevation, and complex sewer infrastructure sewer system hydraulic specifics such as available wet weather flow capacity, travel times from outfalls, as well as the location of the green infrastructure assets within a given watershed. Consequently, constructing green infrastructure in certain waterbody drainage areas such as Flushing Creek or Flushing Bay yields higher CSO reduction credit as compared to others, such as Westchester Creek. The Stormwater Capture Equivalency Rates, Waterbody Drainage Area Specific Equivalency Rates, and the exact calculation for CSO volume reduction are provided in Exhibit A.

In addition to the above milestones, under the 2023 Modification, DEP has agreed to complete the Tibbetts Brook day-lighting project according to the following schedule:

- Notice to Proceed to Construction 24 months after the later of either site acquisition/access or design completion.
- Construction Completion 36 months after Notice to Proceed to Construction but no later than December 2035.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4)

The MS4 refers to the portions of the sewer system owned by the City where there are two types of pipes in the street: sanitary and stormwater. The sanitary pipes go directly to Wastewater Resource Recovery Facilities without the potential of combined sewer overflows, which can occur in the CSS where there is one pipe in the street for both sanitary and stormwater, and the stormwater pipes discharge directly into waterbodies. To reduce the risks of pollution being carried by stormwater to waterbodies, the MS4 permit requires that the City manage the quality of the stormwater in MS4 areas. The MS4 permit also regulates overland flow from City-owned property to waterbodies, which includes portions of parkland and the waterfront. Green infrastructure in MS4 areas helps manage stormwater by reducing the risks of pollution entering waterbodies through treatment as well as volume capture.

Table 2 summarizes the progress DEP has made towards the CSO volume reduction goals to date. Geographic locations of constructed public green infrastructure practices included in the table below, as well as upcoming projects, can be seen on DEP’s interactive online Green Infrastructure Map at www.nyc.gov/dep/gimap.

TABLE 2: CUMULATIVE GREEN INFRASTRUCTURE IN CSS AREAS FROM 2012-2023

Waterbody Drainage Area	Number of Assets	Managed Acres ³	Stormwater Managed (MGY)	SW to CSO Equivalency Rate (SW MGY/CSO MGY)	CSO Volume Reduced (MGY)
Alley Creek	11	2	2	2.75	1
Bronx River	490	125	70	2.35	30
Coney Island Creek	69	9	5	2.75	2
East River/Open Waters	2,906	655	247	1.87	131
Flushing Bay	893	92	64	1.25	51
Flushing Creek	2,238	285	228	1.91	119
Gowanus Canal	177	31	15	2.75	5
Hutchinson River	218	166	155	1.73	89
Jamaica Bay and Tributaries	4,735	747	600	3.67	162
Newtown Creek	1,723	220	147	1.72	86
Westchester Creek	263	30	17	5	4
Total⁴	13,723	2,363	1,549	-	680

3 Managed Acres = an area equivalent to one acre of impervious surface covered by one-inch of stormwater for distributed ROW assets (rain gardens, infiltration basins, stormwater greenstreets) and tributary drainage area for ROW porous pavement and all other assets.

4 Sum may not add up to total due to rounding.

2023 NYC GREEN INFRASTRUCTURE PROGRAM UPDATES

RIGHT-OF-WAY GREEN INFRASTRUCTURE

The public right-of-way (ROW) includes sidewalks, parking lanes, medians, and the roadway. It makes up approximately 30% of the impervious cover in the city and generates stormwater runoff during rain events. The public ROW offers a tremendous opportunity for siting green infrastructure and, as such, has been the largest implementation area of the NYC Green Infrastructure Program thus far. DEP implements area-wide ROW green infrastructure projects in partnership with the Department of Transportation (DOT), the Department of Parks and Recreation (Parks), the Department of Design and Construction (DDC), and the Economic Development Corporation (EDC). DEP has also been coordinating with the Office of Environmental Remediation (OER) to source materials. Over the years, rain gardens have used more than 1,300 reclaimed soil tons from the NYC Clean Soil Bank operated by OER. To date, these area-wide projects have led to the vast majority of Program accomplishments.

Rain Gardens, Stormwater Greenstreets, and Infiltration Basins

In 2023, DEP continued widescale implementation of green infrastructure in the ROW through two construction contracts with over 900 rain gardens and infiltration basins¹ combined. DEP also registered two additional construction contracts, which include over 1,000 rain gardens and infiltration basins combined in Jamaica Bay CSO tributary areas. DEP intends to initiate new area-wide design contracts in Flushing Bay and East River/Open Waters watersheds in 2024.

Porous Pavement

To date, DEP has constructed 77,908 SF of permeable pavement within NYC streets through pilot projects. In 2023, a construction contract for over

100,000 SF of porous pavement in Brooklyn, draining to East River/Open Waters, registered and is anticipated to break ground in 2024. Procurement of two additional area-wide porous pavement construction contracts, comprising of 400,000 SF in Brooklyn, is anticipated to be initiated in 2024. A fourth contract in Brooklyn with over 100,000 SF is anticipated to complete design in 2024. A porous pavement design contract in the Bronx, aiming to implement 150,000 SF of porous pavement, also registered in 2023.

Multi-agency GI Protection and Enforcement Efforts

In 2023, DEP focused field efforts on constructed assets and ongoing protection and coordination measures. Utilizing the designated GI Utility DEP email address, DEP was able to coordinate with private utilities and contractors working near green infrastructure on various projects, ensuring green infrastructure protections were implemented. DEP also coordinated with NYC Department of Buildings (DOB) to establish a procedure for green infrastructure, whereby DOB submits all Builders Pavement Plan applications with green infrastructure conflicts to DEP for review. Any application that may impact green infrastructure must be reviewed by DEP prior to DOB's approval. DEP continued coordinating with DOT to ensure all constructed green infrastructure assets are included on DOT's street-opening permits system and stipulations to protect green infrastructure are included when the planned street-opening projects may impact green infrastructure. DEP increased internal enforcement efforts and now has seven trained inspectors who issued 17 violations in 2023. DEP is utilizing this multi-agency approach to address any potential negative impacts to green infrastructure proactively and following through with violations issued by DOT and DEP as needed.

¹ <https://www.nyc.gov/site/dep/water/rain-gardens.page>

PUBLIC PROPERTY RETROFITS

DEP has been working with key public agency partners since 2011 through its public onsite program to implement green infrastructure retrofits on publicly owned properties. DEP’s core public onsite partners are Parks, Department of Education (DOE), School Construction Authority (SCA), and NYC Housing Authority (NYCHA). Additional partners include the Trust for Public Land (TPL), DDC, EDC, and other public agency landowners and their project delivery partners.

In 2023, DEP continued design and construction of agency-specific contracts to retrofit NYCHA, parks, and school properties, and continued its partnership with TPL for schoolyards. Table 3 shows the status of public property retrofits in DEP’s portfolio. After a successful implementation of the Green Infrastructure On-site Design Manual, many projects are now in the procurement and construction phases. Projects slated for construction are bundled by geographic proximity and number of sites to achieve cost efficiencies. In coordination with partner agencies, multiple NYCHA, parks, and school projects were bid out in 2023 and will be constructed over the next couple of years.

TABLE 3: SUMMARY OF GREEN INFRASTRUCTURE PROJECTS ON PUBLIC PROPERTY (2023)

	Parks and Playgrounds	Public Schools	NYCHA Housing	Other Public
Constructed/In Construction	98	81	29	8
In Design	56	25	18	2

The projects counted in Table 3 consist of different types of practices including surface, subsurface, and green roof practices, with surface and subsurface practice types being further categorizable into infiltrating retention practices or slow-release detention practices depending on the underlying soil properties. The practice types are selected and designed to fit existing site constraints and align with owner-agency programming needs.



LARGE-SCALE MEDIANS

DEP's in-house design team identifies opportunities for large-scale green infrastructure practices within City-owned medians to target both citywide water quality objectives and inland flooding challenges. In addition to their ability to target a multitude of objectives, large-scale green infrastructure opportunities are a cost-effective strategy because they manage more stormwater runoff than typical right-of-way assets and concentrate maintenance needs in central locations. Large-scale street median design prioritizes the conveyance of stormwater runoff into stormwater practices that facilitate stormwater capture, retention, and detention, dependent upon soil conditions. Moreover, street median cover materials are converted to softscape with plant species that are adapted and suitable for the site's specific soil conditions in lieu of concrete or asphalt paving materials. Through this work, medians are reconfigured and redesigned to contribute to a vibrant and attractive public realm that promotes a better quality of life and helps protect the city's urban

ecology, enhancing the health and well-being of its residents.

In 2023, construction began on three green street median projects in Queens Village. These medians are expected to be completed in early 2024 and will capture stormwater from major roadways in the vicinity of Martin Van Buren High School. As of Spring 2024, five additional projects are in design and 10 are in the early planning stages.

DEP was awarded \$5,000,000 from the NYS Environmental Facilities Corporation in 2022 to retrofit three existing medians in Queens at Springfield Boulevard between Lucas Street and Merrick Boulevard, Union Turnpike between Metropolitan Avenue and 71st Road and Frances Lewis Boulevard between 21st Road and 20th Avenue. Designs for these medians have been finalized and are expected to go into construction in the summer of 2024.



MEDIAN LOCATED BETWEEN WINCHESTER BLVD, HILLSIDE AVE, AND MARTIN VAN BUREN H.S., QUEENS

Gateway to Greenpoint

The Gateway to Greenpoint project is located in Brooklyn, in an area served by MS4, just outside the Newtown Creek Wastewater Resource Recovery Facility between Kingsland and Greenpoint Avenues. The purpose of this project is to replace the existing open space with a new landscape design that complements the built environment, softens the appearance of hard surfaces, enhances aesthetic qualities, and provides a neighborhood amenity. To this project, DEP's in-house design team will also be incorporating green infrastructure to improve stormwater management by capturing almost 1 million gallons of stormwater a year. Overall, the Gateway to Greenpoint project will provide 0.4 acres of public open space and create opportunities for environmental stewardship. The scope includes installation of underground storage chambers, curbside inlets, large planting beds of native species, and tree plantings. DEP anticipates that this project will begin construction in 2026.



RENDERING OF GATEWAY TO GREENPOINT PROJECT,
BROOKLYN

PRIVATE PROPERTY INITIATIVES



DEP provides financial incentives for installing green infrastructure on private property through the Green Infrastructure Grant Program and the Resilient NYC Partners Program. Through the Grant Program, DEP funds design and construction costs for green roof retrofits. Through Resilient NYC Partners, DEP funds retrofit drainage improvements such as subsurface storage, porous pavement, and rain gardens for properties with large areas of impervious surface. Projects funded through these public-private partnerships help make NYC more sustainable and resilient

Green Infrastructure Grant Program

Since its introduction in 2011, the Green Infrastructure Grant Program¹ has sought to strengthen public-private partnerships and public engagement regarding the design, construction, and maintenance of green infrastructure on private property in NYC. To date, DEP has committed more than \$14 million for 34 private property owners to build green infrastructure through the Green Infrastructure Grant Program. DEP hosts quarterly virtual webinars that cover funding eligibility requirements and application tips.

In 2023, construction began at River Crossing, a housing development in the East Harlem neighborhood of Manhattan. The project consists of two extensive green roofs on adjacent buildings that are centrally located within the housing complex and visible to the surrounding residents. The green roofs total 13,111 SF and will manage 0.29 million gallons of stormwater annually.

An additional green roof grant project is expected to start construction in 2024 at a condominium in Harlem.

DEP has committed more than \$14 million to 34 private property owners to build projects through the Green Infrastructure Grant Program

¹ <https://www.nyc.gov/site/dep/water/green-infrastructure-grant-program.page>

Resilient NYC Partners

Resilient NYC Partners² funds the design and construction of site-level green infrastructure practices such as subsurface storage, permeable pavements, and rain gardens on properties with 50,000 SF or more of site-level impervious area. The program provides an opportunity for large property owners to improve their property by addressing drainage issues such as localized flooding, resurfacing parking lots, and adding more greenery, all while helping the City to manage stormwater.

In 2023, DEP completed the construction of a subsurface storage system and permeable pavement at T. Mina Supply Inc., a 1.3-acre supply yard in the College Point neighborhood of Queens. DEP worked with the property owner to determine where flooding tended to occur on the property and designed a solution that mitigated surface flooding and runoff in those areas without impacting existing operations or disrupting the workflow on the site. The system will capture approximately 1.26 million gallons of stormwater annually, and will help to reduce flooding in the area and

improve the health of the nearby Flushing Bay.

Additionally, construction began in December 2023 on a project that will complement larger stormwater resiliency efforts at Green-Wood Cemetery in Brooklyn. The project features a subsurface storage system and bioretention area in the cemetery's service yard, designed to accommodate the day-to-day needs of the yard while providing enhanced stormwater management services. The system will manage approximately 1.29 million gallons of stormwater annually, helping reduce stormwater runoff on the property and the surrounding neighborhood, and reducing CSOs to the East River/Open Waters waterbody.

Three projects are expected to start construction and an additional three are expected to advance designs in 2024. DEP will continue to discuss the program with property owners, conduct site visits to evaluate potential projects, and develop concept plans for participating property owners.



² <https://www.nyc.gov/site/dep/whats-new/resilient-nyc-partners.page>

STORMWATER REGULATIONS

Stormwater regulations are a core part of DEP’s work to improve water quality and enhance sewer operations. With the promulgation of the Unified Stormwater Rule¹ in 2022, DEP updated and aligned its water quality and sewer operation objectives. The Unified Stormwater Rule provides a comprehensive, citywide stormwater management policy for both public and private development (see Figure 3 on page 14).

2012 Stormwater Performance Standard

From 2012 to the promulgation of the Unified Stormwater Rule in 2022, new development and redevelopment projects that required sewer certification complied with a stormwater performance standard to limit flow from lots to ensure adequate capacity in the sewer system (2012 Stormwater Rule). Because of the delay between receiving a permit for construction and completing a development or redevelopment project, there are projects that received a site connection permit or house connection permit prior to the Unified Stormwater Rule that may still be under construction. Therefore, stormwater management practices associated with the 2012 Stormwater Rule will continue to be counted in future reports.

Additionally, DEP revised its methodology for collecting data on the implementation of the 2012 Stormwa-

ter Rule to correct incomplete data reporting procedures. As a result, the 2023 update includes a greater number of site/house connection permits compared to previous updates. DEP’s next step will be to analyze records from 2012 to 2022 to collect data on the number of additional assets and managed acres that were not previously reported. Table 4 provides a breakdown of the type of stormwater management assets employed by applicants affected by the 2012 Stormwater Rule that DEP is reporting on.

Unified Stormwater Rule

In February of 2022, DEP promulgated the Unified Stormwater Rule, which included amendments to Chapters 31 and 19.1 of Title 15 of the Rules of the City of New York to update DEP’s site and house connection requirements and the Stormwater Construction and Maintenance Permitting Program (i.e., Stormwater Permitting)². Under the Unified Stormwater Rule, stormwater regulations for citywide sewer operations and water quality objectives have been integrated and enhanced. Some projects are covered by both requirements.

In combined sewersheds, the Unified Stormwater Rule will lead to a reduction in CSO volume as lots redevelop over time. The benefits from the new rule

TABLE 4: 2012 STORMWATER PERFORMANCE STANDARD ASSETS AND MANAGED ACRES IN GREENHUB³ (2012-2023)

GI Type	Asset Count CSS	Managed Acres CSS	Asset Count MS4	Managed Acres MS4
Subsurface Retention	31	15	3	2
Green Roof	3	1	0	0
Other Rooftop System	685	148	17	8
Drywell	216	36	139	40
Multiple GI Components	191	157	12	11
Rain Garden	3	1	1	0.03
Detention System	714	378	67	14
Stone Trench	0	0	1	0.05
Total	1,843	736	240	75

3 GreenHUB is DEP’s internal green infrastructure tracking system. Details on publicly funded green infrastructure assets are viewable on the NYC Green Infrastructure Public Map and downloadable through NYC Open Data. Regulated assets reported in this section are primarily on private property and not included in the publicly accessible data.

1 <https://www.nyc.gov/site/dep/water/unified-stormwater-rule.page>

2 <https://www.nyc.gov/site/dep/water/stormwater-permits.page>

will contribute to the NYC Green Infrastructure Program’s CSO reduction goal and continue beyond it, helping to institutionalize green infrastructure in new developments across NYC.

Post-construction stormwater practices with Stormwater Maintenance Permits under the Stormwater Permitting Program and practices built under the updated site/house connection requirements are tracked in GreenHUB and summarized in Table 5 and Table 6 below.

TABLE 5: SUMMARY OF 2022-2023 UNIFIED STORMWATER RULE ASSETS AND MANAGED ACRES IN GREENHUB

GI Type	Asset Count CSS	Managed Acres CSS	Asset Count MS4	Managed Acres MS4
Subsurface Retention	2	0.22	0	0
Other Rooftop System	111	6	4	0.28
Drywell	157	348	110	10
Multiple GI Components	77	11	3	1
Detention System	45	9	1	0.04
Rain Garden/Bioretenion	1	0.05	2	0.02
Filtration Practice	0	0	1	5
Stone Trench	2	1	1	0.13
Total	395	375	123	17

TABLE 6: SUMMARY OF 2022-2023 STORMWATER CONSTRUCTION PERMIT POST-CONSTRUCTION ASSETS AND MANAGED ACRES WITH MAINTENANCE PERMITS IN GREENHUB

GI Type	Asset Count CSS	Managed Acres CSS	Asset Count MS4	Managed Acres MS4
Filtration Practice	-	-	1	5
Subsurface Retention	-	-	1	1
Total	-	-	2	6



Because of the delay between submission to DEP of an application for a project under the Stormwater Permitting program and the completion of the project, many of the anticipated stormwater management practices that will be built under the Unified Stormwater Rule are still being constructed and are expected to be a larger part of DEP’s reporting in the future, as the program continues and as green infrastructure continues to be required for development and redevelopment. Figure 1 illustrates the breakdown of projects submitted through the Stormwater Permitting program with active construction permits that are anticipated to have stormwater management practices (SMPs), or green infrastructure, in CSS and/or MS4 areas, and Figure 2 shows the general distribution of these projects across the LTCP waterbodies for those served completely or partially by CSS. Including the projects depicted in Figure 1, over 430 project applications that do or are likely to require SMPs in either CSS or MS4 areas have been submitted since the implementation of the DEP online Stormwater Permitting and Tracking system in 2019.

FIGURE 1: SUMMARY OF ACTIVE STORMWATER CONSTRUCTION PERMIT POST-CONSTRUCTION SMPs IN CSS AND MS4 AREAS

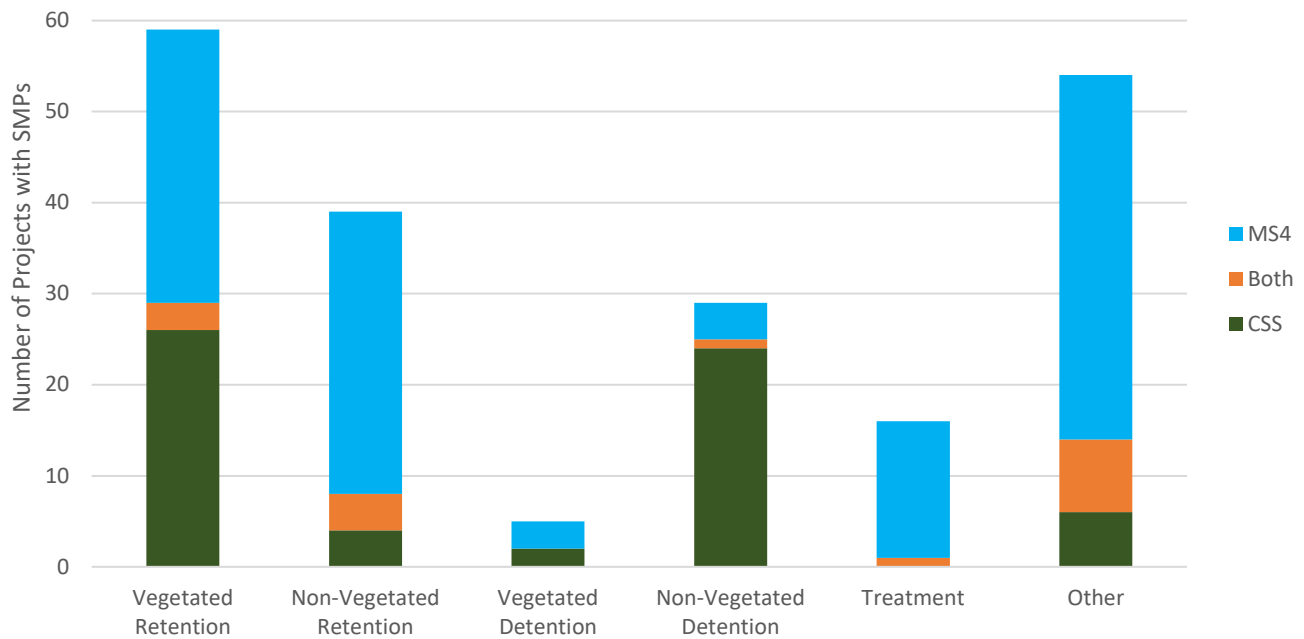


FIGURE 2: SUMMARY OF UPCOMING STORMWATER CONSTRUCTION PERMIT POST-CONSTRUCTION SMPs IN CSS BY WATERBODY

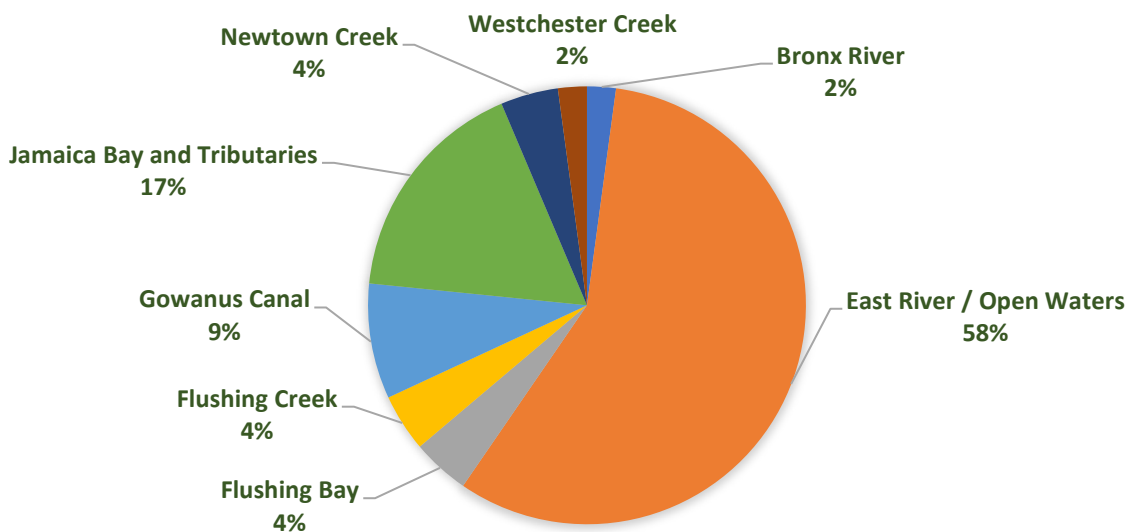


FIGURE 3: UNIFIED STORMWATER RULE CHAPTER AMENDMENTS

Unified Stormwater Rule

Aligns the RCNY Chapter 31 stormwater quantity and flow rate requirements with the RCNY Chapter 19.1 Construction/Post-Construction permitting program water quality requirements.

Ch. 31 Stormwater Quantity and Flow Rates


Site/House Connection Proposal

- Applies to CSS/MS4 projects that require a sewer connection proposal
- Projects must provide new detention volume and maximum-release rates
- Simplified formulas and change in minimum orifice size to streamline design

Ch. 19.1 Water Quality Requirements

Stormwater Construction Permit

- Applies to CSS/MS4 projects that disturb 20,000 sf or more of soil, or add 5,000 sf or more of new impervious surface
- On-site projects must manage volume of 1.5-inch rainfall event using a new retention-first stormwater management practice hierarchy
- ROW projects also have construction and post-construction requirements



Green infrastructure framework supports the application of practices to meet both objectives



DAYLIGHTING

Tibbetts Brook originates in Yonkers and flows through Van Cortlandt Park in the Bronx before discharging into Hester and Piero's Mill Pond (formerly Van Cortlandt Lake). Since the early 1900s, the brook has been diverted as it leaves Van Cortlandt Lake into an 8 ft diameter tunnel that connects to a combined sewer flowing to the Wards Island Wastewater Resource Recovery Facility. During wet-weather events, overflow from the combined sewer discharges to the Harlem River at an outfall on W 192nd St, which, volumetrically, is one of the largest CSO discharge points in NYC.

Daylighting will restore the historical connection of Tibbetts Brook from Hester and Pierro's Mill Pond in Van Cortlandt Park to the Harlem River via a new water conveyance system consisting of an open channel stream in Van Cortlandt Park and the former railroad right-of-way and a closed conduit through the Metro North property, reducing flows to the CSS. On a parallel path, DEP is also collaborating with Parks to build a new public greenway between Van Cortlandt Park and W. 230th St, intended to be part of the Empire State Trail. The City is planning to implement this project in two phases. Phase 1 will focus on lake improvements at Hester and Piero's Mill Pond. Phase 2 will focus on daylighting Tibbetts Brook, including re-routing flow from its current path through the sewer into a new channel and on a parallel path, constructing the greenway.

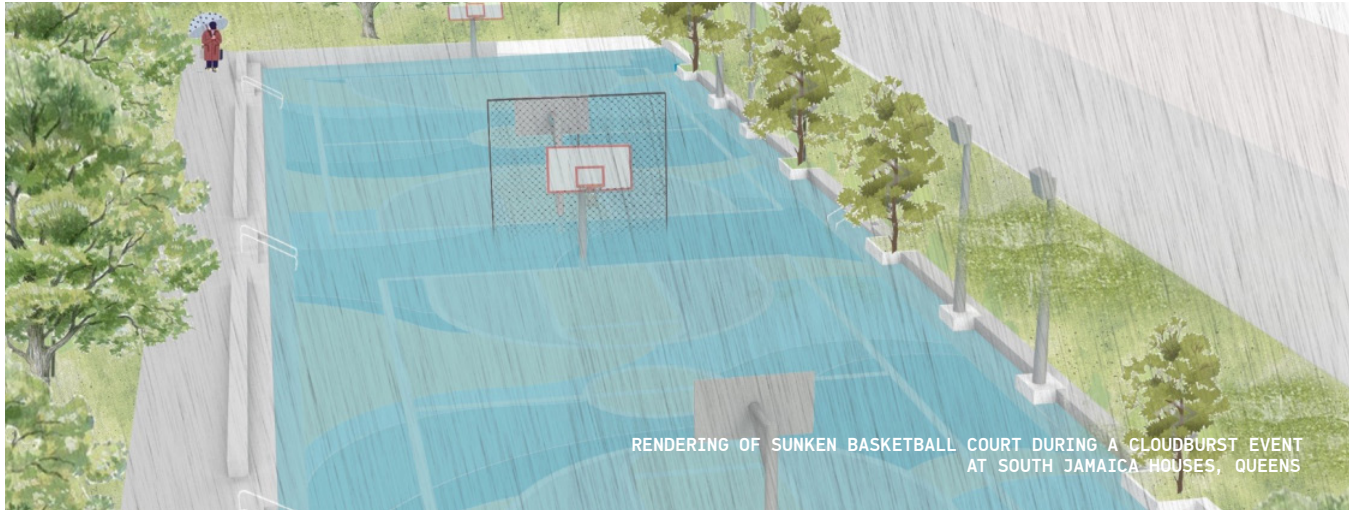
Final Design for the Tibbetts Brook Daylighting project is continuing. In 2023, DEP made several key achievements:

- Advanced interagency coordination and design development with final design anticipated to be completed in 2024. Held meetings and a site visit with the Tibbetts Advisory Group to provide critical updates on project milestones and integrate stakeholder feedback as part of design development.
- Received Preliminary Approval and unanimous support of Public Design Commission in August 2023.
- Completed City Environmental Quality Review and released Environmental Assessment Statement in January 2024.
- Released Request for Proposals and selected a Construction Manager, who will be brought on to join the project team prior to construction.
- Registered contract to begin Phase 1 lake restoration – with work anticipated to begin in Summer 2024.

Upon completion, this project is anticipated to reduce combined sewer overflows to the Harlem River at 215-220 MGY.



CLOUDBURST



A “cloudburst,” as seen in 2021 during Hurricane Ida, is a sudden, heavy downpour that occurs in a short amount of time and may lead to flooding, property damage, disruptions to critical infrastructure, and pollution of NYC’s waterways. Cloudburst management implements a combination of methods that absorb, store, and transfer stormwater to reduce flooding. Using gray infrastructure (e.g., drainage pipes and underground storage tanks) and green infrastructure (e.g., rain gardens and porous pavement), cloudburst management can minimize damage by reducing the strain on the municipal sewer system. DEP is designing cloudburst projects capable of capturing greater quantities of stormwater than traditional green infrastructure projects. In addition to managing localized flooding, these cloudburst projects will also help DEP meet its stormwater management water quality goals to reduce CSOs in CSS areas and to reduce the risk of polluted stormwater discharging to local waterways in MS4 areas.

DEP and NYCHA are designing two cloudburst pilot projects at South Jamaica Houses in Queens and Clinton Houses in Manhattan to combat these high-intensity rain events. The South Jamaica Houses project is expected to break ground in 2024 and design for the Clinton Houses project, which is currently underway, is expected to be completed in Fall 2024. NYCHA has continued to advance cloudburst strategies across its portfolio, completing design at Jefferson Houses in Manhattan and evaluating proposals for cloudburst infrastructure design services at five additional developments with high vulnerability to flooding.

In Southeast Queens, DEP is working with Parks on two cloudburst projects that are currently advancing designs: Archie Spigner Park in the neighborhood of St. Albans, and Rufus King Park. These projects are designed to improve drainage conditions in the park and on select adjacent streets where possible. Additionally in the neighborhood of St. Albans, DDC and DOT have partnered with DEP on a roadway improvement project to address frequent flooding issues near the intersection of 177th Street and 112th Ave. The proposed cloudburst design for this project involves a combination of green infrastructure in the roadway and includes roadway changes that will also improve roadway safety for pedestrians and vehicles.

In January 2023, Mayor Eric Adams’ administration announced an expansion of the cloudburst program¹ to four new neighborhoods. Supported with \$390 million in City capital funds — and in partnership with DEP, DOT, and Parks — these specially designed, built, and engineered infrastructure projects will be an important component of a larger multi-layered strategy to manage extreme rainfall in the neighborhoods of Corona and Kissena, Queens; Parkchester/Morris Park, Bronx; and East New York (Hendrix/Linden), Brooklyn. In Fall 2023, DEP kicked off design contracts for these four initial projects. DEP is currently working with the design teams to conduct targeted outreach to inform design, which is anticipated to be completed in late 2025. More than two dozen additional locations are also being evaluated for inclusion. This investment, and continued advocacy for Federal and State funds, cements NYC’s status as a global leader in stormwater resilience.

¹ <https://www.nyc.gov/site/dep/environment/cloudburst.page>

SPECIAL PROJECTS

Stormwater Reuse

DEP is embarking on stormwater reduction and reuse projects in the East River/Open Waters waterbodies that provide a synergistic approach to demand management and CSO reduction goals. In addition to reducing potable demand, these projects also reduce discharge to the CSS, contributing to the NYC Green Infrastructure Program's goal to reduce CSOs. Through these projects and others in the pipeline, DEP is actively working to reduce flows to sewers and wastewater facilities through water conservation and reuse, as part of an integrated approach to water resources management in NYC.

Central Park

Central Park Conservancy and DEP have partnered with Parks to construct a system to capture and recirculate water in Central Park's northern waterbodies. These waterbodies – the Pool, Loch, and Harlem Meer – are currently fed by City water. City water flows by gravity from the Pool to the Loch and Meer and overflows to the CSS at the outflow of the Meer. By replacing City water with stormwater, this project will reduce potable water demand and reduce combined sewer overflows to the East River. In addition, recirculation will improve the water quality of the Park's northern waterbodies. Recirculating this stormwater will save up to an estimated 0.48 million gallons per day (MGD) of potable water and relieve system stress during potential water supply shortages. It is anticipated that this project will reduce CSO discharge by up to 3.8 MGY, addressing capacity constraints on the wastewater and stormwater infrastructure.

Central Park design is underway and will continue through 2024. Potential additional benefits to the Central Park Recirculation project were identified in South Harlem. To help fund this, DEP is currently applying for the National Oceanic and Atmospheric Administration's Climate Resilience Regional Challenge Grant. If awarded, construction would begin in October 2025. The Harlem Blueways project proposes to expand the Central Park Recirculation project to include a stormwater conveyance system to the neighboring corridors in South Harlem, layering in green infrastructure along the corridor for additional benefits.

Prospect Park

Since 2020, DEP has been coordinating with Prospect Park Alliance (PPA) to replace an existing service line valve in Prospect Park to achieve an estimated demand savings of 0.8 MGD. The service line supplies potable water to Prospect Park Lake and during rain events, PPA staff discharge water from the lake into the CSS to avoid flooding the park. Additionally, during summer when evaporation occurs, Prospect Park Lake is supplied with an estimated 1 MGD or more of potable water, to maintain health and aesthetics. As an integrated One Water project, this valve replacement is also expected to reduce CSOs during rain events to Gravesend Bay and the Upper Bay by 12 million gallons per year. Design for this project is complete and bid procurement is currently underway with construction anticipated to begin in Spring 2024.

STAY CONNECTED WITH DEP NEWSLETTERS

Get the latest updates from DEP by subscribing to newsletters of your choice. DEP newsletters cover topics such as cloudburst design projects, stormwater management updates, procurement opportunities, agency press releases, and more.

To sign up, visit:

<https://www.nyc.gov/site/dep/about/newsletters.page>

BLUEBELTS

Bluebelts are nature-based drainage systems that DEP uses to handle runoff from streets and sidewalks. Bluebelts were originally constructed in areas where traditional sewer construction was challenging by preserving natural drainage corridors that included streams, ponds, wetlands, and other ecological spaces that convey, store, and filter stormwater runoff. These systems, like other types of green infrastructure, help to reduce urban flooding and improve the health of local waterways while also providing open green space for communities and diverse habitat for wildlife. With the 2023 Modification, Bluebelts now meet DEP's regulatory definition of green infrastructure. To date, DEP has constructed 94 Bluebelt assets in MS4 areas.

While the majority of these Bluebelts have been built in Staten Island, DEP is continuing to expand Bluebelt projects to flood-vulnerable areas throughout the city as part of a Five Borough Bluebelt Expansion program.

DEP is currently preparing the encumbered costs data of Bluebelt projects for DEC review. Going forward, new Bluebelt project encumbered costs will be included in DEP certification metrics, as well as stormwater volume captured if a project is constructed in a CSS area.

Bluebelt projects can now be viewed on DEP's interactive online Green Infrastructure Map¹.



SWEET BROOK BLUEBELT, STATEN ISLAND

¹ www.nyc.gov/dep/gimap

GREEN INFRASTRUCTURE MAINTENANCE



As of the end of 2023, DEP manages the maintenance of over 10,700 curbside rain gardens and infiltration basins, over 10 green infrastructure installations constructed on public properties across NYC, and nearly 80,000 square feet of roadway porous pavement.

Frequent maintenance plays an important role in keeping our green infrastructure assets clean, safe, and functioning, delivering essential stormwater management and many co-benefits. Comprised of trained field personnel teams and supported by administrative, technical and supervision staff, the Green Infrastructure Maintenance unit regularly inspects and maintains each of the growing number of green infrastructure assets across NYC. The unit is assisted by DEP's growing rain garden volunteer base, as well as contracted litter removal work for select areas of the City and supplemental contracts that provide non-routine maintenance support.

During 2023, the Green Infrastructure Maintenance unit continued to grow significantly, hiring additional staff, increasing the frequency of routine maintenance visits, and expanding the types of maintenance being conducted. Utilization of new data collection tools and technologies first deployed in 2022 have helped to target maintenance and inspections with increasing accuracy, even as the

number of assets has risen sharply. The supplemental contracts initiated in 2022 have also been extremely important in supporting the work of the Green Infrastructure Maintenance staff.

In Spring 2023, the Green Infrastructure Maintenance unit embarked on a robust plan to enhance rain gardens with additional plant materials and additional pruning. Staff and volunteers planted 3,500 additional plants, seeded 1,000 rain gardens, and conducted enhanced pruning at 4,000 assets. Part of the long-term management of rain gardens will require continued assessments and investment of resources to ensure that the vegetation will thrive in their surrounding conditions.

The number of infiltration basins being maintained by the Green Infrastructure Maintenance unit rose steeply in 2023. After extensive research on different types of vacuuming equipment and resource requirements to operate them, the unit conducted several successful field trials, which demonstrated that the selected equipment could significantly enhance the efficiency of cleaning operations moving forward. DEP aims to deploy this equipment in 2024 to support the maintenance of this growing class of assets.

WORKFORCE DEVELOPMENT

As the NYC Green Infrastructure Program continues to grow and expand, DEP continues to research various technologies and workforce development frameworks to adapt to the varying conditions and maintenance needs observed throughout NYC and anticipates making continued progress on these fronts in 2024.

In 2023, DEP began drafting a workforce development pilot program for the green infrastructure/water management industry space that will utilize partnerships with local non-profits working with vulnerable and underserved communities in NYC. Through such partnerships, DEP will facilitate an educational training program designed to prepare participants for careers in green infrastructure and the water industry, combining education and professional training with the necessary experience of hands-on green infrastructure field work. This on-the-job maintenance training, combined with soft skill training support, will help DEP develop a workforce pipeline to feed NYC's growing need for green infrastructure and water industry professionals.

PUBLIC ONSITE MAINTENANCE

DEP works closely with agency partners to ensure that green infrastructure practices built on public properties will function over the long term by continually assessing designs for maintenance and supporting agency partners through budgeting and contracting services.



STEWARDSHIP AND PUBLIC ENGAGEMENT

In 2023, DEP hosted 16 rain garden community engagement events, interacting with nearly 250 members of the public across these events. Through the DEP Rain Garden Stewardship Program, over 170 rain gardens were stewarded by local residents and community groups at the end of 2023. DEP encourages the public to engage in the green infrastructure program by signing up for stewardship activities or reporting through 311 for any rain garden-related issues or requests.

VOLUNTEER WITH DEP

If you would like to volunteer to help care for rain gardens in your neighborhood, please email raingardens@dep.nyc.gov to request more information.

To learn more about the Rain Garden Stewardship Program, download the Raingarden Stewardship Program Maintenance Manual¹.

PRIVATE PROPERTY PROJECTS

Maintenance for green infrastructure projects installed on private properties is governed by a number of factors, such as the unique needs of individual projects and respective program requirements, including, but not limited to: maintenance agreements specified alongside the funding requirements for DEP's green infrastructure financial programs; the requirements listed in the Maintenance Permits for the Stormwater Permitting projects; and Chapter 31 of the Rules of the City of New York for Site/House Connection Proposal projects.

¹ <https://www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/green-infrastructure/rain-garden-stewardship-manual.pdf>

NYC GREEN INFRASTRUCTURE PROGRAM SPENDING AND BUDGET



As a result of the 2023 Modification, DEP has a new financial milestone to expend \$3.5 billion on green infrastructure in CSS and MS4 areas by December 2045. The first milestone towards the funding obligation is \$1.4B encumbered by December 31, 2025.

CSO REDUCTION SPENDING AND BUDGET

Capital Expenditures and Budget

Capital funding covers costs such as site selection, design, construction, and construction management for green infrastructure projects, and that funding registered into contracts is known as encumbered capital funding. Table 7 shows the encumbered capital funding for CSS areas. The Capital Budget is a budgeting document that outlines the Program’s projected capital commitments over ten years, as shown in Table 8 for CSS areas.

TABLE 7: CAPITAL ENCUMBRANCE FOR CSS (FY12-24)

Fiscal Year	Encumbered Capital Funding - CSS
FY12	\$9,015,345
FY13	\$15,202,880
FY14	\$152,935,548
FY15	\$58,041,000
FY16	\$114,976,273
FY17	\$118,115,069
FY18	\$69,811,175
FY19	\$203,035,478
FY20	\$160,754,308
FY21	\$169,294,738
FY22	\$58,929,787
FY23	\$127,201,264
FY24 ¹	\$3,205,980
Total	\$1,260,518,845

TABLE 8: 10-YEAR CAPITAL IMPROVEMENT PROGRAM BUDGET FOR CSS (FY24-34)

Fiscal Year	Approved FY25 Preliminary Capital Improvement Program - CSS
FY24 ²	\$33,601,020
FY25-34	\$973,086,000
Total	\$1,006,687,020
Grand Total³	\$2,267,205,865

Expense Expenditures and Budget

The Program’s expense expenditures and budget covers operational costs, such as maintenance of green infrastructure, office and field staff, materials, equipment, and other non-capitally eligible programmatic needs including research and development. Tables 9 and 10 show the expense expenditures and budget for CSO reduction.

TABLE 9: EXPENSE BUDGET - OTHER THAN PERSONNEL SERVICES (OTPS) ONLY FOR CSS - (FY12-23)

Fiscal Year	OTPS Expenditures - CSS
FY12	\$60,265
FY13	\$2,039,773
FY14	\$1,989,918
FY15	\$2,006,620
FY16	\$2,234,715
FY17	\$4,134,828
FY18	\$4,300,363
FY19	\$4,752,478
FY20	\$3,169,903
FY21	\$2,214,366
FY22	\$3,878,877
FY23	\$4,744,003
Total	\$35,526,109

TABLE 10: EXPENSE BUDGET-OTHER THAN PERSONNEL SERVICES (OTPS)-ONLY FOR CSS (PLANNED FOR FY24-25)

Fiscal Year	OTPS Budget (as of FY25 Preliminary Plan) - CSS
FY24	\$23,926,665
FY25	\$21,748,365
Total	\$45,675,030
Grand Total⁴	\$81,201,139

1 FY24 encumbered as of 4/29/24

2 FY24 remaining as of 4/29/24

3 Program Grand Total is based on the total encumbered and the Approved FY25 Preliminary Capital Improvement Plan (FY24-FY34)

4 Program Grand Total is based on the total OTPS expenditures, the FY24 Adopted Budget, and the FY25 Preliminary Plan

TOTAL CITYWIDE GI PROGRAM SPENDING AND BUDGET

As part of the 2023 Modification, DEP will report on NYC Green Infrastructure Program spending on green infrastructure in CSS and MS4 areas. Expenditures that are eligible for meeting the \$3.5 billion funding obligation include project design, construction, and land acquisition, including easements, for projects that meet the regulatory definition of green infrastructure, including those that are part of resiliency programs. Eligible expenditures for green infrastructure practices include those in both CSS and MS4 areas, those constructed by City agencies, including DEP, for compliance with the MS4 Permit, and those installed to comply with the 2022 Unified Stormwater Rule or the 2012 Stormwater Rule that would not otherwise be required by a New York State Construction General Permit. Federal, state, or other grant funding that the City obtains to construct green infrastructure capital projects is also eligible towards the \$3.5B expenditure obligation.

DEP is currently in the process of compiling citywide encumbered funds and will include them in future reporting.



External Funding Sources

The table below represents DEP’s efforts to explore federal and state grant funding opportunities, as well as funding secured, from 2021 to 2023. DEP has targeted grant funding primarily for the design and construction of cloudburst and median projects. With the 2023 Modification, DEP will include grant amounts received and encumbered from external funding sources as part of DEP’s financial milestones. Funding will not be reflected in the Funds Awarded column in the table below until an award letter is received by DEP. Two cloudburst hubs have been initially selected for FEMA BRIC Funding and one has been selected for HUD Community Development Block Grant Disaster Recovery Ida - Round 2, and award letters totaling \$123M are pending as of this Report. The Cloudburst hubs Kissena, Brownsville, and Corona were all selected for federal funds and are currently pending awards.

TABLE 11: GRANT OPPORTUNITIES CONSIDERED BETWEEN 2021 AND 2023

	Sum of Funds Requested	Sum of Funds Awarded
FEDERAL	\$423,100,000	\$44,660,000
FEMA Building Resilient Infrastructure and Communities	\$211,300,000	\$8,360,000
FEMA Hazard Mitigation Grant Program	\$6,300,000	\$6,300,000
HUD Community Development Block Grant Disaster Recovery Ida - Round 1	\$30,000,000	\$30,000,000
HUD Community Development Block Grant Disaster Recovery Ida - Round 2	\$44,500,000	--
NOAA Climate Resilience Regional Challenge	\$11,000,000	--
US Senate Committee on Environment and Public Works Water Resources Development Act	\$120,000,000	--
STATE	\$18,000,000	\$5,000,000
EFC Green Innovation Grant Program	\$6,000,000	\$3,000,000
EFC Water Quality Improvement Project Program	\$12,000,000	\$2,000,000
Grand Total	\$441,100,000	\$49,660,000



LOOKING AHEAD TO 2024

01 CLOUDBURST HUB OUTREACH KICK-OFF

Cloudburst Hub designs for Corona, Kissena, East New York (Hendrix-Linden), and Parkchester/Morris Park are underway with anticipated design completion in late 2025. Alongside the design and planning for these four Cloudburst Hubs, DEP is advancing a robust community outreach program in 2024 that will ensure community feedback is incorporated into the final designs for these neighborhood-scale projects. Outreach activities are anticipated to begin in Late Spring/Early Summer 2024. To participate in Cloudburst Design outreach, sign up for DEP newsletters¹.

02 RESILIENT NYC PARTNERS PROGRAM ADVANCEMENT

The Resilient NYC Partners Program has successfully completed two projects on private property to date and is well underway to complete at least three additional projects in 2024. These projects include constructing subsurface storage practices in Brooklyn, Queens, and the Bronx, which would manage stormwater runoff where it falls and help improve water quality in the East River/Open Waters, Alley Creek, and Westchester Creek waterbodies. The program team plans to escalate its strategic outreach to private property owners in 2024. These strategies include updating the Resilient NYC Partners Program webpage so that it is more comprehensive and engaging elected officials along with other stakeholders to help DEP get the word out to targeted property owners.

03 POROUS PAVEMENT CLEANING PILOT

As part of the overall strategy to expand the use of porous pavement, DEP has been working with the Department of Sanitation (DSNY) on a porous pavement cleaning pilot. Through this pilot, DSNY is providing valuable NYC experience on managing operations and resource requirements for conducting routine activities on City streets.

04 RAINPROOF NYC

To address increased heavy rainfall in New York City, the Mayor's Office of Climate & Environmental Justice, DEP, and NYC Housing Recovery Operations, along with Rebuild by Design and One Architecture & Urbanism, have launched Rainproof NYC², a collaborative initiative that brings together government agencies, non-profits, and an array of stakeholders to further develop innovative policies and programs aimed at addressing the challenges NYC faces as climate change causes increased heavy rain. The working groups, co-facilitated and composed of NYC agency staff and community leaders, will meet until summer of 2024 to recommend strategies and policies to adapt to increased heavy rainfall.

05 NEW RIGHT-OF-WAY AREAWIDE CONTRACTS

DEP will initiate new area-wide design contracts in Flushing Bay and East River/Open Waters (EROW) watersheds in 2024, evaluating over 1,300 acres in Flushing Bay and 1,700 acres in EROW watersheds utilizing the best standard green infrastructure approach for site specific conditions. Through this hybrid implementation approach, these areas are anticipated to be saturated with green infrastructure assets including an estimated 1,000 sidewalk assets, like rain gardens and infiltration basins, and 100,000 SF of porous pavement.

¹ <https://www.nyc.gov/site/dep/about/newsletters.page>

² <https://rebuildbydesign.org/rainproof-nyc/>

06 WORKFORCE DEVELOPMENT PILOT

In early 2024, DEP released a request for proposals to pilot a workforce development program to diversify its maintenance program and work with community partners to manage over 1,000 right-of-way rain gardens. Through this pilot, a workforce development group will train participants in aspects of green infrastructure maintenance, including horticulture, to equitably grow the local green jobs sector.

ACTIVE PROJECTS TOWARDS THE NEXT CSO MILESTONE

TABLE 12: LIST OF ACTIVE PROJECTS TOWARDS THE NEXT CSO ORDER MILESTONE (2030)

Waterbody Drainage Area	Project	Current Status
East River/Open Waters (EROW)	OH-015 Areawide ROW-Phase 1	Advanced design
EROW	OH-015 Areawide ROW-Phase 2	In construction
EROW	OH-015 Areawide ROW-Phase 3	Advanced design
EROW	TI-03/23 Areawide ROW	In construction
EROW	Tibbetts Brook Daylighting	In design
Jamaica Bay	CI-005 Areawide ROW-Phase 1	In construction
Jamaica Bay	CI-005 Areawide ROW-Phase 2	In construction
Jamaica Bay	CI-005 Areawide ROW-Phase 3	In construction
Coney Island Creek, EROW, Gowanus, Jamaica Bay	Expanded Public Onsite-GI-CONS-01	In construction
Alley Creek, EROW, Gowanus, Jamaica Bay	Expanded Public Onsite-GI-CONS-02	In construction
EROW	Clinton Houses	In design
EROW	Central Park Stormwater Recovery and Reuse	50% design
EROW	Prospect Park Stormwater Recovery and Reuse	In construction procurement
Various	Resilient NYC Partners – Phase 1	Ongoing
Various	Public Onsite GI-H-CONS-1	In construction
Various	Public Onsite GI-H-CONS-2	In construction
Various	Expanded Public Onsite-GI-CONS-03	In construction
Various	Expanded Public Onsite-GI-CONS-04	Designs complete
Various	Expanded Public Onsite-GI-CONS-05/5A	In construction procurement
Various	Expanded Public Onsite-GI-CONS-06	Designs complete
Various	Expanded Public Onsite-GI-CONS-07	Designs complete

OTHER PLANNED PROJECTS

DEP continues to seek public-private partnerships through its financial incentive programs, such as Resilient NYC Partners and the Green Infrastructure Grant Program. DEP's stormwater regulations will also expand the implementation of green infrastructure citywide as development and redevelopment continues. DEP is exploring the following projects through early planning and feasibility studies to evaluate the potential to include such projects to meet the 2023 Modification milestones:

- New areawide contracts in new neighborhoods within East River/Open Waters watershed, as well as revisiting Gowanus to implement additional ROW green infrastructure
- Public property retrofits through continued partnerships with public property owner agencies
- Additional cloudburst projects from the initial list of 31 hub identified
- Additional daylighting opportunities, such as potentially diverting stormwater from the sewer system and redirecting it to Oakland Ravine and Lake
- Onsite reuse projects
- Bluebelts expansion

ADAPTIVE MANAGEMENT AND LESSONS LEARNED



Since the start of the NYC Green Infrastructure Program, DEP has been conducting various studies to enhance understanding of the benefits of green infrastructure, optimize project development and designs, evaluate cost-benefit beyond stormwater management, and plan for long-term maintenance needs. To meet this wide spectrum of objectives, DEP has undertaken monitoring techniques including sensors installed in place capturing real-time data, simulated runoff testing at constructed green infrastructure locations, small scale laboratory-type setups in semi-controlled environments, and modeling studies at various spatial scales calibrated with field data wherever possible.

Work in 2023 focused on incorporating the data collected from these studies and from related peer research to estimate stormwater runoff and the resulting CSO reduction impacts of the differing green infrastructure typologies, which were used to establish the equivalency rates of stormwater capture volume for different green infrastructure practice types for the new 2023 Modification reporting requirement.

DEP, in partnership with City DOT, has also been studying permeable pavement installations in the roadway to evaluate their suitability for citywide expansion. Previous efforts led to the development of siting criteria to avoid certain types of streets such as high bus and truck traffic areas, as well as updated standardized designs

for right-of-way porous concrete. Through in-sewer flow monitoring, surface infiltration testing, and modeling, DEP established that roadway porous pavement can continue to perform with routine maintenance involving the application of high-pressure water and vacuuming. With this information, DEP and DOT are working with DSNY to develop a maintenance program that makes use of existing City resources and experience operating within City streets.

FLOODNET

DEP partnered with researchers and other City agencies in 2022 to support the development and implementation of an innovative real-time sensor network called FloodNet, which provides valuable data on the presence, depth, and frequency of street flooding throughout NYC. Sensors are installed in priority locations identified by City agencies and through community outreach, particularly in neighborhoods vulnerable to high tides, storm surge, and stormwater runoff. The surface flooding data collected by these sensors will allow DEP to better understand the frequency, severity, and impact of flooding in NYC, to inform planning decisions, as well as operations and outreach efforts related to stormwater flooding. To date, 87 sensors have been installed across NYC.

ECOLOGICAL SERVICES AND WETLAND RESTORATION



DEP STAFF COLLECTING WATER SAMPLES AT ALLEY CREEK, QUEENS

Wetlands, which are transitional lands between aquatic and terrestrial ecosystems, provide many ecological, economic, and cultural benefits. They attenuate flooding, help maintain stream flow, provide erosion control and water filtration, and are important natural habitats for fish and other wildlife. Communities also benefit from wetlands through opportunities for recreation, aesthetic appreciation, and environmental education.

Tidal wetlands have been found to effectively reduce microorganisms within the aquatic environment. Fecal Indicator Bacteria (FIB), which consists of total coliforms, *Escherichia coli* (*E. coli*), and *Enterococcus*, are used as indicators of possible sewage contamination because they are commonly found in human and animal feces. DEP has initiated a study at Alley Creek as part of the Alley Creek LTCP to determine the efficacy of wetlands at specifically reducing environmental FIB. Within a tidal environment, marshes can dissipate tidal flow energies approximately one order of magnitude when the flows encounter the vegetated marsh surface and flow velocity continues to decrease as vegetation density increases. These tidal patterns have important implications concerning the assessment of water quality parameters associated with FIB because they may provide a method to remove suspended bacteria and deposit them within marshes.

Over a 7-month period between June and December 2023, DEP monitored the wetland at four locations through periodic sampling events and with sensors collecting continuous data for dissolved oxygen, temperature, salinity, and pH. Site 0 was located outside the engineered wetland channel to serve as a reference, Site 1 was located in the engineered wetland primary creek channel near the inlet, Site 2 was located

in the engineered wetland secondary creek channel mid-marsh, and Site 3 was located in an engineered wetland tertiary creek channel (see Figure 4).

In total, DEP collected 17 FIB water quality samples, 17 sediment samples, and 7 nutrient samples during both wet and dry weather. During wet weather, the highest concentrations of FIB were detected during events with CSO advisories, as expected. However, following a rainfall event, the majority of the water quality samples indicated that the designed wetland was acting as a sink for FIB: 65% of *Enterococci* samples and 68% of *E.coli* samples from paired flood and ebb tidal cycles demonstrated the wetland to be a FIB sink, often with high concentrations of FIB removed.

FIGURE 4: ALLEY CREEK FIB SEDIMENT AND WATER COLUMN SAMPLING STATIONS



In line with the functions of a tidal wetland system, turbidity data indicate that the wetland is a sink for particles. While more data and analyses are required to validate these results, the 2023 data collection looks promising and indicates that the wetland was able to reduce FIB levels in the water column.

Additional data collection in 2024 will further understanding of the potential for engineered wetlands to remove FIB and improve water quality. DEP is also planning to include wetland restoration projects in future updates to DEP's interactive online Green Infrastructure Map.

Ribbed Mussels

Evidence in the literature shows that ribbed mussels (*Geukensia demissa*) can filter out particles as small as bacteria from the water column, but no work has been conducted specifically looking at the filtration of *E. coli* and *Enterococcus* bacteria from the water column. As part of the Jamaica Bay LTCP, DEP has initiated a study to determine the efficacy of ribbed mussels to reduce the pathogen influence of CSO on receiving waterbodies. Working with Stony Brook University and Cornell Cooperative Extension, extensive microcosm and mesocosm laboratory experiments demonstrated good removal of bacteria. To expand DEP's understanding of the bacteria removal rates, these experiments were then studied in an in-situ installation within Bergen Basin to understand how the mussels survive when kept sub-tidally and to evaluate their FIB removal rates.

The Bergen Basin in-situ installation is evaluating the following: pathogen removal, water quality monitor-

ing, ribbed mussel monitoring, sediment nutrient/gas processes, spat recruitment research, and aquaculture research and development. This work requires a multi-faceted approach with a wholistic/ecosystem perspective to examine the potential challenges of this project. Each of the above areas of inquiry provide useful information that will help inform and expedite the final design and installation.

During 2023, DEP maintained a population of about 3,000 mussels in a basket system, beginning in February. Another approximately 6,000 mussels are being held in Paerdegat Basin for a Spring 2024 installation. Results from 2023 showed that ribbed mussels remove a significant proportion of water column bacteria with a 28% reduction. Average monthly mortality of mussels at Bergen Basin was low, at 6.8%, while the control site had an average monthly mortality of 7%. Mortality is consistent with expected mortality for bivalve aquaculture operations. Inter-tidal spat collectors installed along the shoreline of Bergen Basin showed good recruitment (as high as 400 spat/m²) of mussels. Recruitment to intertidal collectors may be an important tool for stocking and maintaining populations for the final installation.

Results from the 2023 hatchery studies demonstrated ribbed mussels could be conditioned for spawning, using standard bivalve aquaculture techniques, outside of their natural spawning period. In addition to the inter-tidal recruitment and wild sources, this will help with providing populations for the final installation.

Additional work will be conducted in 2024 to increase the number of mussels in the Basin and continue studies that will help refine how the mussels remove FIB from the water column under various environmental conditions and different design configurations. This includes the installation of a 26' x 26' flow-through system with two flow-ways that will allow DEP to modify various experimental parameters (e.g., density, horizontal spacing, vertical height within water column, etc.) to allow for greater refinement of the final installation design.

Building on the inclusion of wetlands and other ecological systems in the 2023 Modification's expanded definition of green infrastructure, DEP plans to look for more opportunities for wetland expansion and other ecological water quality solutions on top of the projects already committed to in the approved LTCP. DEP is also preparing previous wetland cost data for inclusion in the financial milestones.



LINKS TO RESOURCES

Green Infrastructure Homepage

- <https://www.nyc.gov/site/dep/water/green-infrastructure.page>
- The documents **Standard Designs and Guidelines for Green Infrastructure (Right-of-Way)**, **Right-of-Way Green Infrastructure Protection During Construction Presentation**, and **Green Infrastructure Onsite Design Manual - Version 2** can all be accessed via the Green Infrastructure homepage.

Municipal Separate Storm Sewer System (MS4)

- <https://www.nyc.gov/site/dep/water/municipal-separate-storm-sewer-system.page>

2023 CSO Consent Order Green Infrastructure Modification

- https://extapps.dec.ny.gov/docs/water_pdf/2023nycgiordermod.pdf

Green Infrastructure Grant Program (GIGP)

- <https://www.nyc.gov/site/dep/water/green-infrastructure-grant-program.page>

Resilient NYC Partners Program (RNYCP)

- <https://www1.nyc.gov/site/dep/whats-new/resilient-nyc-partners.page>

Unified Stormwater Rule and NYC Stormwater Manual

- <https://www.nyc.gov/site/dep/water/unified-stormwater-rule.page>

DEP's Flickr Webpage

- <https://www.flickr.com/photos/nycwater>

FloodNet

- <https://www.floodnet.nyc/>

EXHIBIT A - TRACKING AND VERIFICATION OF CSO VOLUME REDUCTION UNDER 2023 MODIFICATION

CSO VOLUME REDUCTION CALCULATION

DEP calculates CSO volume reduction by applying the green infrastructure practice class or program specific Stormwater Capture Equivalency Rates in Table 1 to each constructed asset to determine the amount of stormwater captured. DEP then converts the calculated stormwater capture volume to CSO volume reduction using the Waterbody Drainage Area Specific Equivalency Rates for stormwater capture to CSO volume reduction in Table 2, as illustrated by the formula below.

Formula for Calculating CSO Volume Reduction

$$\text{CSO Volume Reduction (MGY CSO)} = \frac{A \text{ (acres)} \times \text{SW ER (MGY SW / acre)}}{\text{SW / CSO ER (MGY SW / MGY CSO)}}$$

Where:

A = Greened Acre for Right-of-Way retention practices (rain gardens, infiltration basins, and stormwater green streets only) and tributary area (acres) for all other green infrastructure program areas

SW ER = Green Infrastructure Practice or Program Specific Stormwater Capture Equivalency Rate

SW / CSO ER = Waterbody Drainage Area Specific Equivalency Rate

TABLE A1: GREEN INFRASTRUCTURE PRACTICE OR PROGRAM SPECIFIC STORMWATER CAPTURE EQUIVALENCY RATES

Green Infrastructure Practice Class or Program	Retention or Detention	Equivalency rate ¹ (SW MGY ¹ /unit ²)
Right-of-Way Rain Gardens and Stormwater Greenstreets	Retention	0.86
Right-of-Way Infiltration Basins	Retention	0.91
Right-of-Way Porous Pavement	Retention	0.96
Public/Private/External Onsite and Large-scale Median Projects	Retention	0.95
Public/Private/External Onsite and Large-scale Median Projects	Detention	0.68
Green Roofs without Orifice Control	Detention	0.35
2012 Stormwater Rule	Detention	0.13
2022 Unified Stormwater Rule ³	Retention	0.97
2022 Unified Stormwater Rule	Detention	0.68
Green Roofs with Orifice Control	Detention	0.68
Cloudburst Practices	--	SW Equivalency Rates will be selected from Right-of-Way and Public Onsite program areas based on assets implemented
Special Projects Not Specified Elsewhere	--	Modeled

- 1 The technical basis for these equivalency rates is documented in a Green Infrastructure Equivalency Rate Technical Memorandum, per Appendix F of the 2023 CSO Consent Order.
- 2 For purposes of these Equivalency Rates, "Unit" shall be defined as Greened Acre for Right-of-Way retention practices (rain gardens, infiltration basins, and stormwater green streets only) and tributary area (acres) for all other green infrastructure program areas. "Greened Acre" is an area equivalent to one acre of impervious surface covered by one inch of stormwater.
- 3 The 2022 Unified Stormwater Rule or other city legislation/rule or regulation can be used to fulfill the 1.67 BGY CSO volume reduction milestone.

TABLE A2: WATERBODY DRAINAGE AREA SPECIFIC STORMWATER CAPTURE TO CSO VOLUME REDUCTION EQUIVALENCY RATES

Waterbody Drainage Area	Equivalency Rate ⁴ (SW MGY/CSO MGY)
Alley Creek	2.75
Jamaica Bay and Tributaries	3.67
Bronx River	2.35
Coney Island Creek	2.75
Hutchinson River	1.73
East River / Open Waters	1.87
Flushing Bay	1.25
Flushing Creek	1.91
Gowanus Canal	2.75
Newtown Creek	1.72
Westchester Creek	5

- 4 DEC calculated equivalency rates based on data provided by DEP on June 14, 2016 for the 2016 Performance Metric Report. DEC selected equivalency rates for Alley Creek and Coney Island Creek drainage areas to represent a value closest to the mid-point of the range of calculated equivalency rates for the other drainage areas.

EXHIBIT B - NYC GREEN INFRASTRUCTURE PROGRAM IMPLEMENTATION AREAS

DEP tracks projects through these five primary Green Infrastructure Program implementation areas:

- **Right-of-Way** – primarily funded by DEP and implemented within City streets and sidewalks
- **Onsite** – primarily funded by DEP and implemented within publicly owned property, such as schools, parks, and public housing
- **External** – not funded by DEP and may be implemented in the ROW or within public or private property
- **Incentives** – implemented on private property through incentives provided by DEP
- **Regulations** – implemented through DEP stormwater regulations

The figures below illustrate the implementation areas where different types of green infrastructure practices are being constructed across CSS and MS4 areas. Readers should note that these graphics represent a one-time snapshot and that actual numbers will change as the Green Infrastructure Program progresses.

FIGURE B1: BREAKDOWN OF MANAGED ACRES (CSS + MS4) BY PROGRAM AREA

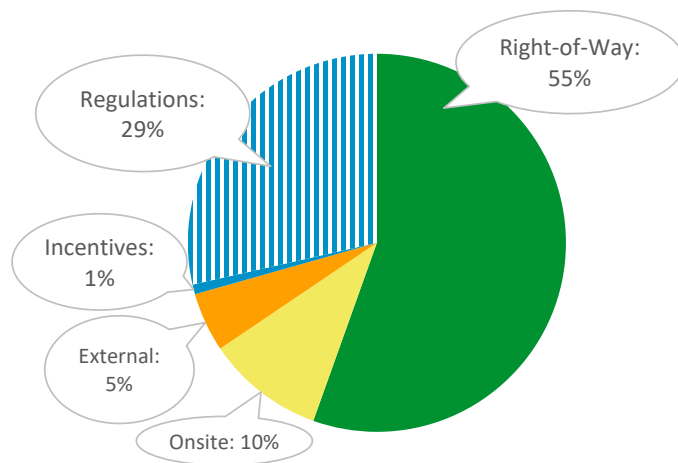
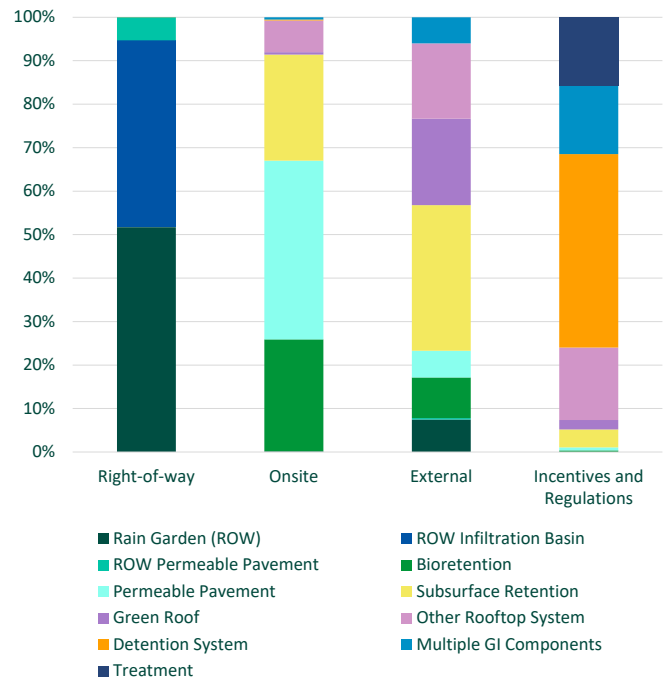


FIGURE B2: BREAKDOWN OF PROGRAM AREA MANAGED ACRES (CSS + MS4) BY GREEN INFRASTRUCTURE TYPE



ACRONYMS

BGY billion gallons per year
CSO combined sewer overflow
CSS combined sewer system
DDC Department of Design and Construction
DEC Department of Environmental Conservation
DOE Department of Education
DOT Department of Transportation
DPR/Parks Department of Parks and Recreation/Parks
EDC Economic Development Corporation
EROW East River/Open Waters
FIB Fecal Indicator Bacteria
LTCP Long-Term Control Plan
MGD million gallons per day
MGY million gallons per year
MS4 Municipal Separate Storm Sewer System
NYC New York City
NYCHA New York City Housing Authority
NYS New York State
OER Office of Environmental Remediation
PPA Prospect Park Alliance
ROW right-of-way
SCA School Construction Authority
SMP stormwater management practice
TPL Trust for Public Land



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